Total Quality of Supply Chain Management

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ABSTRACT

In today's business, companies must make use of the resources of their whole supply chains to be successful in the intensely competitive market place. Therefore, supply chain management (SCM) has become a useful and strategic tool for companies to achieve competitive advantage.

Many SCM studies focus on the information flow and material flow between organisations and their suppliers. They do not have a holistic view of SCM with little emphasis on parameters such as culture, quality, relationship and process factors. This study develops a more comprehensive SCM model which can help organisations better manage their supply chains and achieve business excellence. Since Total Quality Management (TQM) principles are useful in helping companies achieve business excellence, they should also be able to help companies' supply chains achieve business excellence. Hence, the study utilises TQM principles to enrich the existing SCM model and form the new Supply Chain Management Excellence (SCME) Model.

The study was conducted in Hong Kong which offers a good Asian setting for the study of the western concepts of TQM and SCM. Data were collected from supply chain managers of 139 companies. Structural equation modeling was used to develop the new SCM structural model. EQS programme was employed to test the Goodness of Fit of the new SCM model. Once the theorised model has been tested to fit with the data in the study, indices for the application of SCM success factors and companies' overall performance for the 139 companies are calculated by the Partial Least Squares (PLS) method using the SAS programme. The same procedure was also applied to a construction company to further validate the Model at the company level.

Findings of this study indicate that the new SCM model fits with the data of the 139 companies and the construction company very well. The Model is valid and useful for companies to achieve business excellence through supply chain management and thus the development of the Model contributes to supply chain management research. The study also contributes to TQM research by extending TQM principles from the company's level to the business-to-business level of companies and their suppliers.

The Supply Chain Management Excellence Index generated by the SCME Model serves as an objective and comprehensive single measure of organisational effectiveness, and can be used for purposes of comparison across companies. Companies can use this Model to self assess their strengths and weaknesses on success factors for supply chain management and develop improvement plans. Moreover, the study offers a valuable database for future benchmarking exercises on supply chain management.

WONG SHIU HO, ALFRED

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CHAPTER 1

TOTAL QUALITY OF SUPPLY CHAIN MANAGEMENT

1.1 INTRODUCTION

Total Quality Management (TQM) is concerned with total involvement from a company in satisfying customers competitively. TQM has played a dominant role in organizational survival and prosperity. The conceptual and contextual development of TQM have been incremental - from Quality to Quality Management and Total Quality Management and from manufacturing to servicing industries. Several Quality Masters have contributed very much to the development of Total Quality Management. Examples include Crosby's (1979) "zero defects concept", Deming's (1986) "14 points", Feigenbaum's (1983) work on total quality control, Ishikawa's (1976) "Seven Quality Tools", Juran's (1988) "Trilogy" and Taguchi's (1989) focus on design of experiments. In practice, TQM has been applied in various settings giving rise to an enlarged scope of analysis and concern from top management.

Because of the all-encompassing nature of Total Quality Management, the scope includes both intraorganisational (e.g. leadership; customers satisfaction; people-based management; management by fact and continuous improvement) and interorganisational (e.g. supplier relationships) issues. In meeting and exceeding the needs of customers, it requires not only the effort of a firm itself but also the concerted effort of its suppliers.

The role of supplier relationship takes on various forms e.g. comakership (Merli,1991), JIT II(Greenblatt, 1993), partnership sourcing (Macbeth & Ferguson, 1994) etc. All of these forms aim at integrating the supplier and the manufacturer through relationship. The supplier, the manufacturer and the distributor represent the three basic components of a supply chain in delivering a product to the final customers. Suppliers occupy the upstream position of the supply chain and play a very important role in providing input to the manufacturer.

The term "Supply Chain Management" seems to be an all-embracing terminology that covers an integrated logistical flow of materials from suppliers to end-users. According to Jones (1989), Supply Chain Management (SCM) represents a network of

firms interacting to deliver a product or service to the end customer, linking flows from raw material supply to final delivery. Most of the SCM applications focus on the role of information flow in reducing the level of inventory along the supply chain and thus lowering the total cost to the benefit of all partners along the chain. While Supply Chain Management and Total Quality Management are complementary concepts, in light of TQM, literature and application history of Supply Chain Management (SCM) seem to have given little emphasis on some parameters such as culture, quality, relationship and process factors. These inadequacies of Supply Chain Management will be discussed fully in chapter two.

A critical examination of what and how a TQM approach would enhance the effectiveness of Supply Chain Management would be of high application value to companies in managing their suppliers. It will also contribute to the theoretical development of both TQM and SCM.

1.2 THE BACKGROUND OF THE STUDY

An interesting setting for the study of TQM and SCM relationship is the Asian region. Since both the concepts of TQM and SCM are mainly developed in the West, it will add to knowledge in understanding their application in this part of the world, i.e. the Asian setting. Hong Kong is a place where the East meets with the West. Over 90 percent of the Hong Kong people are Chinese. Hong Kong has a very close economic linkage with China even before it has become the Special Administrative Region of China after 30 June 1997. Hong Kong companies, though largely managed by Chinese managers, are to certain extent receptive to the western management practices. Total Quality Management was first promoted by the Hong Kong Government in the early 1990's, while Supply Chain Management was promoted by the practitioners in the mid 1990's. So, companies in Hong Kong have been subjecting to the influences of the two concepts. Therefore, it is high time to make an assessment on whether these largely western concepts can be applied to the Asian setting using Hong Kong companies as the focus of analysis. Moreover, since Hong Kong is a place with no resources, it has to source for its requirements, both industrial goods and consumer goods, from its major trading partners, such as China, the States, and the UK. In order to become competitive and better meet the needs of customers, Hong Kong companies should better utilize the

resources of their supply chains. A good Supply Chain Management model that has been enriched by TQM principles would be especially useful to Hong Kong companies. Hence, Hong Kong offers a very rich context for this study.

Moreover, with China playing a more active role in the world economy, especially if she has become a member of the World Trade Organisation, more western companies will have business operations in this part of the world. They will very often establish their offices in Hong Kong to deal with their businesses in the area. The new SCM model based on how companies in Hong Kong manage their suppliers would be valuable for those companies outsourcing their requirements from this part of the world.

1.3 THE PROBLEM STATEMENT

The purpose of this research is to develop a new SCM model that can better help companies manage their supply chains. The new SCM model will be enriched by the Total Quality Management principles. It is envisaged that the new model should be able to help companies assess the performances of their supply chains, and identify the strengths and weaknesses in the different aspects of Supply Chain Management. Moreover, when following the new SCM model, it will help companies achieve business excellence by utilising their supply chains. This research attempts to answer the following research questions:

- What are the inadequacies of the existing SCM model, which is derived from the existing SCM literature?
- How do the Total Quality Management principles help enrich the existing SCM model and form a new SCM model?
- What is the validity and reliability of the new SCM model?
- How does the new SCM model help companies better manage their supplier chains?

1.4 THE SIGNIFICANCE OF THE STUDY

The concept of Total Quality of Supply Chain Management is relatively new. Even though experts of Total Quality Management do include supply chain in their teachings, the actual application of the principles of total quality is not yet explored in depth. The study will provide a validated model of Supply Chain Management, which is

enriched by the Total Quality Management principles.

Since the new SCM model developed in this study has incorporated the Total Quality Management principles into the key elements of SCM, companies following the principles of the new SCM model are also following the critical success factors of TQM and should be able to obtain satisfactory performance from its suppliers which would then help the companies achieve business excellence. In other words, the new SCM principles are also those critical success factors for business excellence through Supply Chain Management.

The new SCM model is an improvement model. It performs simultaneous computation of mathematical equations of factor relationships to obtain SCM success factor indices and SCM excellence index. It allows organisations to assess the performances of their supply chains, identify the strengths and weaknesses in the different aspects of Supply Chain Management and compare themselves against the different organisations with whom they are competing. This is of particular benefit to organisations who are not doing as well as they might, as it will give them an incentive to do something about their failings.

Moreover, a database on supply chain management in this part of the world is formed. This database can be served as a benchmark for companies to compare with their own supply chain performances.

1.5 OVERVIEW OF METHODOLOGY

This research study adopts both the quantitative and qualitative perspectives. As Supply Chain Management concerns with how a company manages its supply chains, therefore, the buying companies are the unit of analysis in the study. Ideas are obtained from those key informants, i.e. supply chain managers, who are responsible for managing suppliers in each buying company. Through the in-depth interviews with the key informants of a few case companies, a better understanding of what is happening in supply chain management can be obtained.

The information collected through interviews, coupled with the information obtained from literature review on TQM and SCM are used to develop a new SCM model or a Supply Chain Management Excellence (SCME) Model. It is a structural model that links the different concepts of the new SCM model with supply chain

performance and the overall performance of a company.

Structural equation modeling (SEM) is a useful research method especially in theory testing. It is being promoted for use in the supply chain management discipline (Garver and Mentzer, 1999). The focal point in analysing structural equation models is the extent to which the hypothesized model "fits," or, in other words, adequately describes the sample data (Byrne, 1994). The overall model fit of the new theorised SCM model will be assessed by using EQS programme (Bentler & Wu, 1995). The program produces two useful fit indices: Bentler and Bonett's (1980) Normed Fit Index (NFI) and Bentler's Comparative Fit Index (CFI). Values for both the NFI and CFI range from zero to 1.00. According to Bentler (1992), a value greater than .90 indicates an acceptable fit to the data.

The different concepts of the new SCM model will be operationalised into different items of a questionnaire and administered to a sample of companies. These companies consist of manufacturers, importers and exporters, both large and small and medium companies which all have to buy goods or materials for organisations' use or for resale. The Federation of Hong Kong Industries (FHKI) compiles a convenient and often used directory. The members contained in the FHKI Members' Directory 1997 were targets of this study.

Once the theorised model has been tested to fit with the data in the study, indices for the application of the different concepts, the suppliers' performance and companies' overall performance for the sample companies surveyed will be developed by the Partial Least Squares (PLS) method using the SAS programme. PLS is a second-generation multivariate analysis technique used to estimate the parameters of causal models (Igbaria et al., 1995). The PLS method is used in the calculation of the factor weights which are then used for computing the index scores for each of the constructs or factors of the new SCM model.

These indices can be used in conducting benchmarking studies, both cross-sectionally and over time. To further validate the model, the instrument is administered to all the supply chain staff of a company. The different indices are calculated for the company and compared with the indices obtained for all the sample companies in the survey.

1.6 ORGANISATION OF THE STUDY

This study is organised into eleven chapters. Chapter one introduces the background to the study. Chapter two contains a critical review on the existing Supply Chain Management model so as to identify its inadequacies. Chapter three reviews the concept of Total Quality Management and its linkage to Business Excellence. Through the literature review, the linkage between TQM and Business Excellence is obtained and Kanji's Business Excellence Model is chosen to enrich the existing SCM model. Chapter four further looks at the interface between TQM, Business Excellence Model and SCM. The chapter examines the similarities and differences between TQM and SCM and the ways TQM can enrich SCM. Moreover, it outlines how the principles of Kanji's Business Excellence Model can be applied to the existing SCM model in theory. In Chapter five, the context of this study, i.e., the supply chain situation in Hong Kong, is laid out. Three case studies are also reported in this chapter to explore on how TQM principles can be applied to SCM in practice. Then, the research methodology for this study is outlined in Chapter six. It shows the research perspectives, the research types, the research design and the data collection and analysis methods adopted in the study. In Chapter seven, the development of the new SCM model or Business Excellence Model for Supply Chain Management is described in details. It is then validated in Chapter eight, using structural equation analysis with the EQS programme. To show that the Business Excellence Model for Supply Chain Management can help companies better manage their supply chains, Chapter nine elaborates on the steps in using the Partial Least Squares method to calculate the indices on companies' supply chain performance based on the validated model. The Supply Chain Business Excellence Indices of all the sample companies are computed as examples on the use of the new model. Companies can make improvements on their supply chain management by increasing their efforts on those factors that have low indices. Chapter ten further validates the use of the model and the PLS method by applying them to a construction company, i.e. validating the model and the indexing method by extending their use from industry level to company level. Also, the chapter validates the success factors of the model through some critical incidents experienced by four companies. Chapter eleven outlines the summary and conclusions for the study. Further work is also suggested in this chapter.

CHAPTER 2

LITERATURE REVIEW ON SUPPLY CHAIN MANAGEMENT

2.1 INTRODUCTION

A review of the literature on supply chain management is provided here to introduce the concept of supply chain management and establish the need to develop a new SCM model that can best help companies to manage their supply chains. First, the different definitions of supply chain management and the underlying theories and concepts are furnished as some background information to supply chain management. Next, the reasons for the development of supply chain management and the key ideas and concepts proposed by different authors on SCM are given with a view to understand the main questions and problems that have been addressed to date. Finally, the main concepts of the existing SCM literature are summarized into a traditional SCM model. It is then subjected to a critical review to identify any inadequacies in the model, which will form a basis for the development of the new SCM model.

2.2 WHAT IS A SUPPLY CHAIN?

Many authors provide their definitions on a supply chain. According to Scott and Westbrook (1991), the term "supply chain" is used to refer to the chain linking each element of the production and supply process from raw materials through to the end customer. Typically such a chain will cross several organisational boundaries. It consists of flows of materials and product through various production and distribution processes in one direction and flows of information to provide control mechanisms, mostly in the other direction. The definition emphasizes on the supply processes and the activities involved.

A supply chain can also be viewed as a system. Towill et al. (1992) outline a supply chain as a system, the constituent parts of which include material suppliers,

production facilities, distribution services and customers linked together via the feedforward flow of materials and the feedback flow of information.

On the other hand, a supply chain can be interpreted from a network perspective. For instance, Christopher(1992) defines a supply chain as the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer. Lee and Billington (1993) define a supply chain as a network of facilities that performs the functions of procurement of material, transformation of material to intermediate and finished products, and distribution of finished products to customers. Davis (1993) looks at a supply chain simply as a network of material processing cells with the following characteristics: supply, transformation, and demand.

The meaning of "network" is made explicit by Axelsson and Easton (1992) who define a network as "a model or metaphor which describes a number, usually a large number, of entities, which are connected. In the case of industrial as opposed to, say, social, communication or electrical networks, the entities are actors involved in the economic exchanges which are themselves conducted within the framework of an enduring relationship. The existence of such relationships are the *raison d'être* for industrial networks. They provide the stability, and hence structure, which makes the network metaphor particularly apposite."

The above definitions have formed a basis for defining the term of "supply chain" by later authors. To summarise on the above definitions, a supply chain is a network of organisations involved in the processes of creating products and services for the ultimate consumer. It consists of a company and its upstream and downstream organisations who are actors involved in the economic exchanges and who work as a system in providing the functions of supply, transformation and demand. However, a company may integrate backward by acquiring its suppliers and integrate forward by acquiring its distributors. In this case, the company is trying to do all the functions of supply, transformation and demand by itself and the supply chain can be regarded as an internal supply chain. If the company does not have ownership over its upstream and downstream organisations, then together they form the external supply chain. Relationship among internal functions and departments or the concept of internal customer / supplier relationships is as important as relationship among organisations in the external supply chain. This view is also supported by Handfield and Nichols (1999) who state that "Supply chains are essentially

a series of linked suppliers and customers; every customer is in turn a supplier to the next downstream organisation until a finished product reaches the ultimate end user."

2.3 WHAT IS SUPPLY CHAIN MANAGEMENT?

Again, there are various definitions on supply chain management. It has been a relatively new approach which first appeared in the mid 1980's. Houlihan (1985) proposes the adoption of a new approach, i.e. supply chain management to managing the materials flow in international supply chains so as to meet with the increasingly competitive pressure in the international markets. According to Houlihan (1985), "what were hitherto considered *mere* logistics problems have now emerged as much more significant issues of *strategic management*." This was in response to the challenges of the marketplace at that time. The business environment then was facing slower growth and uncertainty in demand which made investment decisions all along the supply chain - whether in capacity, systems or inventories - riskier than ever before. However, as revealed by the findings of a survey by Booz-Allen, firms that were successful in supply chain management could do a better job of not only providing a high level of customer service, but also simultaneously keeping inventory costs down (Houlihan, 1985).

Jones and Riley (1985) also adopt more or less the same view as Houlihan. They suggest:

> Competitive pressures will force major changes in inventory management in the next few years. Changes will result from business identifying and capitalising on the opportunities to manage their entire supply chains as single entities. Supply chain management techniques deal with the planning and control of total materials flow from suppliers through end-users.

Ellram (1991) suggests it 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 maximise efficient use of resources in achieving the supply chain's customer service goals.

Towill et al. (1992) advocate on using integrated information flow throughout the supply chain to improve companies' performance. According to them, "great benefit is obtained (often much more cheaply) by encouraging collaboration between all *players*

within the chain. This applies particularly to the free exchange of information concerning true market demand. If this is done, then the control systems can operate on *real* orders rather than respond to *distorted* data, which have already been operated on by other echelons within the chain."

On the other hand, Cavinato (1992) focuses on the value contributed by supply chain management. Cavinato states that, "The supply concept consists of actively managed channels of procurement and distribution. It is the group of firms that add value along product flow from original raw materials to final customer. It concentrates upon relational factors rather than transactional ones. The supply chain view includes firms that cooperate in such areas as research and development and produce design, and often conduct multiple firm joint analyses all with the quest of making the final product at overall lesser total cost and / or with a greater set of values than competing sets of supply chain firms."

The above definitions of different authors have suggested different perspectives of supply chain management. In fact, Giunipero and Brand (1996) have reviewed the literature concerning SCM and summarised the definitions of SCM into three major categories: 1)Flow of Goods; 2) Managing the Flow of Goods and information; and 3) Integrative Value Added. (Table 2.1)

Table 2.1: *Typologies of Supply Chain Management (Source: Giunipero and Brand,1996)*

1. Flow of Goods Approach
   SCM presents a total flow of goods from supplier to end-user; it links each element of production and supply in the channel.
   (Jones and Riley, 1985; Houlihan 1985; Novack and Simco, 1991; Scott & Westbrook, 1991).
2. Managing Flow of Goods and Information
   Integrative philosophy, managed and analysed in order to achieve the best outcomes for the entire system. Includes information flows as well as physical flow.
   (Ellram & Cooper, 1990; Towill, Naim, & Wikner, 1992).
3. Integrative Value Added Approach
   Include entire sourcing process, value added and marketing activities of firms up to the final customer and insuring that these activities provide best value for the customer. Concentrates on relations versus transactions.
   (Cavinato, 1992; Cavinato, 1991; Langley & Holcomb, 1992).

Giunipero and Brand (1996) point out that the first category describes SCM as

the total flow of goods from supplier to end-user or customer. Under this view SCM includes linking each element of production and supply in the chain. The purpose of linking the different elements is to better control the flow of goods.

The second approach treats SCM as a philosophy that must be managed and analysed as a total system, which includes both physical product and information flows. This approach recognises that integrative information control is necessary in order to control the flow of goods.

Finally, the integrative value added approach defines SCM as the sourcing, value added, and marketing, activities which must be effectively managed to provide the best customer value. Achieving value for the customer requires developing a relational philosophy with other parties in the supply chain versus a short-term transactional approach. In addition, all processes or all activities involved in meeting the needs of the customers are being considered in order to achieve the best value for the final customers.

Besides, later definitions highlight other aspects of supply chain management. For instance, Berry et al. (1994) emphasise on the activities of supply chain management in their definition. According to them, "supply chain management is a new way of managing supply chains which is aimed at building trust, exchanging information on market needs, developing new products, and reducing the supplier base to a particular OEM (original equipment manufacturer) so as to release management resources for developing meaningful, long-term relationships".

Davies and Brito(1996) stress on channel efficiency and effectiveness as contributed by supply chain management and point out that "SCM, the control of the supply chain as a whole, is seen as a significant technique towards improving channel efficiency and effectiveness. A major focus has, to date, been on the distribution and transaction costs within supply chains."

Some writers consider SCM a channel management philosophy. Cavinato (1992) states that "the supply chain concept is the ultimate extension of the distribution channel." He further adds that "the supply chain concept consists of actively managed channels of procurement and distribution." Besides, Ellram and Cooper (1993) suggests that supply chain management is "an integrating philosophy to manage the total flow of a distribution channel from supplier to ultimate customer". Walton and Miller (1995) suggest that "the strategic integration of trading partners is the Supply Chain Management concept."

However, Ellram (1991) suggests that the scope of SCM is wider than that of channel management in two aspects. First, supply chain management has a broader goal, managing inventory and relationships to achieve a high level of customer service rather than accomplishment of specific marketing objectives. Second, the supply chain management approach attempts to manage both upstream and downstream activity within the supply chain.

There are also people who use SCM as a substitute or synonym for logistics. However, many authors suggest that the scope of SCM is broader than logistics. For instance, Giunipero and Brand (1996) consider that the scope of SCM extends beyond logistics. In its broadest context SCM is a strategic management tool used to enhance overall customer satisfaction that is intended to improve a firm's competitiveness and profitability.

Lambert et al. (1996) also argue that their definition of SCM, i.e. "the integration of business processes from end user through original suppliers that provides products, services, and information that add value for customers," is much broader than logistics.

Tan et al. (1998) advocate that there are two alternative perspectives for SCM: the Purchasing/Supply Perspective and the Transportation / Logistics Perspective. According to the former perspective, "SCM is synonymous with the supply base integration that evolved from the traditional purchasing and materials function. It is a management philosophy that extends traditional intra-enterprise activities by bringing trading partners together with a common goal of optimisation and efficiency. In effect, SCM tries to create a virtual organisation with the goal of efficiently and effectively managing the processes and operations of the separate organisations." Besides, they also point out that "from the transportation and logistics perspective, SCM is synonymous with integrated logistics systems."

Some authors suggest that SCM is an approach that can enable companies achieve competitive performance. As pointed out by Vickery et al. (1999), " supply chain management seeks to enhance competitive performance by closely integrating the internal functions within a company (e.g., marketing, product design and development, manufacturing) and effectively linking them with the external operations of suppliers and channel members." Moreover, Handfield and Nichols (1999) define supply chain management as "the integration of all supply chain activities through improved supply chain relationships, to achieve a sustainable competitive advantage."

To sum up the definitions of SCM by the different authors, SCM is a new way of managing supply chains. It adopts a systems and integrative approach in managing the operations and relationships within a company and among the supply chain partners of the company. It has aims of building trust and cooperation, improving coordination, exchanging market information, developing new products, and streamlining material flow among all parties in the supply chain. The outcome will be benefits to all parties involved in the process of meeting the needs of customers at the end of the supply chain. SCM is not limited to managing the total flow of goods and the flow of information from supplier to end-user. It is increasingly being known as an integrative value added approach and a strategic tool to compete with other competitors. Its scope is broader than logistics and channel management. It covers the various aspects of both purchasing and logistics. It is a tool to compete with other competitors. The value obtained through managing the supply chain as a whole may be better quality, lower cost, quicker delivery and more innovation. As a result, they will help companies achieve a sustainable competitive advantage.

2.4 DEVELOPMENT OF THE SCM CONCEPT

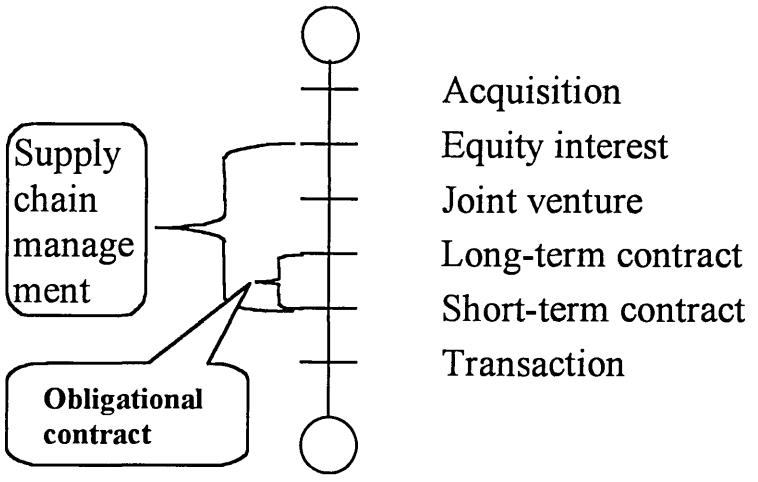
Supply chain management is a relatively new concept. According to Wilson (1996), "The paradigm of supply chain management was first developed as a management tool in the USA, theorists having studied Japanese business practices and their non-confrontational ways of conducting exchanges, and their emphasis on just-in-time distribution. The concept of SCM builds on the theories of the firm, especially transaction cost economics, Porter's value chain optimization and the networking approach, and has become established as a useful business paradigm."

Ellram (1991) makes use of the industrial organisation literature and associated transaction cost literature as a basis for exploring the supply chain management phenomenon. In her article, she explores the type of contractual relationship which Williamson (1990) defines as "obligational contracting" and the channels literature refers to as "relational exchange"

According to Ellram (1991), vertical integration can be viewed as an alternative to supply chain management, in that it attempts to manage and control channel efficiency through ownership. Obligational contracting can be viewed as one form of supply chain

management, in that it attempts to manage parts of the channel through formal agreements. The different types of competitive relationships are outlined in fig. 2.1.

Figure 2.1: *Types of Competitive Relationships (Source: Ellram, 1991)*



Ellram (1991) discusses in detail the advantages and disadvantages of vertical integration and obligational contracts. The reasons for vertical integration can be classified into the categories of control, communication and cost. The disadvantages of vertical integration can be classified as the manner in which vertical integration limits competition, diseconomies of scale, or increased risk. On the other hand, the advantages of obligational contracts may be classified as cost reduction or risk reduction. However, contractual relationships may create dependence without the control to balance that dependence.

One factor that contributes to the success of obligational contracting is that the expectation of future business discourages opportunism. In obligational contracting, the pressure to maintain the relationship creates a credible commitment among parties, avoiding opportunism (Anderson and Narus, 1990). The reference point for interaction is not a single transaction; it is the entire relationship that has been established (Harrigan, 1983). A credible commitment, as identified by Williamson(1990), encourages firms to co-operate to "support exchange".

According to Ellram (1991), SCM as a competitive form brings together many advantages of obligational contracts and vertical integration. SCM positions each firm to do what it does best, while spreading the risks of asset ownership, and reducing market risk through improved co-ordination and communication. Building on the participant's

strengths, supply chain management attempts to overcome some of the disadvantages of both vertical integration and obligational contracting.

Hobbs (1996) considers that, "transaction costs are simply the costs of carrying out any exchange, whether between firms in a marketplace or a transfer of resources between stages in a vertically integrated firm." He also states that " It is useful to divide transaction costs into three main classifications: information costs, negotiation costs, and monitoring (or enforcement) costs. Firms face costs in the search for information about products, prices, inputs and buyers or sellers. Negotiation costs arise from the physical act of the transaction, such as negotiating and writing contracts (costs in terms of managerial expertise, the hiring of lawyers, etc.), or paying for the services of an intermediary to the transaction (such as an auctioneer or a broker). Monitoring costs refer to the costs incurred in monitoring the quality of goods from a supplier or monitoring the behaviour of a supplier." Hobbs (1996) indicates that the nature and level of transaction cost is one of the determinants of the adoption of supply chain management, and companies adopting supply chain management aim to reduce transaction costs.

Porter's value chain model (Porter, 1980) tries to emphasize the flow of the adding value process from supply side through to satisfied customer. It provides a framework for analysing the contribution of individual activities in a business to the overall level of customer value the firm produces. Hence, the value chain concept clearly highlights the importance of customer value. This gives supply chain management the objective of focusing on customers and achieving customer satisfaction.

According to Macbeth & Ferguson (1991), the value chain model takes as its boundary the limits of the given organisation's ownership structure. However, organisations have to interact with their environment. At one end they interact with their supply infrastructure while at the other they will have at least one, and can have many thousands of customers. Each separately identifiable supply or customer unit will have its own value chain model. In effect, the situation is like a network of value chains where one unit's output is another's input.

To summarise the above discussion, SCM is developed as a management tool to better serve the customers. It derived its concepts from the theories of firm, Porter's value chain optimisation and the networking approach. Hobb's work has proposed the different situations based on transaction cost analysis where SCM may be used instead of

the market situation or vertical integration. Ellram's work has suggested that by supply chain management i.e. working together closely with the suppliers, a company's transaction cost in their business exchanges with suppliers can be lowered down. Therefore, the company can also obtain the same benefits of vertical integration.

Porter's value chain model is used to illustrate the flow of the adding value process from supply side through to satisfied customer. This concept recognises the importance of the linkage among different activities in creating customer value. Therefore, supply chain management acquires from the value chain concept the emphasis on integration among different activities and the objective of providing customer satisfaction. The networking approach is used to highlight the fact that in a supply chain, one unit's output is another's input which together serve the final customers.

2.5 REASONS FOR SCM

SCM is becoming more important to companies nowadays. The pressure of global competition is often given as a prime reason for this (Jones, 1989). Increasing competition forces competing companies to focus on what they are good at. Hence, there is the trend to buy out a significant amount of total material content. As companies specialise and focus on a smaller range of activities, the number of organisations involved in a supply chain increases. Supply chains therefore become longer and with a greater number of links. Jones (1989) also points out that differentiated labour costs are one of the reasons for establishing operations in low cost countries, such as Far Eastern and South American countries, or for purchasing from them; many large organisations are now managing supply chains that cover long physical distances because to remain competitive they must either make in or buy from low labour cost base countries. Moreover, enabling technologies and standards, such as Electronic Date Interchange and standards for transfer of invoices and purchase orders, are facilitating changes that help to tackle the pressures on companies to internationalise and lengthen their supply chains. However, more significant is the pressure from the customer (Scott and Westbrook, 1991). Competitive pressure in a global marketplace has greatly altered the nature of customer choice. Japanese producers have shown that it is possible, indeed essential, to compete on price, quality, delivery lead time and reliability simultaneously, and that the reward for so doing is vastly increased market share. In consumer goods especially,

customers like to be offered a wide choice of items, easily available at attractive prices and certain to perform to specification.

The traditional way of coping with the uncertainties of quality variation, supplier unreliability and customer unpredictability has been to build inventory. This is now regarded as costly and inflexible. Instead, companies are seeking ways to integrate their supply chains in meeting the needs of their customers. This approach implies great responsiveness to customers, and close collaboration with suppliers. Moreover, the strategic balance of supply and demand based on firm-wide and chain-wide objectives, and, more particularly, its support by a systems approach that places a premium on the fast transfer and accessibility of information across functional and organisational barriers are all highly relevant.

2.6 PROBLEMS IN A SUPPLY CHAIN

Classical approaches to managing a supply chain have left companies vulnerable to change. In the international supply chain this vulnerability is magnified even more than in the simplest case of local for local production and distribution. Vulnerability to poor management of change can be demonstrated in models applying the techniques of systems dynamics to the industrial environment. The effects described by Roberts (1977) and Forrester (1962) have shed much light on the distortion of information and data as they flow through decision processes in partitioned systems and organisations. Houlihan (1985) suggests that a company's vulnerability can be considered in a dual context - the context of its external placement in a global supply chain and the context of its internal supply system. In the first case, the further a company is from the end user of its products the greater are the swings in demand it experiences (Figure 2.2)

The effects of change in the external context are amplified in the company's internal system. Figure 2.3 depicts the amplification effect and the major contributing factors. Figure 2.4 shows the additional amplification that stems from the weaknesses inherent in many of today's supply chain systems.

Fig. 2.2: *Distance from customers and swings in demand (Source: Houlihan, 1985)*

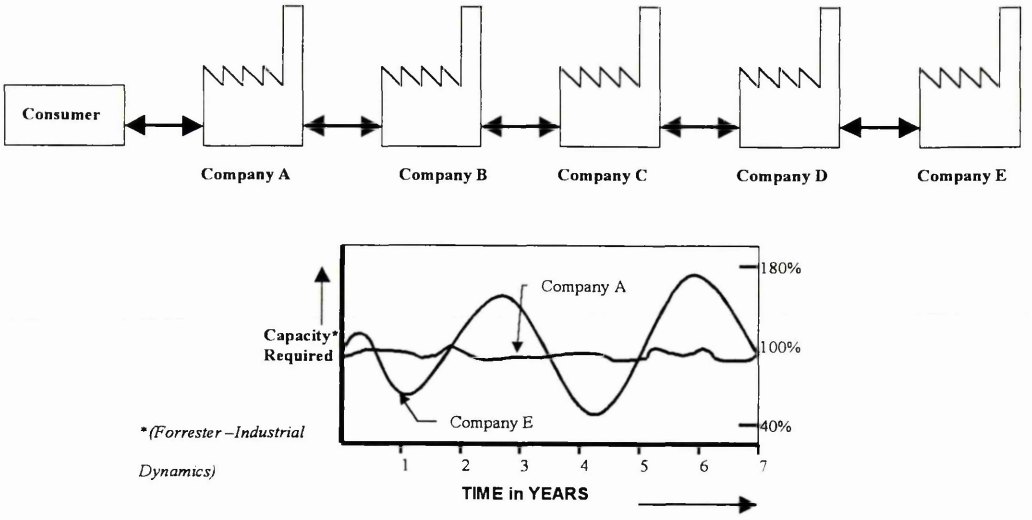


Fig. 2.3: *Amplification effect and the major contributing factors (Source: Houlihan, 1985)*

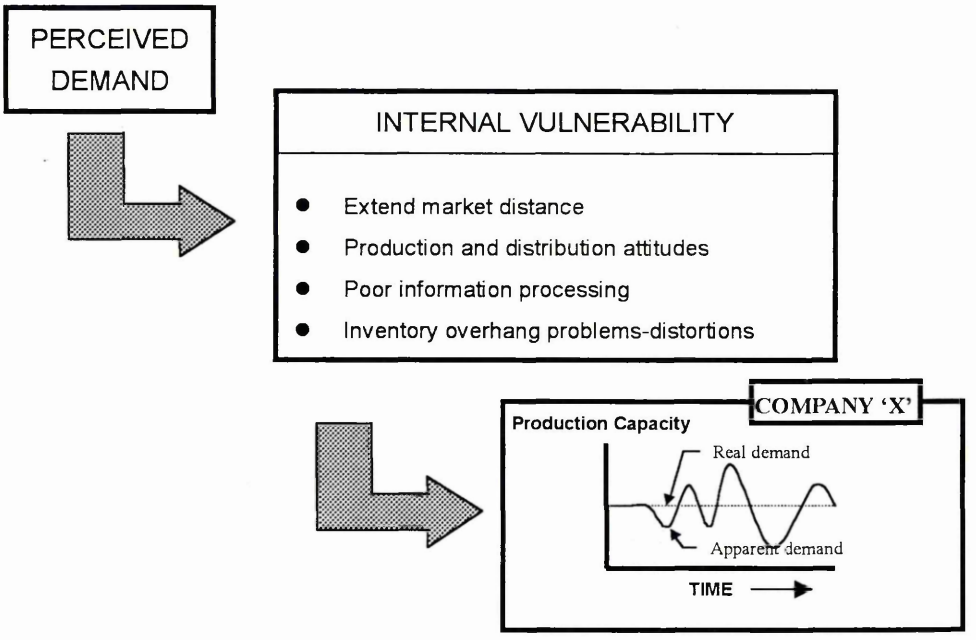
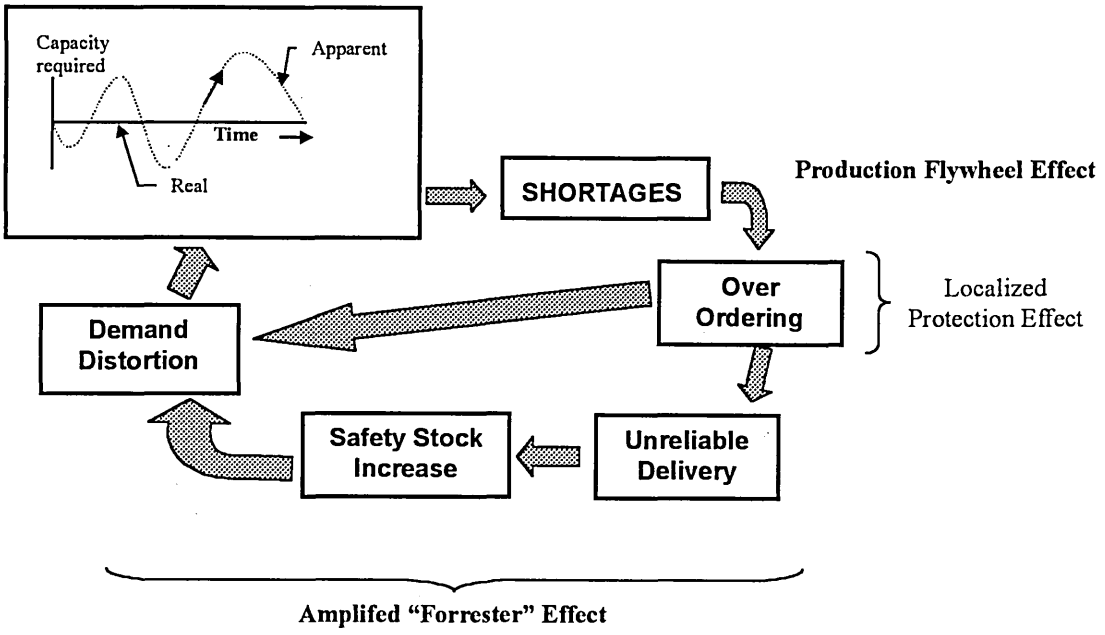


Fig. 2.4: *Amplification that stems from the weakness inherent in the system. (Source: Houlihan, 1985)*



* *Jay Forrester – Industrial Dynamics*

The amplification effect normally operates in the following order:

- An upswing in demand produces shortage somewhere on the chain.
- The normal reaction to any threat of shortage is local protection, the most frequent symptom of which is over-ordering.
- Since most internal forecasting mechanisms are order-book driven this surge in ordering will most likely have an impact on the new forecast and serve to distort the internal perceptions of the upswing.
- Current inventory control logic dictates that unreliable delivery should be compensated for by additional inventory investment.

According to Davis (1993), there are three distinct sources of uncertainty that plague supply chains: suppliers, manufacturing, and customers. Problems like machine breakdown in a firm's plant, late deliveries from its supplier etc. will lead to uncertainties in the supply chain. Very often, inventories are built up to cover these uncertainties. Moreover, uncertainties in the supply chain are accentuated by the lack of communication and coordination among the different supply chain members who often have arm's length relationships with each other.

The above problems which are usually found in SCM literature focus mainly on the logistical aspect, with excess inventory building up because of uncertainty in the supply chain system. Therefore, SCM posits that close cooperation among different parties will help clarify the various uncertainties and thus inventory can be greatly reduced. However, there should be other problems existing in the supply chain that block the achievement of the objective of meeting the ultimate customers' requirements. These problems include difficulties arising from producing the right quality of goods through the different processes in the supply chain and difficulties in making the people in the supply chain work together for the same objectives.

2.7 BENEFITS OF SCM

Discussion on the earlier sections indicates that SCM can bring together many advantages of obligational contracts and vertical integration, while spreading the risks of asset ownership, and reducing market risk through improved co-ordination and communication. Moreover, SCM can help companies better tackle the problems related to their supply chains, i.e. the various uncertainties relating to customers' demand. The outcome will be benefits to all parties involved in the process of meeting the needs of customers at the end of the supply chain. Besides, SCM is a significant technique that can improve channel efficiency and effectiveness. Hence, it can also enable companies achieve competitive performance.

Moreover, as suggested by Jones (1989), the supply chain focuses on customers at the end of the chain and that the chain strives for synergy. The end customers are the decision makers whose decisions determine an industry's success or failure now and in the future. SCM will enable a company to manage its total supply chain to ensure the end customer is satisfied. It will utilise the resources of the whole chain in providing product/service package that will meet the different needs of final customers.

Jones (1989) also states that in a supply chain, synergy can be achieved either by applying distinctive competence or expertise to a related activity (e.g. supplier development to improve supplier performance and therefore improve the developer's performance) or through using one resource many times resulting in economies of scale efficiencies (e.g. by centralising purchasing at one node in a supply chain). From a systems viewpoint, managing the supply chain system as a whole will enable exploitation

of emergent properties or synergy i.e., two plus two equals five. According to Spekman et al. (1998), the top five benefits that companies adopting SCM want to achieve are "Increased end-customer satisfaction", "Improved profits", "Secure reliable source/market for this item", "Satisfy supplier/customer request" and "Reduce overall operating costs".

2.8 THE MAIN CONCEPTS AND COMPONENTS OF SUPPLY CHAIN MANAGEMENT

A review of the literature on supply chain management suggests several main concepts and components of supply chain management. The different definitions on a supply chain emphasize on the different aspects of supply chain management. They include **supply chain processes**, i.e. information flow and material flow, and the **supply chain structure**, i.e. supply network and internal and external supply chain. The definitions on supply chain management indicate different perspectives on supply chain management. The three perspectives of supply chain management proposed by Giunipero and Brand (1996) identify the information and material flow approaches and the integrative value added approach. The first two perspectives refer to **supply chain process**. Their third approach indicates other elements of supply chain management: **supply chain integration** and **supply chain relationship**. These two elements are also found in the definitions put forward by other authors such as Lambert et al.(1996) and Tan et al. (1998). Another element on supply chain management is **supply chain performance and evaluation**. They can be found in the supply chain management definitions of authors such as Vickery et al. (1999) and Handfield and Nichols (1999).

The five elements of supply chain management including supply chain integration, supply chain relationship, supplier chain structure, supply chain processes, and supply chain performance and evaluation, can also be traced from the theories underlying the development of the supply chain concept. These theories as discussed in an earlier section of this chapter include relational exchange theory, transaction costs theory, value chain model, and network theory. Relational exchange theory is related to the elements of supply chain integration and supply chain relationship. Value chain model and transaction costs theory concerns with supply chain processes, while network theory

relates to the supply chain structure. Moreover, the value chain model concerns with the supply chain performance.

Besides, the benefits of supply chain management and the pressure of increasing business competition has highlighted the importance of integrating the supply chain through partnering relationship to achieve best value for customers. Moreover, the problems of uncertainty in the demand and supply for a supply chain has indicated the immense value of having coordinated information and material flow among supply chain members. So, studying supply chain management and developing a new model on supply chain management should also take the different components into consideration. The different components are further discussed below:

2.8.1 Supply Chain Integration

Integration among different parties in a supply chain is essential to reap the benefit of supply chain synergy. Stevens (1989) identifies four stages in the development of an integrated supply chain. A summary of the different stages given by Towill et al. (1992) is as below:

- Stage one -base line - is typified by the company which vests responsibility for different activities within the supply chain in separate, almost independent compartments. There will be stand-alone and often incompatible control systems and procedures.
- Stage two - functional integration - develops factory functional integration by focusing principally on the inward flow of goods. The emphasis is on total cost reduction rather than total business system performance improvement.
- Stage three - internal integration - recognises that there is very little point in just focusing on the flow of goods within the organisation. The management of flow to the customer is therefore also improved. This requires local integration under the control of the company.
- Stage four- external integration - full supply chain integration is achieved by extending the scope of management outside the company to embrace the suppliers and customers. It embodies a change of focus away from being product-oriented to being customer-oriented. Integration back down the supply chain to include all suppliers is also undertaken.

According to Stevens(1989), in stage 4, it represents a change of focus, i.e. being customer focused. It also represents a change in attitude, away from the adversarial attitude of conflict to one of mutual support and co-operation. Co-operation starts at the early stages of product development and encompasses full management involvement at all levels; the supply of high quality products shipped direct to the line on-time; shared product, process and specification change information; technology exchange and design support, and above all, long-term commitment, which usually means the elimination of multiple sourcing.

Therefore, in the full integration stage, a company concerns about the total process of satisfying its customers. It manages both the customers and the suppliers. It will cooperate with its suppliers in meeting the needs of customers. It is hoped that the close linkages with its suppliers will engender some synergistic effect which will ultimately benefit the company's final customers. Hence, supply chain integration leads to cooperative supply chain relationship.

2.8.2 Supply chain relationship

As pointed out by Dyer et al. (1998), "two widely differing supplier management models have emerged from both practice as well as academic research on the issue of how to optimally manage suppliers." They are the traditional view, or the *arm's-length model* of supplier management and a *partner model* of supplier management. The former model advocates minimizing dependence on suppliers and maximizing bargaining power. Its acceptance as the most effective way to manage supplier relationships in the United States was not challenged until the success of Japanese firms - who developed close supplier relationships, or *a partner model* of supplier management. Since then, partnering with suppliers has been advocated as a means to obtain best performance from a supply chain (Ellram, 1991; Ellram and Cooper, 1990; Ellram and Edis, 1996; Sellers,1992; Stuart, 1993; Yovovich, 1991). Poirier and Houser (1993,p.56) described the concept of partnering as " the creation of cooperative business alliances between constituencies within an organisation and between an organisation and its suppliers and customers. Business partnering occurs through a pooling of resources in a trusting atmosphere focused on continuous, mutual improvement." They argue that the maximum benefits of partnering are realised when all parties in the value chain from supplier to

customer cooperate.

There are internal partnering and external partnering (Goetsch & Davis, 1997). Internal partnering refers to the partnering effort between different levels, different teams and different employees within an organisation. External partnering refers to the partnering effort between an organisation and its upstream or downstream organisations, i.e. the supply chain partners. In order to have better cooperation from supply partners, a long-term relationship should be developed (O'Neal, 1989; Spekman, 1988). Literature documents that supplier partnering will lead to quality results from the supply chain (Smith, 1990; House, 1990; Dyer, 1996; Wong et al.1999).

2.8.3 Supply chain structure

Integrating a supply chain will have some impacts on the structure of a supply chain. According to Bhattacharya et al (1996), probably the two most important structural changes taking place under the banner of SCM are:

- Redefining the ownership of value boundaries through outsourcing of more value by the product owner, usually the final assembler.
- Reduction in supplier base by the product owner, in a move towards single sourcing.

Allied to these structural changes is the recognition that management of the streamlined supply chains should be underscored by more open and more highly integrated partnership relationships, in which information sharing and trust is paramount.

The re-defined value boundaries are changing the supply chain structure, with a logical multi-tier structure emerging. The first-tier are the system integrators each of which would be supported by its own group of suppliers.

The outsourcing of more value into re-defined value boundaries and the resultant tiered structure of the industry means that technology and capability diffusion is taking place from the product owner to his suppliers. Since not many suppliers can handle this technology diffusion and work the new technology, there is a process of consolidation among suppliers at the system integrator or first tier supplier level with less capable suppliers moving down the supply chain as second or third tier suppliers.

However, the emergence of a multi-tier structure should also depend on the type of industry. For industries involved in producing highly technical and complex products,

there are more complicated tasks being outsourced because of the technologies an organisation can master are limited. Therefore, the number of tiers in the supply chain will be greater and the first-tier suppliers sometimes have to act as system integrators. For simple products, the number of tier will be much shorter and system integrator might not be necessary.

Under SCM, a company needs to work closely with its suppliers in order to better meet the customers' requirements. Therefore, its attention to each supplier will be much greater than before. However, it often does not have the time to deal directly with all of its suppliers. Hence, it will try to reduce its supplier base and work closely with those suppliers that are important to it.

2.8.4 Supply chain processes

Supply chain processes are related to the material flow and information flow both up and down the supply chain. Handfield and Nichols (1999) suggest that "the sharing of information among supply chain members is a fundamental requirement for effective supply chain management. At the ultimate level of integration, decision makers at all levels within the supply chain member organisations are provided with the information they need, in the desired format, when they need it, regardless of where within the supply chain this information originates. Providing decision makers within the supply chain with the *right* information, in the necessary format, and in a timely manner is a major challenge." The recent advancement in information technology has facilitated companies' processes in communicating and sharing information along their supply chains. Other authors also suggest the importance of sharing information with supply chain members (Braithwaite, 1992; Ellram, 1995; Noordewier et al., 1990).

On the other hand, Handfield and Nichols (1999) also state that in order to improve the performance of supply chains, companies have to better manage the physical flow of materials. They advocate on the development of supply chain process maps (flowcharts) for major supply chains and their related processes. Examples of key processes and associated entities given by them include order transmittal (sales), order entry (materials planning), order preparation (purchasing, manufacturing, warehousing), and order shipment (distribution and transportation) . Others (Gattorna, 1992; LaLonde and Powers, 1993) also share their view on better managing the processes in order to

improve supply chain performance.

Besides, the Supply Chain Council in the States introduced its Supply Chain Operations Reference Model (SCOR) in 1996. It proposes four core processes which are plan, source, make and deliver. The 'Plan' process is to balance aggregate demand and supply to develop a course of action which best meets the established business rules; the 'source' process is to procure goods and services to meet planned or actual demand; the 'make' process' is to transform goods to a finished state to meet planned or actual demand; and the 'deliver' process is to provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and warehouse management.

2.8.5 Supply chain performance

This component has been relatively neglected until recently (Handfield and Nichols, 1999). It is in fact difficult to devise a model that can assess the performance of the supply chain. First of all, there are different parties involved in the supply chain which make it difficult to solicit views regarding supply chain performance. Second, supply chain management is so broad that it is difficult to devise appropriate measures.

The importance of having a system to measure the supply chain performance is that measuring supply chain performance in and of itself leads to improvements in overall performance. The existing literature, especially the earlier ones emphasize on improving customer service level such as lower inventory level, and shorter delivery time (Jones and Riley, 1985; Lee and Billington, 1992). Besides, the lack of an appropriate performance measurement system has been a major pitfall to effective supply chain management (Lee and Billington, 1992). Stank and Lackey (1997) argue that a good performance measurement system should be "actionable": it allows managers not only to identify but also to eliminate causes of supply chain operational problems so that relationships with customers are not permanently harmed.

2.9 RECENT RESEARCH ON SCM

The above key components of SCM can be used to categorize the research focus of the articles published in the recent two years in the journal of "Supply Chain

Management". Table 2.2 gives a summary of the research focus of articles from Supply Chain Management.

Table 2.2: *Research focus of articles published in Supply Chain Management in 1998 and 1999*

Research Focus	Authors of articles in Supply Chain Management[1]
Partnership / relationship	O'Keeffe (v.3, n.1); Spekman et al. (v.3,n.2); Fynes & Ainamo (v.3,n.2); Graham & Hardaker (v.3,n.3); Rademakers & McKnight (v.3,n.4); Fearne (v.3,n.4); Burnes & Coram (v.4,n.1).
Material Flow	Lehtonen & Holmstrom (v.3,n.1);Blatherwick (v.3,n.1); Humphreys et al. (v.3, n.4); Lehtonen et al. (v.4,n.1); Harris et al. (v.4,n.1); Hoek (v.4,n.1); Stank et al. (v.4,n.2); Koehorst et al. (v.4,n.2)
Information flow	Calder & Marr (v.3,n.3); Wilson & Clarke (v.3,n.3); Leat et al. (v.3,n.3); Viaene & Verbeke (v.3, n.3).
Performance & Measurement	Green et al. (v.3,n.2); McIntyre et al. (v.3,n.3); Hoek (v.3,n.4).
Supply chain structure	Hobbs et al. (v.3,n.2); Kennett et al. (v.3,n.3); Kornelius & Wamelink (v.3,n.4); Hamdar (v.4,n.1);
Supply chain integration	Hobbs & Kerr (v.3,n.1);Siragher (v.4,n.1); Desbarats (v.4,n.1); Kerr (v.4,n.2);Collin et al. (v.4,n.2).
Overall discussion on SCM	Lopez & Poole (v.3,n.1); Bateman (v.3,n.2); Simpson, et al. (v.3,n.3); Jack et al.(v.3,n.3); Stanford et al. (v.4,n.2).

Note: The above articles are found in Vol.3, Issues 1 to 4 and Vol. 4, Issues 1 to 2 of the journal of "Supply Chain Management" which is published by MCB University Press. The volume and issue number for each article are enclosed in bracket and are put immediately after the author (s).

The subjects discussed in the articles categorized under material flow include Just-in-time, vendor-managed inventory (VMI), efficient customer response (ECR), business process reenginneering (BPR), process postponement and standard packaging to facilitate the flow of materials. These subjects focus on the logistical aspects of the supply chain. The aim is to achieve a smooth and efficient flow of materials.

Topics in the articles included under information flow are electronic data interchange (EDI), a traceability system for material flow, and information technology. These topics relate to the use of information technology to better trace and manage the material flow of the supply chain. Both articles on the material flow and information flow are in fact concerned with the **supply chain processes**.

On the other hand, there are articles focusing on the **supply chain relationship**. Areas discussed in the articles grouped under partnership and relationship consist of

evolution of partnership, barriers to supplier partnership, channel relationships, lean supply relationship and inter-firm cooperation. In sum, the articles center on buyer-supplier relationships and propose that cooperative relationship or supplier partnership is an essential technique or tool of supply chain management.

Some articles look at the **supply chain structure** that provide the framework for the development of supply chain relationship and the flow of material and information. Regarding the articles on supply chain structure, the topics included are vertical alliances, re-structuring the supply chain to improve links, organisation of the supply chain, and vertical and horizontal interdependence. There is a common theme among the articles, i.e. rationalisation of the supplier base which would help the supply chain achieve better integration.

Articles on **supply chain integration** discuss on topics such as vertical coordination, the benefits of integration of functions or processes within an organisation and integration with upstream and downstream organisations within the supply chain. In sum, these articles propose that an integrated supply chain would be more preferable nowadays.

The first two articles on **supply chain performance** relate to green purchasing and devising environmental strategy from the supply chain's perspective respectively. The third article discusses on the problem of measuring supply chain performance.

Areas covered by other articles concerning supply chain management include quality assurance for the supply chain, development of supply chains in the transition economies, and countries and the relative importance of a number of supply chain attributes.

In sum, the research focus of the recent articles of *Supply Chain Management* can be classified according to the basic components of supply chain management. So, these components should form the basis for the study of supply chain management. Moreover, in the formulation of a new SCM model, the various components should also be taken into consideration. With the above review on the background of the SCM concept and the recent research, a more comprehensive idea of what topics have been tackled in the past by researchers can be obtained. Most of the recent research in the journal only focus on a particular aspect of Supply Chain Management. There is a lack of a holistic model taking care of all the major aspects of supply chain management. There is no article that works on assessing the overall supply chain performance of a company.

2.10 EXISTING SCM MODEL AND ITS INADEQUACIES

2.10.1 A traditional SCM model based on existing literature

Having reviewed the existing literature on Supply Chain Management, it appears that several of the studies propose on using supplier partnership as a means to integrate buyers and customers in supply chains (such as Ellram & Cooper, 1990; Stuart, 1993). Literature also suggests that companies adopting supplier partnership should have long-term relationship (see O'Neal, 1989; Spekman, 1988) with their suppliers so that their interactions can be more close. Apart from relationship, companies working together with their suppliers should have information sharing with each other (Braithwaite, 1992; Ellram, 1995; Noordewier et al., 1990) and have integrated processes (Gattorna, 1992; LaLonde & Powers, 1993) for the smooth flow of materials between them. In turn, existing literature suggests that adopting supply chain management, i.e. developing supplier partnership, having a long-term relationship with supply partners, maintaining close and frequent information flow and establishing an integrated material flow processes with supply partners would lead to good supply chain performance. However, most literature emphasizes on customer service level such as lower inventory level, shorter delivery time, as the main performance indicator of a supply chain (Jones and Riley, 1985; Lee & Billington, 1992; Giunipero & Brand, 1996). These various components can be put together into a traditional supply chain management model based on the existing literature (Figure 2.5).

As shown in figure 2.5, the forming of supplier partnership is the foundation for good supply chain performance. The existing literature suggests that supplier partnership will lead to long - term orientation and relationship instead of short - term perspective. Long - term relationship will help companies avoid short - term opportunistic behaviour by suppliers and hence better performance can be resulted. Besides, supplier partnership should be conducive to more frequent flow of information and a more smooth and integrated material flow process between a company and its suppliers. In turn, the close information and material flow process contribute to better supply chain performance. This model crystallises the existing views of authors on the different components of supply chain management. However, this model has its inadequacies and should be enriched before it will be more useful to companies hoping to

better manage its suppliers.

2.10.2 Inadequacies of the existing SCM model

Supplier partnership should be useful as a measure to improve the interorganisational relationship and operation and should be an important element of Supply Chain Management.

There are various models for supplier partnership in the literature. Lambert, Emmelhainz, and Gardner (1996) developed a model which can be used to determine whether a partnership is warranted, and if so, how close of a partnership is warranted. Gardner, Cooper, and Noordewier (1994) proposed a model of partnership formation and management with five stages: choosing a partnership strategy, choosing a specific partner or partners, designing the partnership, evaluating the partnership, and evaluating the partnership strategy. Ellram (1995) advocated a different five-stage process for purchasing partnerships (preliminary phase, identify potential partners, screen and select, establish relationship, and evaluate). Stuart (1993) focused on the key factors for determining the degree of partnership that should exist: level of committed resources, potential for productivity improvements and competitive advantage, and level of joint problem solving and sharing of benefits.

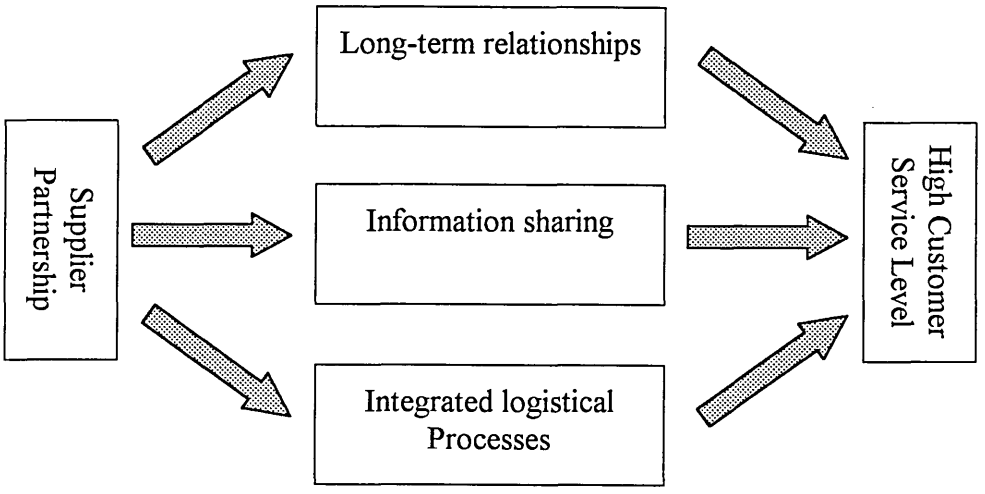
The different models emphasise on the process of determining whether partnership is required and the stages of developing supplier partnership. However, they pay less attention on the factors that contribute to the success of supplier partnership, the role played by supplier partnership in the performance of the supply chain and the existing performance of companies' various supply chains. Although Gardner and Cooper (1988) do propose some behavioural characteristics of successful partnering relationship, they are looking at the behaviour that good partners should display instead of the factors that can explain successful partnering relationship.

A possible area that should be covered in developing close partnering relationship between the parties is that someone in the supply chain should assume the leadership to integrate the various parties. Moreover, close relationship with supply chain partners does not come so easy. It may require some cultural changes among the people in the supply chain. This change of mind-set has to be strongly supported by the leaders of organisations in order to be successful. This human factor is not covered in

most SCM writings. 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 at meeting the various needs of a customer so as to fully satisfy 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 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 involve in different processes so as to better utilise their combined resources. 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 can support the suppliers in improving their production process. Continuous improvement of the supply chain activities is the key towards meeting the ever-changing needs of the ultimate customers.

In conclusion, the existing supply chain management model focuses mainly on working closely with suppliers in providing 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 (Figure 2.5).

Figure 2.5 : *Existing SCM model and its inadequacies*



From Fig. 2.5, it can be seen that some inadequacies exist in the existing SCM model. These inadequacies include:

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

Therefore, a new SCM model should be developed to fulfill the inadequacies of the existing SCM model. Companies can make use of the new SCM model to understand, to better manage and fully utilise their supply chains to achieve organisational effectiveness. Hence, it is the aim of this study to develop a new SCM model.

Most of the literature reviewed only focus on a particular aspect of supply chain management, such as supplier partnership, managing the material and information flow. Hence, despite substantial research on supply chain management, there is a lack of a holistic perspective that basically covers all of the different aspects of supply chain management. In addition, inadequate attention has been paid to the leadership's role in laying down the infrastructure for supply chain management and the need of customers that supply chain management has to meet. Besides, although the benefits of supplier partnership have been widely covered in existing SCM literature, however, the way to

develop effective supplier partnership is not well documented (Wong, 1999). Therefore, the new SCM model should take the above considerations together.

2.11 CONCLUSION

In this chapter, literature on SCM has been reviewed. As a result, a better understanding on SCM has been obtained, especially on the development of the SCM concept, the driving force for SCM, the problems of a supply chain and the benefits of adopting SCM. Moreover, the main questions or aspects being dealt with by existing SCM studies are also summarised into five basic components of SCM which are supply chain integration, supply chain relationship, supplier chain structure, supply chain process, and supply chain performance. Most of the existing studies only focus on one of the various aspects of SCM and prescribe their suggestions for SCM. A model on SCM consolidating the views of existing authors is presented as a framework for further extending the study on SCM. A review of the model reveals that there are some inadequacies of the existing model which provide the driving force for developing a new SCM model that can fulfill the present model's inadequacies. It is believed that the principles of Total Quality Management would certainly help enrich the existing SCM model. The principles of Total Quality Management are being reviewed in the following chapter.

CHAPTER 3

TOTAL QUALITY MANAGEMENT AND BUSINESS EXCELLENCE

3.1 INTRODUCTION

The previous chapter reviews the existing literature on SCM and outlines the inadequacies of the traditional SCM model. The inadequacies are mainly related to the missing links that can enrich the existing SCM model into a new SCM model which can help companies better manage their supply chains so as to achieve competitive advantages over their competitors. To fulfill the inadequacies of the existing SCM model, the principles of Total Quality Management should be useful. This chapter reviews the concept of TQM, with particular reference to its principles. Since companies use TQM principles to help them achieve business excellence, therefore, this chapter also looks at the linkage between TQM and Business Excellence. Moreover, this chapter explains why Kanji's Business Excellence Model is selected to enrich the existing SCM model.

3.2 WHAT IS QUALITY?

Since TQM deals with quality, it is worthwhile to first understand the word "Quality". There is no one single definition on "Quality". The meaning of quality is different for different people and different organizations. There are broad definitions of quality and narrow definitions of quality. Moreover, the meaning of quality is evolving and changing over time. Some of the definitions are cited and examined below.

The Oxford English Dictionary on Compact Disc (2nd Edition) offers some definitions of the word "Quality" that are relevant to managers. They are "the degree of excellence"; "all the attributes of a thing"; and "peculiar excellence or superiority".

Juran (1992) also makes use of the definitions of quality from dictionary to elaborate on the meanings of quality. According to Juran, the two most important definitions are "product features" and "freedom from deficiencies." The main lessons for

the manager are:

- Product features impact sales. As to this kind of quality, higher quality usually costs more.
- Product deficiencies impact costs. As to this kind of quality, higher quality usually costs less.

A convenient phrase chosen by Juran to describe the above two definitions is "Fitness for use". Juran further states that the terminology of quality has been changing. He advocates the concept of "Big Q and little Q." Juran (1992) points out that "until the 1980s managers generally associated quality with factories, manufactured goods, and production processes. During the 1980s there emerged a wide trend to broaden the definition of quality to include all products, all processes and all industries. Quality is being evaluated on a company's responsiveness to customer needs."

Feigenbaum(1988) defines quality as "The total composite product and service characteristics of marketing, engineering, manufacture, and maintenance through which the product and service in use will meet the expectations of the customer."

British Standard 4778 (1979) defined quality as " The totality of features and characteristics of a product, service or process, which bear on its ability to satisfy a given need."

Garvin (1988) tries to categorise the numerous definitions of quality existing in the literature in an effort to create a common understanding. According to him, there are the following five approaches to defining quality:

- The transcendent approach defines quality as a condition of excellence implying fine quality as distinct from poor quality. This approach lacks objectivity.
- The product-based approach identifies specific features or attributes that can be measured to indicate higher quality.
- The user-based approach proposes that the user determines the quality of the goods. Juran refers to this approach as "Fitness for use".
- The manufacturing-based approach defines quality as the precision of meeting the target specifications of a product or service. Crosby described this approach as "conformance to requirements".
- Value-based approach introduces the element of price. Broh (1982) provides one expression of this approach: " Quality is the degree of excellence at an acceptable price and the control of variability at an acceptable cost."

In practice, a company adopts a mix of these approaches. Since the manufacturing and product-based approaches are objective, it is relatively straightforward to measure competitive quality on these yardsticks. When a company tries to assess the competition as perceived by the user, the company will make use of the user - based and the value - based approaches.

Garvin (1988) put forward his eight dimensions of quality which include performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. If a product or service was rated better than the competition on one or more of these dimensions, it would be considered a higher quality. On the other hand, a study done by Berry, Zeithaml, and Parasuraman (1990) identified five principal dimensions of service quality. They are reliability, responsiveness, assurance, empathy, and tangibles.

To sum up, there are different definitions of quality. Each definition has its own emphasis. It may be related to the specific features of a product, its fitness for use, its conformance to specifications and its value for money. However, all of them are just different aspects of meeting customers' requirements. It can be observed that the meaning of quality has been changing over time and therefore, its emphasis is also changing. It is in line with changes in the demands of customers which become more demanding and the business environment which becomes more competitive. It departs from a limited view of quality to that of a wider view, i.e. instead of associating quality with factories, manufactured goods, and production processes, the definition of quality is broadened to include all products, all processes and all industries. Nowadays, quality is seen more to tie up with the needs of both the internal and external customers. Companies often aim to satisfy the needs of customers continually at low cost.

3.3 QUALITY AS A COMPETITIVE STRATEGY

The attainment and maintenance of satisfactory levels of customer satisfaction with the quality of products and services are today fundamental determinants for business health, growth, and economic viability. Correspondingly, quality is becoming a principal guidepost in the development and successful implementation of the managerial and engineering programs for realising major business goals (Feigenbaum,1988).

The importance of quality is well recognised. Nakane (1986) also points out that

quality is at the base of all improvements. Once quality has reached a critical level, then dependability can be improved. Next, the company can improve cost efficiency and finally speed or flexibility. Ferdows and De Meyer (1990) hold a similar view that quality is the basis of any subsequent improvement.

Research studies also support the importance of quality as a competitive strategy. The PIMS researchers point out that the single most important factor affecting a business unit's performance relative to its competitors' is the quality of its products or services (Wheelen, 1995). Therefore, quality is increasingly being used as a strategy to differentiate a company's products or services from their competitors so as to outcompete them.

3.4 WHAT IS TOTAL QUALITY MANAGEMENT?

A concept concerning and incorporating quality in it is Total Quality Management. It adopts a wider view of quality, and is not just limited to quality of products and services. In order to better understand Total Quality Management (TQM), it is worthwhile to first start with its definitions. There are very many definitions on Total Quality Management. Some people look at the terminology of TQM as a whole while some people explain TQM by the meaning of the different words making up the terminology. Examples of definitions explaining the meanings of the different words of TQM selected here are those given by Kanji & Asher (1993), Cartin (1993) and Besterfield et al. (1995).

Kanji & Asher (1993) defined TQM as follows:

> Quality is to satisfy agreed customer requirements continually.
>
> Total Quality is to achieve quality at low cost.
>
> Total quality management is to obtain total quality by involving everyone's daily commitment.

Cartin(1993) has the following definition:

> Total refers to the involvement of everyone in the organisation-every function and activity. It is a systematic approach to achieving excellence.
>
> Quality is the dimension by which the value of this management method is measured.

Management is the actions involved in applying TQM principles and techniques to all activities.

Besterfield et al (1995) believe that TQM is the art of managing the whole to achieve excellence and suggest:

Total - made up of the whole.

Quality - degree of excellence a product or service provides.

Management - Act, art, or manner of handling, controlling, directing, etc.

The segregation of the term TQM into three elements helps to give out the message that TQM is not just about quality, rather the other two elements should also be taken into consideration. In practice, there is a danger that too much emphasis might be put on just one of the three elements.

Examples of definitions looking at the terminology as a whole include those from Pike and Barnes (1988), Dale et al. (1990), Oakland (1990), Rampey and Roberts (1992), Ross (1993), and Cortada (1995).

Pike and Barnes (1994) state that "It (TQM) is a process of individual and organizational development, the purpose of which is to increase the level of satisfaction of all those concerned with the organisation: customers, suppliers, stakeholders and employees."

Dale et al.(1990) suggest that "Total quality management requires that the principles of quality management should be applied in every branch and at every level in the organisation.....The process would extend beyond the organization itself to include partnerships with suppliers and customers."

Oakland (1990) defines TQM as "A way of managing to improve the effectiveness, flexibility and competitiveness of a business as a whole. It applies just as much to service industries as it does to manufacturing. It involves whole companies getting organised in every department, every activity and every single person at every level."

Rampey and Roberts (1992) consider TQM as "A people - focused management system that aims at continual increase in customer satisfaction at continually lower real cost. Total Quality is a total system approach (not a separate area or program), and an integral part of high - level strategy. It works horizontally across functions and departments, involving all employees, top to bottom, and extends backwards and forwards to include the supply chain and the customer chain."

Ross (1993) explains that "TQM is the integration of all functions and processes within an organisation in order to achieve continuous improvement of the quality of goods and services."

Cortada (1995) advocates that "TQM is a means of operating a business that seeks to maximize a firm's value through maximizing customer satisfaction at the lowest possible cost."

Besides, some institutions also put forward their definitions on TQM. Some notable examples include those from British Standard Institution, and the Department of Defense of the United States.

The Department of Defense of the United States (1991) defines TQM as "Both a philosophy and a set of guiding principles that represent the foundation of a continuously improving organisation. TQM is the application of quantitative methods and human resources to improve the materials and services supplies to an organisation, all the processes within an organisation, and the degree to which the needs of the customer are met, now and in the future."

In the British Standard BS5750: Part 1:1992 Section 3.1,TQM is defined as "Management philosophy and company practices that aim to harness the human and material resources of an organisation in the most effective way to achieve the objectives of the organisation"

Table 3.1 summarises the different definitions on TQM. In fact, different definitions emphasize on different aspects of TQM. To have a better and more thorough understanding on TQM, some consolidations on different definitions are necessary. Concerning the nature of TQM, it can be seen that TQM is a management philosophy. It entails a set of guiding principles and company practices. It is also a systematic approach of managing and operating a business. It can also be a process of individual and organisational development.

The scope of TQM can cover both service industries and manufacturing. It involves all functions and processes within an organisation and extends beyond organisation to include suppliers and customers.

The overall objective of TQM may be to achieve organisational excellence, which should be the major objective of an organisation. Achieving excellence may also mean improving the effectiveness, flexibility and competitiveness of a business. It may also require continuous improvement of the quality of goods and services and the improvement of all the processes within the organisation. Excellence has to be recognised by the customers. To win their recognition, organization excellence should be able to help a company continually satisfy any agreed customer requirements at low cost.

In achieving TQM, it would involve everyone, all functions and processes of an organization and should extend to the supply chain and customer chain. It requires the application of principles of quality management and quantitative methods so as to harness the human and material resources of an organisation in the most effective way and in a continuously improving manner.

Table 3.1 : *A summary of the TQM definitions of various authors*

	Kanji & Asher	Cartin	Besterfield et al.	Pike & Barnes	Dale et al.	Oakland	Rampey & Roberts	Ross	Cortada	Dept. of Defense	BS5750: Part 1:1992
Nature	A Process	A systematic approach	Art of managing	A process of individual & organisation development	A process	Away of managing	A people-focused mgt system Total system approach		A means of operating	A philosophy & a set of guiding principles	Management philosophy & company practices
Scope	All customers			customers, suppliers, stakeholders & employees	extend beyond organisation to suppliers & customers	service industries & manufactur-ing		all functions & processes within an organisation			
Aim	satisfy agreed customer requirements continually & at low cost	achieving excellence through quality	achieving excellence	increase the level of satisfaction of all those concerned with the organisation		improve the effectiveness flexibility & competitive-ness of a business	continual increase in customer satisfaction at continually lower real cost	achieve continuous improvement of the quality of goods & services	maximise a firm value through maximising customer satisfaction at the lowest possible cost	improve the materials & services of supplies to an org, all the processes within an organisation	achieve the objectives of the organisa-tion
Means	involving everyone daily commitment	involvement of everyone applying TQM principles & techniques	involve the whole company		applying principles of quality management in every branch & at every level in the organisation	whole company getting organised	works horizontally across functions & depts, & extends backwards & forwards to supply chain & customer chain	integration of all functions & processes within an organisation		application of quantita-tive methods & human resources continuously improving	harness the human & material resources of an organisa-tion in the most effective way

3.5 TOTAL QUALITY MANAGEMENT AND BUSINESS EXCELLENCE

A rationale for TQM put forward by Goetsch and Davis (1995) is that:

> The best way to win in global competition is with quality at low cost. The best way to produce quality at a low cost is to continually improve people, processes, and environments. The best way to continually improve people, processes, and environments is the Total Quality way.

Many companies have adopted TQM and obtained staggering results. Therefore, Total Quality Management is increasingly being seen as management philosophies and techniques in helping companies to achieve business excellence. Many authors have reported on the different benefits from successful applications of TQM. The different benefits were evidenced by the results of different companies applying TQM. One of the most successful stories comes from Rank Xerox (Pike and Barnes, 1994). TQM has helped the company turn around in the late 1980s and regain its position among the world leaders in face of fierce competition from Japanese competitors. A summary of the range of benefits as cited by Pike and Barnes (1994) are as follows:

- Reduction in customer complaints
- Reduction in costs of quality
- Reduced defects and increased customer satisfaction
- Increased profit, efficiency and market share

The usefulness of TQM in helping companies to achieve business results was recognized by governments and companies in the States and Europe. To promote the use of TQM, the US Government launched the Malcolm Baldrige National Quality Award (MBNQA) in 1987. In 1988, the presidents of 14 major European countries, with the endorsement of the European Commission founded the European Foundation for Quality Management (EFQM). It launched the European Quality Award (EQA) in 1991. The main aim of these awards was to make their businesses more competitive or to achieve business excellence. This was in accord with what the TQM authorities had stated in their definitions for the aims of TQM (see Table 3.1.)

The European Quality Award Model developed by EFQM changed its name in 1998 to "The European Model for Business Excellence". Ian Raisbeck defined business excellence at his presentation at the Third World Congress in Sheffield (1998) as:

The overall way of working that results in balanced stakeholder (customers, employees, society, shareholders) satisfaction – and so increasing the probability of long term success as a business."

In 1998, Kanji also developed the pyramid model into his Business Excellence Model. Details of this model is discussed in a later section of this chapter. The business excellence index (BEI) produced by Kanji's model is a means of measuring customers', employers' and shareholder's satisfaction simultaneously within an organization (Kanji, 1998). In sum, the different TQM models are proposed to help companies achieve business excellence, which can be reflected by whether the companies can meet their different stakeholders' satisfaction.

3.6 HISTORICAL DEVELOPMENT OF QUALITY MANAGEMENT

Various authors discuss about the historical development of quality management. It dates back to the 18th century. There are various stages of quality movement with each stage identified by obviously different characteristics. The view of quality is becoming wider over time. Some good elaboration on the development of quality management can be found in Feigenbaum (1988), Garvin(1988), Dale et al. (1990), Kanji and Asher (1993), Bounds et al. (1994), Pikes and Barnes (1994), Vroman and Luchsinger (1994), and Glassop (1995).

Feigenbaum (1988) discussed the evolution of quality movement from a historical viewpoint. According to him, major changes in the approach to quality-control work have occurred approximately every 20 years. The first step of operator quality control was inherent in the manufacturing job up to the end of the nineteenth century. In the early 1900s, the second step of quality - control progressed to foreman quality control. The manufacturing system became more complex during World War I. The first full-time inspectors appeared at this time and initiated the third step - inspection quality control. The tremendous mass-production requirements of World War II necessitated the fourth step of quality control - statistical quality control. The work of quality control, however, remained restricted to production areas and grew rather slowly. Firms required a specific decision-making and operating framework for product quality which was effective enough to take suitable action on the quality - control findings in order to obtain genuine

results in better quality and lower costs. This need brought to the fifth step, total quality control. As total quality control has come to have a major impact upon management and engineering practices, it has provided the foundation for the evolution in the decade of the 1980s and beyond of total quality control organisation wide and total quality management.

Garvin (1988) outlined the evolution of quality through four distinct eras: inspection, statistical quality control, quality assurance, and strategic quality management. Table 3.2 provides an overview of the four eras. Based on the four eras of Garvin (1988), Bounds et al. (1994) and Vroman and Luchsinger (1994) have reviewed the development of quality management.

Information on the four eras is as follows:

The Inspection Era

Until the nineteenth century, skilled craftsmen manufactured goods in small volume. Informal inspection was carried out by them. In the 1800s, mass production required more formal inspection By the early 1900s, gauging had become more refined, and inspection was even more important. It was prominent in Henry Ford's moving assembly line and Frederick Taylor's system of shop floor management.

The Statistical Quality Control Era

This era was signaled by the publication of the book of W.A. Shewhart *Economic Control of Quality of Manufactured Product* in 1931. Shewhart proposed using statistics as a way of reducing the amount of inspection. Instead of checking the entire lot, only a sample drawn from the lot would have to be checked. In World War II, statistical studies promoted the notion of acceptable quality levels (AQL).

The Quality Assurance Era

During the quality assurance era, the concept of quality in the US evolved from a narrow, manufacturing-based discipline to one with implications for management throughout a firm. Statistics and manufacturing control remained important, but coordination with other areas, such as design, engineering, planning, and service activities, also became important to quality. This era brought a more proactive approach and some new tools. Four elements of the quality assurance era are: quantifying the costs of quality; total quality control; reliability engineering; and zero defects.

The Strategic Quality Management Era

The present quality era incorporates elements of each of the preceding eras. Moreover, top managers began to view quality positively as a competitive advantage, and to address it in their strategic planning processes, which are focused on customer value (Steingraber, 1990). The current era presents managers with an ideal conception of "Quality" towards which they must strive.

Dale (1990) suggested that "during the past twenty years simple inspection activities have been replaced or supplemented by quality control, quality assurance has been developed and refined and the most progressive companies are now working towards total quality management. In this progression four fairly discrete stages can be identified: inspection; quality control; quality assurance; and total quality management."

Kanji and Asher (1993) gave an illustration of the historical development of quality management. They suggested that there are four stages of development in quality management in the following order: inspection-based stage; quality control stage; quality assurance stage and total quality management stage. They highlighted the weaknesses of the first three stages and pointed out that the comprehensive nature of the fourth stage can remedy the weaknesses of its previous stages.

Pike and Barnes (1994) analysed the evolution of quality into the traditional and the new approaches to quality management. The traditional approach was represented by the stages of inspection and rejection, and quality assurance. In the stage of quality assurance, they also traced the development of Quality Management System and ISO9000. The new approach was represented by Total Quality Management.

Glassop (1995) reviewed the history of quality by looking at the teachings of Taylor, Shewhart, and the developments of quality in Japan. He stated that "Taylor introduced the concept of organising work activities and setting standards, Shewhart showed how to understand processes and control variation through control charts, and the Japanese, with the help of Deming and Juran, showed how to enlist the support of workers and engage management in adopting these methods."

Summarising on the discussions of various authors, there are some discrete stages in the development of quality management. It starts with inspection, then quality control, quality assurance and then total quality management. Certain people can be associated

with the formation of a particular stage, such as Frederick Taylor and Henry Ford in the inspection stage, WA Shewhart in the quality control stage, and Deming, Feigenbaum, Crosby and Juran in quality assurance and total quality management stages. Apart from the influences of these people, there are also underlying forces causing the development of quality management. Progress in production technology will make traditional, narrow view of inspection based quality control not appropriate nowadays. The ever changing and more demanding requirements of customers will require a wider view of quality. Moreover, keen business competition will necessitate the concerted effort of a company in using a new view of quality as a strategy to compete with its competitors.

Table 3.2: *The four major quality eras*

	Stage of the Quality Movement			
Identifying Characteristics	Inspection	Statistical Quality Control	Quality Assurance	Strategic Quality Management
Primary concern	detection	control	coordination	strategic impact
View of quality	a problem to be solved	a problem to be solved	a problem to be solved, but one that is attacked proactively	a competitive opportunity
Emphasis	product uniformity	product uniformity with reduced inspection	the entire production chain, from design to market, and the contribution of all functional groups, especially designers, to preventing quality failures	the market and consumer needs
Methods	gauging and measurement	statistical tools and techniques	programs and systems	strategic planning, goal-setting, and mobilizing the organisation
Role of quality professionals	inspection, sorting, counting, and grading	troubleshooting and the application of statistical methods	quality measurement, quality planning, and program design	goal-setting, education and training, consultative work with other departments, and program design
Who has responsibility for quality	the inspection department	the manufacturing and engineering departments	all departments, although top management is only peripherally involved in designing, planning, and executing quality policies	everyone in the organisation, with top management exercising strong leadership
orientation and approach	"Inspects in" quality	"Controls in" quality	"Builds in" quality	"Manages in" quality

Source: Garvin (1988)

3.7 TQM & TRADITIONAL MANAGEMENT THINKING

Various writers agree that TQM is a new managerial ideology, a new paradigm of thinking. It requires organisational change and transformation. It has to break away from the tradition thinking or unlearn the old values and take up the new values (Tuckman, 1994; Grant et al., 1994; Bounds et al., 1994; Pike and Barnes, 1994). TQM does have its uniqueness as a management paradigm (Kanji et al. 1993; Boaden, 1996). However, it also has its roots in theories and practices of management that have been developed (Schmidt and Finnigan, 1992; Boaden, 1996).

Tuckman (1994) argues that "TQM not only poses a mode of conceptualizing organisation in non-bureaucratic terms - and hence might serve as the basis of a postmodern organisation theory (Cooper and Burrell 1988) - but can also be seen to legitimate pseudo-market relations within organisation, i.e. the spread of internal markets and a restructuring of the public sector." He also points out that "the ideology and practice of TQM poses a direct assault on traditional work cultures and practices. TQM offers a managerial ideology articulating a support for systems of internal and external subcontracting, thought to be extinguished by the pattern of modernity - stifled by the standards of Taylorism and Fordism (Littler 1980; 1982). It appears, on the one hand, to support the empowering of individual workers and the autonomy of groups which transcend traditional job demarcations of skill and function, while on the other, rests on the clear articulation of work processes through standards and procedures and its links with quality standards such as BS5750 and ISO9000."

Grant et al.(1994) argue that "TQM induces extensive and fundamental change throughout the corporation. TQM's impact goes beyond management practice. Embedded in the work of Deming, Juran, and other TQM theorists, such as K. Ishikawa, is a philosophy that embraces the purpose of the corporation, the role of work, and human nature. Inevitably, therefore, TQM also carries implications for the principles and theories of management." They further point out that TQM can bridge two broad schools of management theory developed in the past half-century: a "Rationalist" school based on the principles of scientific management and the theory of bureaucracy and a "Human relations" school based on the role of the organisation as a social system, emphasizing psychological and social needs. TQM's scientific approach is consistent with the theories of the rationalist school and its work design, and structural

components are consistent with the human relations approach.

According to Grant et al. (1994), there also has been conflict between TQM and approaches to management based on the economic model of the firm in the 1980s and 1990s. They have different sets of theoretical assumptions. A comparison of the different assumptions between TQM and the economic model of the firm is outlined in Table 3.3. Together, the assumptions of TQM constitute a new management paradigm.

Table 3.3: *Comparison between TQM and the Economic Model of the Firm*

	TQM	Economic Model of the Firm
Organisational Goals	Serving customer needs by supplying goods and services of the highest possible quality.	Maximizing profit(i.e. of shareholder wealth).
Individual Goals	Individuals motivated by economic, social, and psychological goals relating to personal fulfillment and social acceptance.	Individuals motivated only by economic goals: maximization of income and minimization of effort.
Time Orientation	Dynamic: innovation and continual improvement.	Static optimization: maximizing the present value of net cash flow by maximizing revenue and minimizing cost.
Coordination and Control	Employees are trustworthy and are experts in their jobs - hence emphasis on self-management. Employees are capable of coordinating on a voluntary basis.	Managers have the expertise to coordinate and direct subordinates. Agency problems necessitate monitoring of subordinates and applying incentives to align objectives.
Role of Information	Open and timely information flows are critical to self-management, horizontal coordination, and quest for continual improvement.	Information system matches hierarchical structure: key functions are to support managers' decision making and monitor subordinates.
Principles of Work Design	System-based optimization with emphasis on dynamic performance.	Productivity maximization by specializing on the basis of comparative advantage.
Firm Boundaries	Issues of supplier-customer relations, information flow, and dynamic coordination common to transactions within and between firms.	Clear distinction between markets and firms as governance mechanisms. Firm boundaries determined by transaction costs.

Source: Grant et al. (1994)

According to Bounds et al. (1994), to keep up with increasing rates of change in their environments, managers may have to make radical changes in their thoughts and actions. These changes are likely to be part of a paradigm shift to a new approach to management. They have made comparisons between TQM i.e. the new paradigm and the old paradigm on different themes: customer value strategy; organisational systems and continuous improvement.

Pike and Barnes (1994) outline the development of management thoughts since 1900s and up to the development of TQM. They see TQM as a new management thinking and a focused form of Organisation Development.

There have been many approaches to the study of management ranging from the Classical School, with its two components of Scientific Management and Classical Organisation Theory, through to the Human Relations School and its successor, the School of Management Science (Stoner 1982). To these Schools must be added the integrative approaches of systems theory and contingency management. Morris and Haigh (1996) point out that none of these approaches has achieved mutual exclusivity and each has taken something from one or more of its predecessors and added something original. They also suggest that TQM has adopted an integrative approach and added the unique element of holism. Moreover, TQM can claim, because of the holism which it advocates, to be distinctive in affording a strong philosophical underpinning to its prescriptions (Kanji, et al., 1993). Boaden (1996) states that irrespective of the relationship of TQM with other initiatives, some of its key elements, including quality management systems, quality management techniques and tools and teamwork, are valuable in their own right.

Many of the elements of TQM are rooted in theories and practices of management that were developed in the West. Schmidt and Finnigan (1992) suggest that TQM roots include:

- Scientific Management: Finding the best one way to do a job.
- Group Dynamics: Enlisting and organising the power of group experience.
- Training and Development: Investing in human capital.
- Achievement Motivation: People get satisfaction from accomplishment.
- Employee Involvement: Workers should have some influence in the organisation.
- Sociotechnical Systems: Organisations operate as open systems.

- Organisation Development (OD): Helping organisations to learn and change.
- Corporate Culture: Beliefs, myths, and values that guide the behaviour of people throughout the organisation.
- The New Leadership Theory: Inspiring and empowering others to act.
- The Linking-Pin Concept of Organisations: Creating cross-functional teams.
- Strategic Planning: Determining where to take the organisation, and how and when to get there.

Schmidt and Finningan (1992) also point out that certain Western theories and practices are dysfunctional and antithetical to TQM. These include:

- Bureaucratic Management: Direction from the boss, compliance from the subordinate.
- Caveat Emptor: Let the buyer beware.
- MBO and MBR: Management by objectives and management by results.
- Internal Competition: Encouraging each department to be number one.
- The Strategy of Organisational Stability: "If it ain't broke, don't fix it."
- Antagonism toward Unions: Workers' interests are basically different from managers' interests.
- Bottom-Line Driven: Profit is the first test for every decision and action.

Therefore, we can see that many of the elements of TQM are rooted in the theories and practices of traditional management. However, TQM also breaks away from certain existing management thinking. In fact, it evolves from traditional management and becomes something new. Hence, many writers say that TQM brings with it a new paradigm of thinking. It may be natural because managing in modern business world should require a new management philosophy.

3.8 QUALITY GURUS

Many people contributed in meaningful ways to the development of the various concepts that are known collectively as Total Quality Management. They advocate the adoption of TQM by companies and develop their own principles and teachings for companies to follow. In the West, the notable quality pioneers are Deming, Juran and Feigenbaum and Crosby. Comparison of the teachings of various quality pioneers can be found in literature. For instance, Oakland (1990) has compared the teachings of Crosby,

Conway, Deming and Juran. The teachings of the western quality gurus have much impact on Japan. In response to their quality messages, some Japanese quality leaders like Ishikawa, Shingo , and Taguchi also developed their own thinking on quality. The essentials of the teachings of the various gurus are summarised by Brocka and Brocka (1992) as follows:

> Crosby is closely associated with the zero defects concept, but in later years has shifted more towards the mainstream of Quality Management thinking. Deming is a godlike figure of quality, and his "14 Points" pop up everywhere. Feigenbaum's fairly early work on total quality control is well worth reading; he has fallen out of the limelight somewhat as he does not seem to seek publicity. Ishikawa was the aristocrat of Japanese quality, and is associated with his "Seven Tools.": Juran is an indefatigable promoter of Quality Management, and is famous for his indispensable Quality Control Handbook....Taguchi focused narrowly on design of experiments, but his influence in Japan has been dramatic, and his work may present the " next phase" beyond statistical quality control.

3.8.1 The main tenets of the quality gurus

The main tenets of the quality gurus are briefly outlined in the following sections.

Deming

W. Edwards Deming aims to improve quality and productivity, jobs, ensure the long-term survival of the firms and improve competitive position (Dale, 1990). According to Goetsch and Davis (1995), Deming is famous for his systematic approach to problem solving, the Deming cycle; his 14 points; seven deadly diseases and his theme of profound knowledge. They point out that Deming's contribution to Total Quality movement is great and many consider him the father of the movement.

The Deming's cycle was developed from Shewhart's work. Deming taught the Japanese Shewhart's principles of scientific thinking embodied in the Plan, Do, Study, Act (PDSA) cycle, which the Japanese soon referred to as the Deming Cycle. It provides managers with a scientific method for learning how to make improvements (Bounds et al., 1994).

In his book *Out of the Crisis*, Deming (1986) has developed 14 interrelated

points for management which provide a road map for quality management. In his later years, Deming (1993) presented the underlying theory of quality management, "The System of Profound Knowledge" in his book. The system of profound knowledge is in four parts - an appreciation for a system, the theory of variations, theory of knowledge and psychology. Gitlow and Gitlow (1994) point out that understanding the System of Profound Knowledge encourages leaders of organizations to give up existing ideas of management and adopt a perspective that embraces the new paradigms: manage to create a win-win environment, manage to create intrinsic motivation, manage with a long-term process and results orientation, and manage to promote cooperation.

Juran

Juran is best known for his concepts of the cost of quality, the Trilogy and two approaches to quality management.

Juran has created the concept of Cost of Quality (Juran and Gryna, 1970). He emphasises the cost of quality because the language of top management is money; he recommends using cost of quality for identifying quality improvement opportunities. In the concept of the Juran Trilogy, Juran considers quality management as three basic processes: quality planning; quality control; and quality improvement (see Juran, 1986). According to Dale (1990), Juran's programmes on quality basically work in three segments: a programme to attack sporadic problems, one to attack chronic problems and an annual quality programme, in which top management participates, to develop or refine policies. Juran defines two major kinds of quality management: breakthrough (encouraging the occurrence of good things) to attack chronic problems, and control (preventing the occurrence of bad things) to attack sporadic problems.

Crosby

The major tenets of Crosby are the concept of zero defect, the four absolutes of quality, the 14 point program, the quality vaccine and the management maturity grid.

To Crosby, there are four absolutes of quality management: (i) quality means conformance to requirements; (ii) quality comes from prevention; (iii) quality performance standard is zero defects; (iv) quality measurement is the price of nonconformance.

Zero defect is the attitude of defect prevention. It means "Do the job right the first time.' It is a performance standard (Crosby, 1979). To prevent nonconformance, companies should adopt a quality "Vaccine" which include three ingredients:

determination; education; and implementation. Based on the four absolutes of quality management, Crosby has a 14 step programme that focuses on how to change the organisation. He has developed the management maturity grid to measure quality achievement. It charts the five stages management goes through from uncertainty to certainty. In the first stage, management fails to see quality as a tool. By the last stage, the company is convinced that quality is essential to its success.

Feigenbaum

According to Feigenbaum (1988), quality is becoming a principal guidepost in the development and implementation of programmes for realising business goals. He advocates a comprehensive, and companywide system for achieving the business goals of organisations: "Total quality control." It is an effective system for integrating the quality-development, quality-maintenance, and quality-improvement efforts of the various groups in an organisation so as to enable marketing, engineering, production, and service at the most economical levels which allow for full customer satisfaction.

Feigenbaum's major contribution to the subject of cost of quality was the recognition that quality costs must be categorized if they are to be managed (Dale, 1990). He identified three major categories of cost of quality: appraisal costs, prevention costs and failure costs (Feigenbaum 1988). Total quality cost is the sum of these costs.

Ishikawa

Kaoru Ishikawa has made much contribution to quality movement. He advocates company-wide quality control (CWQC) and is associated with CWQC Movement that started in Japan during the period 1955-1960 following the visits of Deming and Juran (Ho, 1995). He has simplified statistical techniques for quality control in industry. He sees that it is not necessary to know all about statistics and statistical methods to promote quality control and business management (Ishikawa, 1991). He has grouped together seven statistical tools which he named as Seven QC Tools. He suggests that the Seven QC Tools, if used skillfully, will enable 95% of workplace problems to be solved. These seven tools are classified by him as introductory grade which are easy to apply and comprehend. One of the seven tools, i.e. the cause-and-effect diagrams is created by Ishikawa.

He is also known as the "Father of Quality Circle" (Bank, 1992). According to Brocka and Brocka (1992), quality circle was responsible for much of the increase in quality of Japanese products during the past three decades.

Shingo

Shigeo Shingo's main contribution was his development in the 1960s of Poka - Yoke and source inspection systems. Poka - Yoke is some mistake - proofing devices which have the effect of reducing defects to zero. These two systems help prevent workers from making errors so that defects could not occur.

Taguchi

According to Rao et al. (1996), and Brocka and Brocka (1992), Genichi Taguchi has had significant influence on the quality movement especially in Japan. He focuses on the use of statistical methods to improve quality, particularly in the area of product design. He postulates two causes for variations in products: design characteristics and "noise". Outer noise is the result of variations in the operating environments and human errors and are not controllable. Inner noise is variation due to controllable factors such as deterioration. His primary methodology is design of experiments.

Moreover, he describes quality in terms of the loss generated by that product to society. This loss is a social cost. The loss function is a formal process for computing the cost of deviation from the target value. As deviation increases, more people become unhappy and the social cost increases. The costs can be accumulated and communicated to management.

3.8.2 A summary on the main tenets of Quality Masters

Although different quality gurus have different ideas and foci in their teachings, they have much in common. In broad terms, as summarised by Rao (1996), the quality gurus all agree with each other. TQM seeks to improve productivity, and it does so by focusing on satisfying the customer and by involving employees in this process. With their contributions, they are making total quality management more comprehensive. However, no quality guru has answers for all the problems faced by organisations. It is essential that an organisation should comprehend the thinking and core concepts of TQM so that it can select suitable advice from different gurus and synthesize their ideas to make them applicable to its own situation.

The Bendell's seven point summary can be a guideline for getting the best out of the Quality Gurus (DTI, 1991):

1. Management commitment and employee awareness are essential from the early stages of TQM implementation. Deming's philosophy is possibly the most useful for encouraging these necessary attitudes.
2. The awareness should be backed up by facts and figures. Planning and data collection are important. Costs of Quality can be used to measure the progress of improvement. Juran has made the biggest impact in this area.
3. TQM programmes normally employ teamwork to facilitate improved communication and problem-solving. QCCs are particularly advocated by Ishikawa, and can be very successful if the rest of a TQM structure is in place.
4. Ishikawa advocated simple tools for problem-solving and improvement to be used by all employees.
5. There are also more technical tools to control industrial design and manufacturing. Shingo's work has been associated with successful Just-in-Time systems.
6. Management tools should be studied to achieve quality. These include the concepts of Company Wide Quality Control and Total Quality control associated with Ishikawa and Feigenbaum respectively.
7. In order to move from an inspection to a prevention culture, emphasis is placed on serving the internal customers and suppliers. This customer focus has been strongly stipulated by Juran's and Deming's recent teachings.

3.9 KEY PRINCIPLES AND CONCEPTS OF TQM

Having looked at the teachings of the various quality gurus, various principles and concepts of TQM emerge. A number of authors extracted some success factors for the implementation of TQM from the teachings of the quality gurus. They are as follows:

Drawing upon principles espoused by the quality "gurus", Saraph et al. (1989) identified 8 critical areas of quality management. These are: (1) the role of management leadership and quality policy, (2) the role of the quality department, (3) training, (4) product - service design, (5) supplier quality management, (6) process management, (7)

quality data and reporting, and (8) employee relations.

Ahire et al. (1996) identified 12 TQM constructs through analysis of the literature: (1) top management commitment, (2) customer focus, (3) supplier quality management, (4) design quality management, (5) benchmarking, (6) statistical process control (SPC) usage, (7) internal quality information usage, (8) employee empowerment, (9) employee involvement, (10) employee training, (11) product quality, and (12) supplier performance. The constructs have been empirically tested and validated.

Black and Porter (1996) identified 10 critical factors of TQM. They are: (1) Corporate Quality Culture, (2) Strategic Quality Management, (3) Quality Improvement Measurement System, (4) People and Customer Management, (5) Operational Quality Planning, (6) External Interface Management, (7) Supplier Partnerships, (8) Teamwork Structures, (9) Customer Satisfaction Orientation, and (10) Communication of Improvement Information.

Tamimi (1998) extracted eight factors from Deming's 14 principles. They are: (1) Top managment commitment, (2) supervisory leadership, (3) education, (4) cross functional communications to improve quality, (5) supplier management, (6) quality training, (7) product/service innovation, and (8) providing assurance to employees. These eight factors are congruent with many of the quality management instruments that were developed by researchers such as Saraph et al. (1989), Black and Porter (1996) and Ahire et al. (1996).

The critical factors for the implementation of TQM as proposed by the above authors have been empirically tested and got some support from their research results. Besides, there are other authors putting forward their critical factors or principles for successful implementation of TQM.

Brocka and Brocka (1992) states that the "Pillars of TQM" or the primary elements of Quality Management philosophy vary from author to author, and their number may vary, but their marrow is the following: organisational vision; barrier removal; communication; continuous evaluation; continuous improvement; customer/vendor relationships; empowering the worker; and training.

Flood (1993) suggests ten main principles of TQM:

- There must be agreed requirements, for internal and external customers.
- Customers' requirements must be met first time, every time.
- Quality improvement will reduce waste and total costs.

- There must be a focus on the prevention of problems.
- Quality improvement can only result from planned management action.
- Every job must add value.
- Everybody must be involved.
- There must be an emphasis on measurement.
- A culture of continuous improvement must be established.
- An emphasis should be placed on promoting creativity.

According to Goetsch and Davis (1995), there are ten critical elements of Total Quality Management. They are customer focus (internal and external); obsession with quality; scientific approach to decision making and problem solving; long-term commitment; teamwork; continual process improvement; education and training; freedom through control; unity of purpose; and employee involvement and empowerment.

Oakland (1990) argues that the core of TQM is the customer-supplier relationship, where the processes must be managed. The "soft" outcomes of TQM - the culture, "communications, and commitment provide the foundation for the TQM model. The process core must be surrounded by the "hard" management necessities of systems, tools and teams.

Rao et al. (1996) have arrived at four concepts of TQM: customer focus; total participation; continual improvement and wide range of applicability.

The principles or critical factors for TQM as proposed by these authors do have some commonalities. They are largely based upon case studies, anecdotal evidence and the prescriptions of leading "gurus." However, they have not been constructed or validated by empirical means. Although the critical factors of the first four studies, i.e. Saraph et al. (1989), Black and Porter (1996), Ahire et al. (1996) and Tamimi (1998) have been empirically tested, the studies cannot show the relationships between the different factors as proposed in each study. Hence, there is no graphical representation of the relationships between the factors in each study. Moreover, the studies do not tell us the role played by each factor in the successful implementation of TQM when taking all the factors together.

Therefore, when selecting TQM principles to enrich the existing SCM model, it is better to find a model which can show the relationship between the different principles and concepts and can identify the contributions of different factors in the model.

Moreover, the model can be empirically tested. The pyramid model proposed by Kanji and Asher (1993), their modified model (1994) and the later development into the Business Excellence Model by Kanji (1998) seem to have met the requirements.

In their pyramid model, there are a set of general governing principles in Total Quality Management. They are : delight the customer; management by fact; people-based management; and continuous improvement. Each of the principles can be used to drive the improvement process. To achieve this, each principle is translated into practice by using two core concepts. The concepts show how to make the principle happen. These concepts are: customer satisfaction; internal customers are real; all work is a process; measurement; team work; people make quality; continuous improvement cycle; and prevention. Later, they have revised their model by extending the base of the pyramid to represent the importance of leadership as a foundation (Kanji, 1994). Therefore, in Kanji/Asher's modified Quality Pyramid, there are Five Governing Principles and Eight Core Concepts (Figure 3.1). Their Pyramid Model is very comprehensive which covers the teachings of various authorities and forms a holistic view of Total Quality Management. The model's comprehensivenss and holistic view are discussed in the following section. The model is able to show graphically the relationships between different factors.

The principles and concepts of Kanji and Asher's pyramid model can cover the principles proposed in the above four empirical studies (Table 3.4). The table shows that their model not only covers the principles of the other studies but also has an additional essential quality principle, i.e. continuous improvement and its related concepts. It is because of its richness, the principles and concepts of this model are being used in my study to enmesh with Supply Chain Management.

Fig. 3.1 : *Pyramid Model*

Source: Kanji (1994)

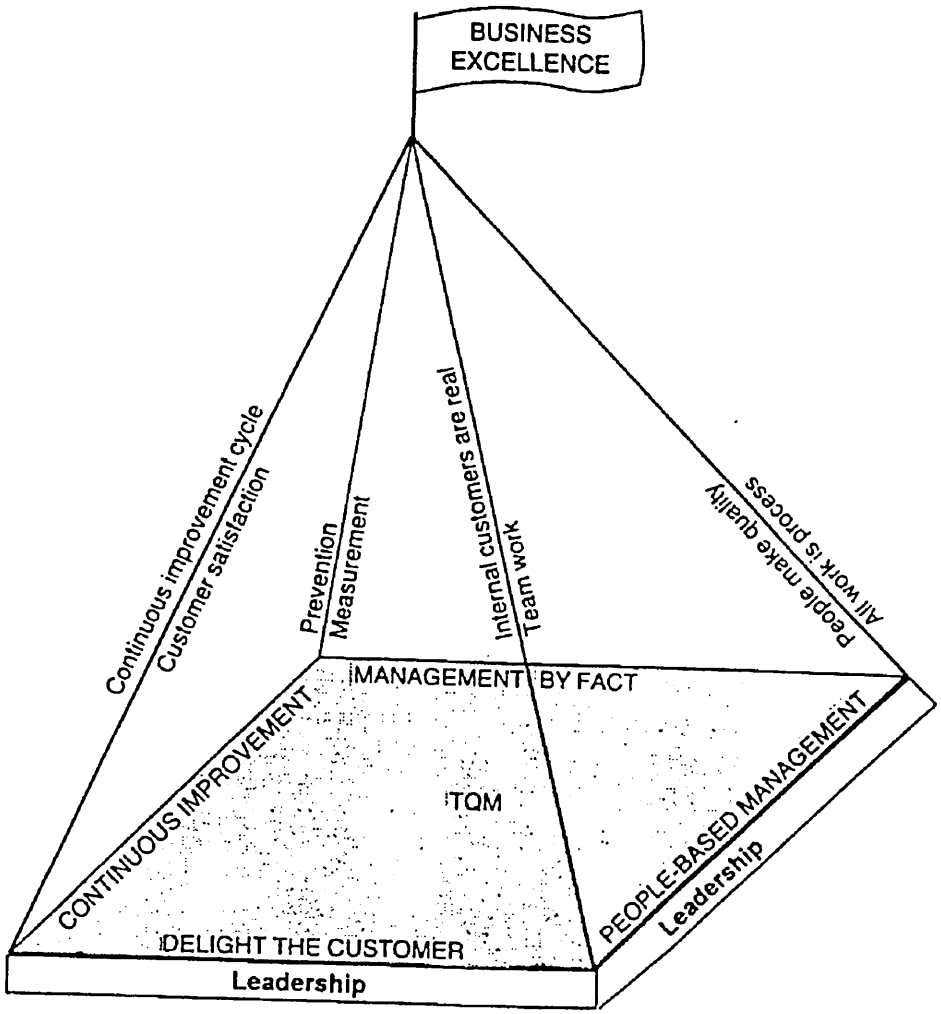


Table 3.4 : *A comparison of TQM principles of different models*

Saraph et al. (8 factor model)	Black & Porter (10 factor model)	Ahire et al. (12 factor model)	Tamimi (8 factor model)	Kanji's Business Excellence model
Top Management Leadership	Corporate Quality Culture Strategic Quality Management	Top management commitment	Top management commitment Supervisory leadership Providing assurance to employees	Leadership
Quality Data & Reporting	Quality Improvement Measurement System	Statistical process control Internal quality information usage Benchmarking	Cross functional communications to improve quality	Management by fact (all work is process; measurement)
Training		Employee training	Education Quality training	People-based management (Teamwork; People make quality)
Employee Relations	People & Customer Management	Employee empowerment Employee involvement		People-based management (Teamwork; People make quality)
Process Management	Operational Quality Planning			Management by fact (all work is process; measurement)
Product/Service Design	External Interface Management	Design quality management Product quality Customer focus	Product/service innovation	Delight the customer (Customer satisfaction; Internal customers are real)
Supplier Quality Management	Supplier Partnerships	Supplier performance	Supplier management	People-based management (Teamwork; People make quality)
Role of the Quality Department	Teamwork Structures Customer Satisfaction Orientation Communication of Improvement Information			Leadership
				Continuous improvement (Continuous improvement cycle; Prevention)

3.10 DISCUSSIONS ON THE PYRAMID MODEL, ITS MODIFIED MODEL AND THE BUSINESS EXCELLENCE MODEL

3.10.1 Addressing the basic questions

Kanji and Asher (1993) advocate that quality is a continuous process that can be broken anywhere in the system of supply and customer service. By letting every person know how his/her activities help to fulfil customer requirements, the organisation can motivate its employees and suppliers to provide quality consistently. They conceptualised their quality thinking into Four Governing Principles and Eght Core Concepts which tied together to form the Quality Pyramid (Kanji and Asher, 1993). The principles and concepts, if applied, will lead to continuous performance improvement - of individuals, groups and organisations. The four-sided pyramid principles with the eight core concepts address the different questions that concern an organisation which intends to continuously meet the needs of customers. The first principle, "Delight the customer" focuses on "What are the customers' needs?". Understanding customers' needs will help organisations ***know what to do***. The principle of "Management by fact" provides organisations information on ***how to do*** based on objective fact. Employees also can get feedback on performance under this principle. The principle of "People-based management" recognises the fact that systems, standards and technology themselves will not mean quality. Therefore, the role of people is vital. People need to be involved in meeting customers' needs and to commit to customer satisfaction. It answers the question of ***who is going to do*** the quality work of meeting customers' needs. The last principle, "Continuous improvement" advocates that total quality cannot be a quick fix. Rather, it should be a continuous process. Through prevention, a continual process of driving possible failure out of the system, a culture of continuous improvement can be formed over time. While the continuous cycle of establishing customer requirements, meeting those requirements, measuring success and keeping on improving can be used to fuel the engine of continuous improvement and can help develop into a quality culture over time. Therefore, this principle helps to create a quality culture for an organisation. Culture provides members of an organisation with a

way of making sense of events. Hence, it answers the question of ***why to do it***.

Kanji (1994) further modified the pyramid model in order to emphasize the leadership's role (see fig.3.1). Therefore, "Leadership" becomes the fifth principle of the model and it is the base upon which quality is built. Kanji (1996) points out the importance of a leader in his role of supporting and leading the quality drive of the whole company. He identified twelve pitfalls in the implementation of TQM in a company and attributed them to the failure of the leader of the company in playing his role. A leader should provide a vision for his organisation and should be a leader of change. In the process of adopting the quality culture and becoming a TQM company, the leader plays an important role. He should lead the staff to ***where the organisation should want to go***. His commitment and support to the total quality process will definitely affect the involvement of other people in the organisation.

3.10.2 The comprehensive view of the model

In discussing the pyramid model, Kanji and Asher (1993) suggest that the criteria adopted for the quality appraisal of three quality awards (The Malcolm Baldrige National Quality Award, the Deming Prize and the European Quality Award) are embedded in their pyramid principles of TQM. Their model takes care not only of the "results" a company has to achieve in the journey to total quality, but also the ways or "enablers" of how results are being achieved.

The pyramid model also entails the basic elements necessary for an organisation to embark on the journey to Total Quality Management. Liu (1996) has an opened view of the Quality Pyramid. He outlines the basic elements propounded by the pyramid model as customer; people; process control; improvement and leadership. Through this open view, the message of the Quality Pyramid can be outlined as follows :

> "PROCESS CONTROL is used by PEOPLE to monitor IMPROVEMENT to meet CUSTOMER satisfaction directed by LEADERSHIP."

3.10.3 Comparison of the Pyramid Model with principles of other TQM authorities

Since the number of principles advocated by different TQM authorities are

different, another way to compare their teachings will be according to their degree of representation and their degree of applicability on some common quality dimensions. Based on these two aspects, Liu (1996) has devised a composite indicator for TQM authorities including Deming, Juran, Feigenbaum, Kanji and Asher, Crosby, Ishikawa and Taguchi. The indicator is a product measure of both the degree of representation and the degree of applicability for the teachings of respective TQM expert on eight quality dimensions which are leadership, people management, policy and strategy, resources, processes, people satisfaction, customer satisfaction and business results. The pyramid principles of Kanji and Asher get the highest score.

3.10.4 Kanji's Business Excellence Model

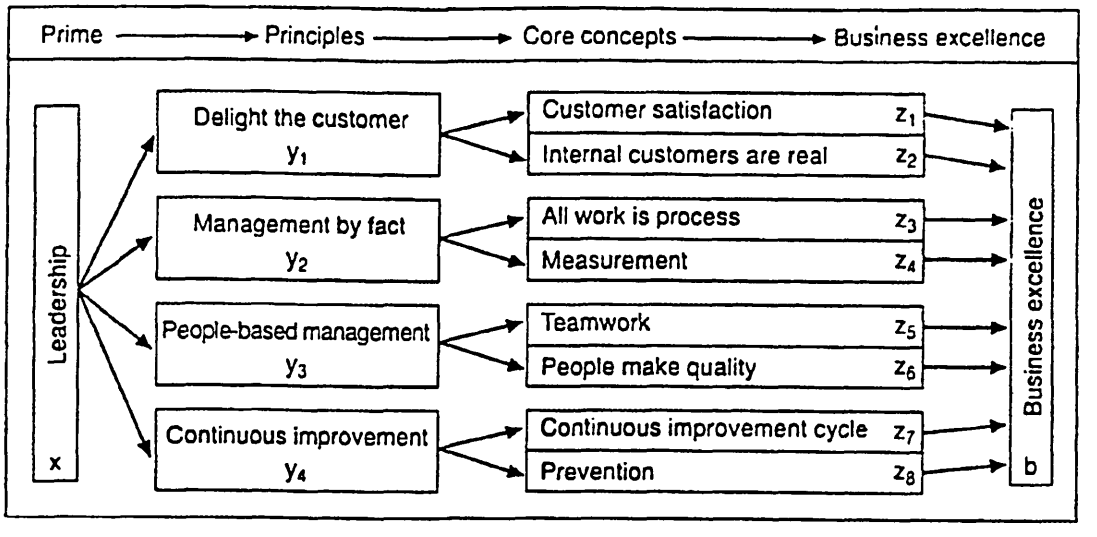
Kanji (1998) further develops his Business Excellence Model based on the pyramid model. This new model of Kanji translated the pyramid model's principles and core concepts into a structural model for business excellence (Figure 3.2). The model components synthesize not only those critical requirements from 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, Baldridge, Japanese) are indicative models, whereas 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 (BEI) which allow organizations to compare themselves against the different organizations with whom they are competing. The indices are produced by using a sophisticated and robust statistical method called latent variable partial least squares. The indices are of particular benefit to organsations which are not doing as well as they might, as they will give them an incentive to do something about their failings.

According to Kanji (1998), in order to make the BEI as a suitable measurement of companies' degree of business excellence, "it is necessary for the model to deliver meaningful results in terms of causal (cause-effect-oriented) relationship and a structural approach (meaning that the analysis shall be model - based). The model to be

used will emerge from theory specifying the business excellence process, where a predefined structure is essential in order to be able to analyse interaction and to drive any cause-effect relationships." Hence, Kanji's model is theory-driven and uses a structural approach.

As mentioned by Kanji (1998), many organisations have adopted Kaplan and Norton's "Balanced Scorecard" (1992) to help them achieve business excellence. So, Kanji shows the commonalities between the business scorecard approach and his business excellence methodology in his paper. However, he also points out the business scorecard approach does not prescribe which performance areas should be used or how they should be measured. On the other hand, from his study it is clear that for a company to achieve business excellence, "it is necessary for them to adopt a total quality management (TQM) process and the critical success factors (see Kanji & Malek, 1999) which provide the business excellence model."

Fig. 3.2 : *Kanji's Business Excellence Model (Source: Kanji, 1998)*



3.11 RELATIONSHIPS OF TQM TO QUALITY AWARDS

Four prestigious quality awards/prizes, namely, the Deming Prize in Japan, the Malcolm Baldrige National Quality Award (MBNQA) in the USA, the Australia Quality Award (AQA) in Australia, and the European Quality Award (EQA) in Western Europe, were established to increase quality awareness and business competitiveness in their respective countries (Tummala et al., 1995). These Awards were initiated to promote

national models businesses could follow to assess their current status and take the necessary steps to improve the quality of their products or services and internal operations based on the Total Quality Management philosophy. Tummala et al. (1995) compare the four awards according to the purpose and structure of the awards, eligibility and evaluation of contenders, and the judging criteria used. They conclude that all the awards were instituted for similar reasons. The evaluation process for all of them are similar. However, major points of difference are the types of organisation eligible, the number of awards made annually and whether they are based on competition or recognition of good approaches to quality management. All except the Deming Prize build their assessment criteria on models of how organisations should approach quality management. All the models are different, but incorporate many similar features. Finally, all except the Deming Prize attempt to maximize transparency in the judging process by giving explicit weightings to the different assessment criteria. There are several differences in the weightings given.

All four awards are designed primarily to create a national model based on the principles of Total Quality Management. They outline the different aspects of an organisation to be examined. In the model of MBNQA, it categorises its examination items into four elements: driver; system; measures of progress and goal. These elements form a basic framework for organisations to pursue on the journey to TQM.

The EQA model or the European Foundation for Quality Management (EFQM) Business Excellence Model is divided into two parts: enablers and results (EFQM, 1997). The "Results" group of criteria indicate what the company has achieved and is achieving; the "enablers" are how results are being achieved. There are nine elements in the model. Basically the Model demonstrates that *customer satisfaction, employee satisfaction* and *positive impact on society*, are achieved through *leadership* driving *policy and strategy, people management, resources* and *processes*, leading ultimately to *excellence in business results.* Each of these 9 elements, therefore, is a criterion that can be used to assess an organization's progress towards excellence (Shergold and Reed, 1996).

However, according to Silvestro (1998), many of the award criteria identify the organisational areas and processes which need to be evaluated, but they do not stipulate how these should be managed in order to realise TQM. Ultimately these systems are, after all, intended to be devices for identifying good practice rather than models of TQM

(Silvestro, 1998). Moreover, Kanji (1998) also states that most of the models in use (e.g. Deming, European, Baldridge, Japanese) are only indicative models. Therefore, he proposes his Business Excellence Model which he claims to be an improvement model for it produces business excellence indices that allow companies to compare themselves against the different organisations with whom they are competing and gives organisations that are not doing as well as they might an incentive to do something about their failings.

3.12 CONCLUSION

In this Chapter, I have reviewed the concepts of Quality and Total Quality Management, and the teachings of different TQM authorities. The purposes of doing this elaborate review are to trace the development of Total Quality Management, study the teachings of different TQM authorities and select a model that I can make use of when applying Total Quality Management to Supply Chain Management.

Quality is becoming more important as a strategy to compete in today's business. Quality is not limited to product or service quality, rather, it relates to the whole process of delivering the product or service to the customers. TQM incorporates this wider view of quality in it. In order to understand the meaning of TQM, I have made a comparison of the different definitions of TQM by various TQM authorities. I analyse them by the headings of nature, scope, objective and means. The following statements are my consolidation of the different definitions:

> TQM is a management philosophy with a set of guiding principles and company practices. It covers both service industries and manufacturing. It has an overall objective of achieving business excellence through continually satisfying any agreed customer requirement at low cost. In achieving the objective, it would involve everyone, all functions and processes of an organisation and should extend to the suppliers and customers. It requires the application of principles of quality management and quantitative methods to harness the human and material resources of an organisation.

Keener competition and increasing customer demands are driving forces for companies to adopt TQM. The development of quality management can date back to the 18th Century and it takes several stages before arriving at the present more mature stage of Total Quality Management. This stage is comprehensive in nature as it adopts a holistic view on quality and it can remedy the weaknesses of its previous stages.

Since TQM is something new, a closer look at it is necessary in order to understand it better. By looking at its relation with the traditional management thinking, its roots can be found in theories and practices of traditional management thinking. However, it has something new which can address the inadequacy of the old management thinking. Its integrative approach and concepts of continuous improvement are examples. An important way to study TQM is to examine the teachings of the various TQM gurus. Their teachings can help us know the different TQM principles and concepts and the ways they are used to implement TQM.

Of the various models by different TQM authorities, I have selected the pyramid model which later is developed into the Business Excellence Model as my working model in my study. It is because it can address the basic questions a company should encounter in implementing TQM and it can help companies achieve business excellence. Moreover, its degree of representation and degree of applicability is the highest. Besides, it emphasizes on TQM principles, and includes critical success factors and model validation.

CHAPTER 4

INTERFACE BETWEEN TQM, BUSINESS EXCELLENCE MODEL AND SCM

4.1 INTRODUCTION

In Chapter two, the inadequacies of the existing SCM model are identified and it is proposed that TQM principles can help fulfill the inadequacies. So, this chapter will study how TQM principles can be applied to enrich the existing SCM model. The first step to do this is to look at the interface between TQM and SCM, i.e., a detailed comparison of the two concepts. In the comparison, the similarities and differences between TQM and SCM will be examined. Since TQM is a holistic model that can help companies achieve business excellence, it will be useful to focus on what TQM has covered but not addressed by SCM. In other words, from studying the differences between TQM and SCM, it will give clues to the ways of enriching the existing SCM model by TQM principles. So, this chapter will identify the similarities and differences between TQM and SCM and the ways TQM can enrich SCM. Since Kanji's Business Excellence Model is selected to enrich the SCM model, this chapter also explains how the principles of Kanji's model can be applied to the existing SCM model.

4.2 TQM EXPERTS ON SUPPLIERS AND SUPPLY CHAIN

Various TQM experts have discussed on supplier relationships. Their ideas are outlined as follows:

4.2.1 Deming

Dr. Deming has outlined his methods for achieving quality and productivity in his "14 points for management" (Deming, 1982). Point 4 is especially about relationships with suppliers. It says : "End the practice of awarding business on the basis of price tag. Instead, depend on meaningful measures of quality, along with price. Move towards a single supplier for any one item, on a long-term relationship of loyalty and trust."

Price and Quality

According to Deming (1982, p.23), price has no meaning without a measure of the quality being purchased. Without an adequate measure of quality, business drifts to the lowest bidder, low quality and high cost being the inevitable result.

As commented by Kanji and Asher (1994), Deming considers the advantage of a long-term and trusting relationship between a firm and its chosen supplier outweighs the immediate gains of playing suppliers off against each other. According to Deming, the outdated supplier policy is perhaps one of the deadly diseases which afflict Western companies, i.e.:

> Management by use only of visible figures (the purchase price), with little or no consideration of all the invisible figures that can result from a "cheap offer" (the hidden quality costs)

Importance of a supplier

Under the Deming philosophy, a company's process expands to include suppliers, customers, investors, and the community. This is known as the extended process (Gitlow and Gitlow, 1987, p.8). Therefore, in order for a firm to produce quality products, it not only has to surpass the customers' specifications but it also has to communicate these needs to its suppliers. Suppliers then have to demonstrate that they are committed to providing materials that will enable the firm to surpass the customers' needs.

Deming emphasised that one cannot make and deliver quality products to customers unless the quality of ingoing materials is up to standard (Kanji and Asher, 1994). Deming uses the flow diagram to illustrate the concept of a system (Deming, 1993, p.60). An organisation can be a system, while suppliers are a key component to the system. In

order to be successful, the different components should work together closely to accomplish the aim of the system.

Number of suppliers

Deming advocates the use of a single supplier for any one item. The rationale for single sourcing includes the following:

- Only in a single-source relationship will a vendor be willing to modify his process to meet revised quality of design specifications at a reasonable price.
- Single-source relationships allow for the possibility that either the buyer or vendor made an error at the time of contracting. Single-source relationship allows for open negotiation of the contract to meet the needs of the buyer and vendor, and ultimately, the customer.
- Manager will not have the time to deal with more than one vendor (per item) in the context of a single-sourcing philosophy, due to the massive effort required to single source.

Moreover, there are costs of multiple sourcing. They include higher transaction costs due to the handling of more suppliers; increased inventory costs due to carrying multiple vendors' items; prolonged time for vendors at the low end of the production learning curve and increased variation in incoming quality characteristics because of vendor - to -vendor variation. In addition, multiple sourcing promotes arm's - length relationship between vendors and buyers, contrary to what is required for quality.

Long-term relationships with suppliers

Deming promotes a long-term relationship of loyalty and trust with suppliers. It is based on his thinking that a supplier is part of a company which together form a system. The different components of a system are interdependent with each other. Through cooperation of the different components, optimisation of a system can be achieved.

As commented by Logothetis (1994), looking forward to long-term business with the purchaser, the supplier will be encouraged and more easily convinced to adopt a philosophy of continuing improvement, open and honest communication and feedback, and prompt delivery for quality supplies at a price reflecting the true value of the materials.

It requires some attitude changes in buyers and suppliers. It shifts from the short-

term adversarial mindset to that of long-term cooperative mindset.

A "Deming company" will be buying both a vendor's process and the vendor's products. It will have to become involved in helping the vendor improve his process over the long run (Gitlow and Gitlow, 1987). It demands a new role on its purchasing agent. Purchasing must be performed by people able to judge quality. This requires education in statistics, supplemented by the experience of trial, error, and relearning.

4.2.2 Crosby

Crosby (1992) advocates "completeness" as a way of business and even personal life. The purpose of Completeness is to avoid problems and guarantee success. There are three principles of Completeness:

- Cause employees to be successful.
- Cause suppliers to be successful.
- Cause customers to be successful.

The successful supplier

Crosby points out that making suppliers successful is based on a recognition that everything a company uses comes from some other organisations. When these become an integral part of the whole, everything begins to work. When employees and suppliers are successful, they will make the customers successful. Suppliers will have to learn that they can become successful by helping their customers become successful, and customers have to give them that opportunity. Therefore, it recognises the interdependence among the different parties. This attitude is different from the traditional arm's length relationship between buyers and sellers.

Requirement on suppliers

According to Crosby (1992), successful suppliers have to supply items that can meet agreed upon requirements every time, be cost competitive and be delivered as committed. Punctual delivery is essential to successful suppliers because unreliable delivery will cause a company to hoard inventory. Suppliers should take up responsibility in meeting the different needs of their customers.

Long-term relationship

Long-term relationship will be beneficial to both buyers and sellers. However, Crosby thinks that a company has to educate its own people first. It involves a big cultural change; a lot of tradition has to be overcome. Besides, a formal program of education and communication will be established with suppliers, to assure that the relationship is soundly based in all concerned.

Crosby suggests that if an organisation is to communicate with its suppliers and develop positive relationships, it is necessary to reach out and share information with them.

Selection of suppliers

A company should identify suppliers whose products and services fit its needs and whose practices and attitudes are compatible with the company. They should prove themselves to be reliable and interested in the firm's success. Long -term relations that are beneficial to both parties will be developed with the right supplier. With the assurance of long term business, a supplier can concentrate on becoming more efficient and productive.

4.2.3 Ishikawa

Ishikawa points out that on the average, Japanese manufacturers spend an equivalent of seventy percent of their manufacturing cost in purchasing raw materials and parts from other companies. Therefore, unless the quality, price, quantity, and the time of delivery of these raw materials and parts are right, the purchaser and the assembler can neither manufacture good products nor guarantee quality to their consumers (Ishikawa and Lu, 1985).

He is in favour of outsourcing the production of parts and components to specialised suppliers instead of making everything within a company.

Ten principles for buyer-supplier relations

Ishikawa sets forth ten principles to improve quality assurance and to eliminate unsatisfactory conditions existing between the buyer and the seller. They are as follows:

1. Both buyer and supplier are fully responsible for quality control application with mutual understanding and cooperation between their quality control

systems.

2. Both buyer and seller should be independent of each other and esteem the independence of the other party.
3. Buyer is responsible to bring clear and adequate information and requirements to the vendor so that the vendor can know precisely what he should manufacture.
4. Both buyer and seller, before entering into business transactions, should conclude a rational contract between them in respect to quality, quantity, price, delivery terms, and method of payment.
5. Seller is responsible for the assurance of quality that will give satisfaction to buyer, and he is also responsible for submitting necessary and actual data upon the seller's request.
6. Both buyer and seller should decide the evaluation method of various items beforehand, which will be admitted as satisfactory to both parties.
7. Both buyer and supplier should establish in their contract the systems and procedures through which they can reach amicable settlement of disputes whenever any problems occur.
8. Both buyer and supplier, taking into consideration of the other party's standing, should exchange information necessary to carry out better quality control.
9. Both buyer and supplier should always perform control business activities sufficiently, such as on ordering, production and inventory planning, clerical work, and systems, so that their relationship is maintained upon an amicable and satisfactory basis.
10. Both buyer and seller, when dealing with business transactions, should always take full account of consumer's interests.

Relationship with suppliers

Ishikawa suggests that a buyer should purchase the same materials and parts from two suppliers. It is proposed to cover the risks of obtaining supplies from a single source, such as risks of fire and strikes. After two suppliers are selected, a buyer will enter into

preliminary dealings with each of them. During this phase, the buyer studies the situation and decides whether or not to continue dealing with the same supplier.

Official dealings confirm the fact that the interests of both parties are best served by maintaining the purchasing agreements for a long period of time. The supplier must continuously strive to improve quality, price, and the efficiency of delivery. The buyer must provide advice and assistance if needed and requested by the supplier.

Ishikawa also points out that in Japan many suppliers are not strong enough on their own. Therefore, nurturing subcontractors is an essential task for the buyer.

4.2.4 Imai

According to Imai (1991), one of the fundamental principles of TQC is that product or service quality downstream is best assured by maintaining quality upstream. This concept extends even to relations between the plant and its suppliers. Improving supplier relations has become one of the top-priority areas of management. One of the purchasing agent's jobs is to develop criteria for checking the relative strengths of the suppliers in terms of price, cooperation, quality, delivery, technology, and overall management competence.

4.2.5 Juran

In Juran's view, supplier relations should be revised. The number of suppliers should be reduced. A teamwork relation should be established with the survivors, based on mutual trust. The traditional adversary approach should be abolished. The duration of contracts should be increased (Brocka and Brocka, 1992).

4.2.6 Other writers

Lascelles and Dale (1990) consider that there is a need to involve suppliers in the process of new product development. Those companies with the best suppliers and which can make most effective use of their supplier's capabilities will have a competitive

advantage. Therefore, a company should try to develop its suppliers. Supplier development requires a fundamental shift in the customer - supplier relationship; it requires a company to treat its suppliers as long-term business partners.

As a prerequisite of the new relationship both parties have to reach an agreement on how they will work together. They point out that there are barriers to supplier development which include poor communication and feedback, supplier complacency, misguided supplier improvement objectives, the credibility of the customer as viewed by the supplier and misconceptions regarding purchasing power.

Dale (1990) suggests that a company should try to integrate with its suppliers. Supplier integration can achieve a better match of the supplier's service to the business unit's needs and thus improve competitiveness in promoting their joint product. It requires development in attitudes and relationships between the business unit and its suppliers, and communication systems and procedures, both formal and informal.

4.2.7 Summary of the views of TQM experts on suppliers and supply chain

The views of different TQM experts on suppliers and supply chain can be summarised under the following points:

Importance of quality

All TQM writers emphasize on the importance of quality as an objective for a supplier to strive for. For instance, Deming has said that "Price has no meaning without a measure of quality." TQM writers also emphasize the importance for suppliers to meet the different needs of customers, i.e. the wider view of quality.

Long-term, cooperative relationship with suppliers

The writers advocate to abolish the traditional arm's-length relationship and develop long-term relationship. They believe that long-term relationship which is built on trust and cooperation will benefit both the buyer and the seller. With long-term relationship, optimisation of the whole supply chain can be achieved and suppliers are willing to continuously improve their performance in view of long-term business.

Suppliers form the extended process of a company

A company's process expands to include its suppliers as everything a company uses comes from some other organisations. A company often has to work on parts and materials which have been processed by its suppliers so as to create products or services to meet the needs of its final customers.

Suppliers are a key component of a system

TQM writers recognise the importance of suppliers. Deming uses the flow diagram to illustrate the concept of a system. Suppliers are a key component to the system. Crosby also points out the interdependence between a company and its suppliers by saying that "when employees and suppliers are successful, they will make the customers successful."

Reducing the supplier base

Deming advocates a single supplier for any one item while Ishikawa suggests the use of two suppliers. As a whole, the TQM writers believe in the benefits and necessities of reducing the supplier base. A reduced supplier base will help avoid quality variation due to supplies from various suppliers. A long-term relationship is easier to develop with a reduced supplier base.

Company's role towards its suppliers

TQM writers suggest that a company should help its suppliers to develop and to improve their processes over the long run. Crosby emphasizes that a company should make its suppliers successful. Ishikawa sets forth ten principles whereby buyer and seller can work together to improve quality assurance and to eliminate unsatisfactory conditions existing between the buyer and the seller. Therefore, a company should work very closely with its suppliers. It should provide its suppliers with advice and support where and when required.

4.3 COMPARISONS BETWEEN TQM AND SCM

4.3.1 Similarities between TQM and SCM

Those points common to the two concepts include long-term, cooperative

relationship with suppliers; reducing the number of suppliers; suppliers are an extended process of a company; suppliers are a key component of a system; and helping suppliers to develop and improve. TQM and SCM writers hold the same view of replacing the traditional adversarial arm's - length relationship with the long-term cooperative relationship. The long-term cooperative relationship relates to an organisation's ***culture*** and its ***attitudes*** towards the suppliers. In order to develop long - term relationship with suppliers, the number of suppliers has to be reduced. As a result the ***supply structure*** has to be changed. In SCM, suppliers are part of the total value adding process of a supply chain. In TQM, suppliers are responsible for the incoming goods of the quality chain. Both of these two concepts agree that supplier is an ***extended process*** of a company. TQM and SCM concepts concur that suppliers are a key component of the ***system*** of an organisation. Therefore, both concepts advocate that a company should help its suppliers to develop and improve so that the whole system will benefit. This point is about helping the suppliers to improve their ***operations***.

4.3.2 Differences between TQM and SCM

Although both TQM and SCM concepts cover the interaction between an organisation and its suppliers and have the above similarities, there are certain areas where the two concepts differ. As pointed out in Chapter two, SCM concept focuses mainly on the ***quantity*** aspect through managing the total material flow and the related information flow. On the other hand, TQM concept emphasizes on the wider scope of ***quality***, i.e. meeting the different needs of the final customers at the lowest cost. The different needs include quality, cost and delivery. The lowest cost can be achieved through various means instead of just being limited to the control of inventory. In SCM, it focuses on developing a ***relational philosophy*** with other parties in the supply chain. In TQM, it preaches a ***holistic approach*** to managing the whole quality chain. The TQM approach includes developing a quality system and structure and a quality culture which will support the relational philosophy. SCM centers on the ***interaction*** between the parties in a supply chain. TQM covers the ***different parties*** in the quality chain and the ***interaction*** between the parties in the chain. SCM is often used as a ***management tool*** or a competitive tool to better meet the needs of

final customers through integrating with suppliers. On the other hand, TQM is a ***management philosophy*** which relates to some cultural changes. It offers some ***principles, guidelines and practices*** that help a company to continuously meet the requirements of customers. Table 4.1 summarises the similarities and differences between TQM and SCM.

From the above comparison, it can be observed that there are many similarities between TQM and SCM. Both concepts agree on some general principles and concepts towards the suppliers and supply chain. On the other hand, there are also some differences between the two concepts. A general observation on the various differences is that the two concepts only differ on the extent of coverage rather than the context of coverage. It can be discovered that TQM concept has a wider coverage than SCM concept in the various dimensions. TQM is not only a management tool, it offers a new management philosophy. It concerns not only the interactions between different parties in the supply chain but also the different parties. It emphasizes on satisfying the different needs of customers rather than limited to supplying customers with the required quantity of goods. It offers a total solution to improving the performance of a company in meeting the customers' needs instead of confining to a relational approach of managing the company's suppliers.

Table 4.1 : *Similarities and differences between TQM and SCM*

Similarities

Dimensions	Common Views of TQM and SCM
Attitude towards suppliers:	long-term, cooperative relationship with suppliers
No. of suppliers:	reducing the number of suppliers
process view:	suppliers are an extended process of a company
systems view:	suppliers are a key component of a system
Role of a company:	helping suppliers to develop and improve.

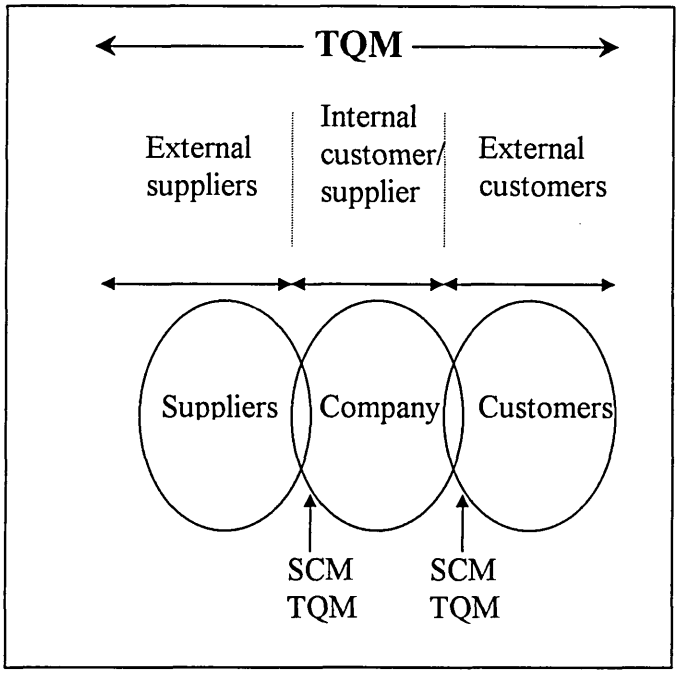
Differences:

Dimensions	Views of TQM	Views of SCM
Nature:	management philosophy, & principles, guidelines & practices	management tool
Scope:	different parties and their interaction	interaction between different parties
Emphasis:	quality (quality, cost, delivery)	quantity
Approach:	holistic approach	relational approach

4.3.3 The inadequacies of SCM when compared with TQM

Therefore, it can be concluded from the differences that TQM can help enrich SCM. The enriched concepts of SCM should be able to better manage the performance of the whole supply chain so as to meet the needs of the final customers. The relationship between the concepts of TQM and SCM can be depicted graphically in the following figure.

Figure 4.1: *Graphical representation of Relationship between TQM and SCM*



4.4 ENRICHMENT OF THE SCM CONCEPT BY TQM

As reviewed in chapter three, TQM is a management philosophy. It focuses on changing the culture of an organisation to that of continuously meeting the customers' needs and developing the mindset of cooperative customer/supplier relationship on everyone involved in the delivering process. Since SCM does not focus on changing the culture of

organisations and people though it advocates having cooperative relationship with suppliers, the building of a quality and cooperative culture by TQM helps prepare the road for SCM. Under SCM, good relationship will help the supply chain reduce conflict and thus work smoothly. However, without a good system, effective and efficient performance of the supply chain cannot be obtained. By advocating the application of principles of quality management and quantitative methods, TQM provides a quality system whereby effective and efficient performance from the supply chain can be facilitated. The continuous improvement philosophy of TQM will also help the supply chain to keep on improving so as to ever meet the needs of its customers. The emphasis on harnessing human resources by TQM will impact strength to SCM to make the whole supply chain work as it is the people working together as teams who make the chain work and not the organisations themselves.

Therefore, it can be seen that TQM can enrich SCM by cultivating a quality culture for an organisation, and spreading it to the whole supply chain. It offers a quality system and helps an organisation change the mindset of people, harness the human resources and continuously improve to meet the needs of customers.

4.5 APPLICATION OF THE PRINCIPLES OF KANJI'S BUSINESS EXCELLENCE MODEL TO SCM

Since TQM can help enrich the concept of SCM, it is worthwhile to examine in detail the application of the principles and concepts of TQM. As Kanji's model is a rather comprehensive model as discussed in Chapter three, therefore, it is selected to be used to enrich the concepts of SCM.

The five principles of Kanji's model are leadership; delight the customer; management by fact; people-based management; and continuous improvement. There are eight concepts which show how to make the principles happen. They are: customer satisfaction; internal customers are real; all work is a process; measurement; team work; people make quality; continuous improvement cycle; and prevention. These principles and concepts of Kanji can be applied to SCM. The message can be as follows:

> ***Customer satisfaction***, supplier satisfaction and employee satisfaction are achieved through ***leadership*** driving ***people*** to work through ***teamwork*** both

within and outside an organization, under a culture of ***continuous improvement*** developed through ***prevention***, in ***processes*** being ***continuously improved*** and controlled through ***measurement*** leading ultimately to ***business excellence***.

Suppliers are key components of the supply chain. They need to be satisfied before the final customers are satisfied. Therefore, supplier satisfaction is included in the message. Integration with suppliers through long-term close relationship is expressed in the message as teamwork outside an organsiation. The supply chain should work under a quality culture so as to better meet the customers' needs. The quality culture should be developed by a company's top management. The whole process in the supply chain should be controlled and improved through objective information in order to improve the chain's performance.

In short, leadership is to drive people through people - based management, continuous improvement and management by fact in order to delight the customers. Delighting the customer will also include delighting the suppliers or the supply partners. The principles of Kanji's model when enriching the existing SCM model could show the direction for the whole supply chain which is customer satisfaction and business excellence. They are the "Results" the supply chain has to achieve. The model also offers the ways of achieving the results, i.e. the "Enablers" which are the principles of leadership, delighting the customers, management by fact, people-based management and continuous improvement and their respective concepts.

The five principles of Kanji can also help address some basic questions concerning the supply chain. Details of the model's applications are as table 4.2. The table shows the application of the principles and concepts of Kanji's model in supply chain management. The model helps to address the basic questions that surround the supply chain. To conclude, from the above analyses, the principles and concepts of Kanji's model can help enrich the concept of supply chain management.

Table 4.2: *Applications of the principles of Kanji's Business Excellence Model on SCM*

Basic questions	Principles	Applications in Supply Chain Management
What to do	Delight the customers	Suppliers need to be satisfied in order to meet final customers' needs
How to do	Management by fact	Information sharing between supply chain partners; objective measures on supply chain performance
Who is going to do	People -based management	Teamwork between the partners (companies and their suppliers) in the supply chain
Why to do	Continuous Improvement	A culture of continuous improvement is formed among the supply chain partners so that they know why they should do a quality work
Where to go	Leadership	Top management of supply chain partners should commit to the cooperative relationship and initiate improvement measures for the benefit of the whole chain.

4.6 CONCLUSION

This chapter has shown that there are both similarities and differences between TQM and SCM. Further, judging from their differences, it can be concluded that TQM is a more holistic approach than SCM in helping companies to achieve business excellence. Hence, the principles of TQM should be able to enrich the existing SCM model into a Total Quality model for supply chain management. The chapter also shows how the principles of Kanji's Business Excellence Model can be applied to Supply Chain Management and can help companies achieve business excellence through their supply chains. It will then be worthwhile to look at how the enriched concept of supply chain management can work in the situation of the Hong Kong supply chain. Detailed discussion will be outlined in the chapter five.

CHAPTER 5
SUPPLY CHAIN MANAGEMENT IN HONG KONG

5.1 INTRODUCTION

This chapter outlines the background information of supply chain management in Hong Kong. It firstly describes the huge amount of import and export trade of Hong Kong as it signifies that supply chain management has an important role to play in Hong Kong. The trade statistics show that Hong Kong purchases a lot of goods from overseas countries and in turn, they also import a lot of goods from Hong Kong. Hence, there are various international supply chains formed between Hong Kong and its trading partners. Of the major trading partners, China is Hong Kong's largest trading partner. Therefore, the chapter also discusses on the economic relationships between Hong Kong and China and their implications to supply chain management in Hong Kong. Besides, the chapter also examines the number of multinational companies using Hong Kong as their regional office. The larger the number, the more important is the role played by Hong Kong in the supply chains of these multinational companies. Apart from external purchases, the chapter also gives an indication on the amount of purchases done within Hong Kong, i.e., between companies in Hong Kong. The last part of the chapter explores on the supply chains of three selected companies through in-depth interviews. The information provides some input for the development of the new SCM model.

5.2 IMPORT AND EXPORT TRADE OF HONG KONG

According to the information on the web page of Hong Kong Trade Development Council, last updated on 16 July 1999 (Hong Kong Trade Development Council, scoreboard.htm), Hong Kong is the world's 9th largest (or 5th if EU countries are regarded as one entity) trading economy although it ranked only 93rd as at mid-1996 in terms of population. The Government's statistics show that the total trade volume for 1998 was HK$ 2776.7 billion, including HK$1,429.1 billion for imports, HK$ 188.5 billion for domestic exports and HK$1,159.2 billion for re-exports (Government

Information Centre, trade1.htm). In 1998, Hong Kong's port remained one of the largest in the world in terms of container throughput. Hong Kong's airport was the busiest in the world in terms of international cargo throughput in 1997. Hence, there are lots of goods importing into and exporting from Hong Kong. It thus offers a rich context for the study of supply chain management.

5.3 MAJOR TRADING PARTNERS

Based on government's statistics (Government Information Centre, 6-1a.htm), the mainland of China is Hong Kong's largest trading partner. In 1998, total trade with the Mainland amounted to HK$1,044 billion, followed by the US (HK$421 billion), the EU (HK$364 billion) and Japan (HK$250 billion).

The economic relation with the Mainland is especially close. According to the Trade Development Council's information, Hong Kong was the Mainland's fourth largest trading partner (after Japan, the US, and the EU) in 1998. On the other hand, the Mainland has been Hong Kong's largest trading partner since 1985. The information also states that "In 1998, the Mainland's share of Hong Kong's global trade jumped from 9.3% in 1978 to 37.5% in 1998. At present, the Chinese Mainland is Hong Kong's largest import source, accounted for 40.6% of Hong Kong's total imports, and the largest export market, accounted for 34.4% of Hong Kong's total exports" (Trade Development Council, china.htm).

Hence, the above information suggests that Hong Kong and these major trading partners have formed various supply chains, i.e., companies in Hong Kong are getting their supplies or delivering their products to mostly these trading partners. Of these supply chains, supply chains formed between Hong Kong and the Chinese Mainland handle most of the external trade of Hong Kong. Moreover, companies in the Mainland of China are one of the major sources of supply to companies in Hong Kong .

5.4 ECONOMIC RELATIONS WITH CHINA

Hong Kong has a very close economic relationship with China. This relationship is reflected in Hong Kong's investment in China and the outward processing trade with China.

5.4.1 Hong Kong's investment in China

Because of the geographical proximity and China's open-door policy and economic reforms, China has become a huge production hinterland for Hong Kong manufacturers. To improve the investment environment, a wide range of measures have been taken by China. They include the "hardware", i.e., infrastructural development and the "software" of the investment environment such as the promulgation of new investment laws, relations and policies covering joint venture, real estate transaction, retail sale and so on (Institute of Industrial Economics, 1996).

Hong Kong is an important source or conduit of external direct investment in China, accounting for about three - fifths of the total. Its major investment in China has been concentrated in light manufacturing industries. Most of Hong Kong's investment is in Guangdong Province. More than four million people are estimated to be working in Guangdong for Hong Kong companies, either through joint ventures or in tasks commissioned by Hong Kong companies in the form of order processing and compensation trade (Hong Kong Government, 1996). The light manufacturing industry includes the manufacture of goods for daily use, such as leather and wool and related products, stationery and sports equipment, toys, household electrical appliances, etc. Hong Kong ranked as the largest source of investment in the light manufacturing industry representing 54.5% of the total in 1991 (Federation of Hong Kong Industries,1993).

5.4.2 Outward processing trade

Because of the low production cost of the mainland China, many manufacturing processes have been relocated to the mainland of China or subcontracted to manufacturers in China in recent years. Raw materials or semi-manufactures are exported from or through Hong Kong to China for processing. The processed goods are then subsequently sent back to Hong Kong for domestic use or for further processing or for direct re-export to other countries. The volume of this kind of outward processing trade is very huge. The information on the web page of Trade Development Council (Trade Development Council, china.htm) suggests :

More than 80% of Hong Kong manufacturers have established production

facilities in the Mainland, which have boosted outward processing activities and Hong Kong's re-export growth. In 1998, 76% of Hong Kong's domestic exports and 45% of re-exports to the Chinese Mainland were related to outward processing activities. Meanwhile, 82 % of Hong Kong's imports from the Mainland and 87.1% of Hong Kong's re-exports of the Mainland origin to all countries other than China were related to outward processing.

Apart from the high percentage of outward processing trade in Hong Kong's overall trade, the importance of outward processing by companies in Hong Kong can be reflected in a survey conducted by the Industry Department on 430 foreign invested companies in Hong Kong in 1996. The results show that only 204 companies (47%) have all the processes done in their own factories in Hong Kong. The remaining 226 companies (53%) have some of their work subcontracted to other companies in Hong Kong or in China or some other countries. The average proportion of work subcontracted out for all these companies is 57 % of their total work. Of the 226 companies which have part of their work subcontracted out, their average proportion of subcontracting arrangement with companies in Hong Kong, China and other countries are 45%, 73% and 22% respectively. Therefore, it can be observed that outward processing among these foreign invested companies is very popular and the proportion of work subcontracted is more than half. The most popular place for outward processing for the foreign companies is China. It is also the case for other companies in Hong Kong as reflected from the overall outward processing figures.

Hence, because of outward processing, many work processes are in fact not carried out in Hong Kong, but rather in other nearby places, notably the southern part of China, i.e. Guangdong. So, Hong Kong companies often have to deal with suppliers in China, Hong Kong and other countries.

5.5 HONG KONG AS A REGIONAL CENTRE

Apart from the overall external trade volume, the number of multinational companies using Hong Kong as a regional office also suggests the importance of Hong Kong in the international supply chain. According to the information on the web page of Trade Development Council (Trade Development Council, economic.htm#8), many

multinational companies have made use of Hong Kong as a regional base to manage their businesses in the Asia Pacific, particularly in the Chinese mainland. The web page reported the information from a government survey covering 12,321 overseas companies known to be operating in Hong Kong in 1998. The results show that of the 4,381 responses, 819 companies identified themselves as regional headquarters and another 1,630 identified themselves as regional offices. The US has the largest number of regional headquarters and offices in Hong Kong with 479 companies, followed by Japan (456), and the UK(223).

The above information suggests that many multinational companies in Hong Kong function as either regional headquarters or regional offices. Their strong presence in Hong Kong suggests that the volume of trade handled by them may be huge. Since more than half of the respondents are using Hong Kong as their regional headquarters or offices, it indicates that Hong Kong has played an important role in the supply chains of these multinational companies. In fact, Hong Kong has been known as a sourcing centre for these multinational companies.

5.6 THE DOMESTIC SUPPLY CHAINS IN HONG KONG

Apart from imports from other countries, Hong Kong has its own domestic outputs to supply for its needs and exports. Government statistics (Government Information Centre, ips97.htm) show that the gross output of the manufacturing sector amounted to $263.9 billion in 1997. Of the gross output of the manufacturing sector in 1997, HK$211.4 billion was destined for export to other countries while the rest HK$52.5 billion was for domestic consumption.

The five principal commodities for domestic exports in 1997 were (1) articles of apparel and clothing accessories, amounting to HK$72.2 billion; (2) electrical machinery, apparatus and appliances, and electrical parts thereof (HK$33 billion); (3) textile yarn, fabrics, made-up articles and related products (HK$12.7 billion); (4) parts and accessories suitable for use with office machines and automatic data processing machines (HK$7.8 billion) and (5) watches and clocks (HK$10.8 billion) (Government Information Centre, trade3.htm)

5.7 THE OVERALL IMPORTANCE OF SUPPLY CHAIN MANAGEMENT IN HONG KONG

The previous sections have discussed about the large volume of trade handled by Hong Kong. It indicates that companies in Hong Kong are heavily involved in their transactions with their suppliers and customers both local and overseas. In fact, this is the concept of the supply chain. Christopher(1992) defines a supply chain as the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer.

The amount of total import and export trade of Hong Kong in 1998 was HK$ 2,777 billion (US$359 billion). For this amount, even a small percentage of saving on material costs by better managing the supply chain would mean a lot. This is supported by the results of two studies conducted by the Hong Kong Article Numbering Association (HKANA) and supported by the Industry Department of the Hong Kong Government in 1996 and 1997. The findings of the first study indicated the total savings to Hong Kong's domestic industry could amount to as much as HK$5 billion deriving mainly from reductions in operating and inventory costs. The second study exposed that Hong Kong's export industries could enjoy projected annual savings of HK$9.2 billion (HKANA, 1998).

5.8 PROMOTION OF SUPPLY CHAIN MANAGEMENT IN HONG KONG

The active promotion of Supply Chain Management in Hong Kong first started in 1995. At that time, the Hong Kong Article Numbering Association (HKANA) conducted a feasibility study to promote Supply Chain Management in Hong Kong. HKANA was established by the Hong Kong General Chamber of Commerce in 1989. It is an independent, non-profit making organisation. It operates as a professional industry support group, and is the local body responsible for the administration and promotion of global EAN/UCC standards. The EAN/UCC system enables companies to have an efficient communication system, integrating all trading partners throughout the supply

chain. The EAN/UCC system consists mainly of a system for numbering items which permits their unambiguous identification; and standard bar codes to represent information which can be easily read by computers through scanning (EAN, international.html).

Since then, the HKANA has put much emphasis on the promotion of Supply Chain Management to companies in Hong Kong. The 1995 study progressed to a project funded by the Hong Kong Government. In May 1996, a Steering Committee of 12 Fast Moving Consumer Goods (FMCG) multinational and local companies was formed to provide guidance for the project. The project measured the impact of SCM on Hong Kong's domestic trade market (HKANA, 1998). In 1997, the Association conducted another study on SCM's impact on the export industry of Hong Kong. The findings of the two studies indicated that there could be significant savings upon implementation of SCM concepts.

Since education and information are considered to be one of the key roles of the HKANA, the Association recently launched Hong Kong's only dedicated SCM Resource Centre for public's access in 1998. The Centre offers both a physical and on-line library, houses a collection of publications and periodicals on SCM (HKANA, 1998).

However, the HKANA puts more emphasis on the logistical aspects of supply chain management. It promotes the use of electronic commerce and the associated electronic technologies such as electronic data interchange (EDI). This may be attributed to the background of the Association because it first started as an organisation to promote article numbering and the associated technologies, i.e. bar coding and scanning which focused mainly on facilitating the physical flow of goods. However, SCM should be more than logistics and customer service level. In order to achieve business excellence through Supply Chain Management, the critical success factors of TQM can be used to enrich the traditional supply chain management model.

5.9 EXPLORATORY CASE STUDIES ON APPLICATION OF TQM PRINCIPLES TO SCM

As discussed in the previous chapter, the inadequacies of the existing SCM model such as the narrow focus of the HKANA can be tackled by using Total Quality

Management principles to enrich the existing SCM model. Kanji's (1996) pyramid principles offer a framework for developing a new SCM model that will eliminate the inadequacies of the existing model. The TQM principles should be able to help companies to achieve business excellence through their supply chains. The last part of the previous chapter has outlined the applications of the pyramid principles to SCM in theory. In this part of the chapter, it aims to explore on examples for the application of the Total Quality Management principles on SCM in practice with the help of the supply chains of three companies.

The use of the case study method is a qualitative technique to obtain a clearer picture of reality. It addresses the problems of using a purely empirical research. Case study research provides rich and deep insights to quality management practices (Simon et al., 1996). Yin (1989) indicates that case studies are preferred when "how" or "why" questions are being posed, when the investigator has little control over events and when the focus is on contemporary phenomena. Since the researcher wants to know how the TQM principles can be applied to Supply Chain Management, therefore, the case study method suits the purpose in the exploratory stage of this study. Theoretical sampling was used to determine the number of cases and adding of cases was stopped when the incremental learning diminished (Sutton and Callahan, 1987).

Semi-formal interviewing was adopted with the four companies in 1997. According to Rubin (1995), structured interview with a set of answer categories, such as `agree' or disagree' will not be able to find out what the interviewees actually think. On the other hand, unstructured interview will take a longer time and cannot give a focus for discussion. Therefore, a semi-structured format was used. In the process, the researcher introduced the topic, then guided the discussion by asking specific questions. In the interview, the interviewees did most of the talking. This approach is suitable for it is suggested that when researchers want more specific information, they use a semi-structured format (Merton, Fiske, & Kendall, 1990).

The aim of the semi-formal interviews was to elicit in-depth answers about the companies' supply chains and the application of Total Quality Management principles to Supply Chain Management. The key informants being interviewed were supply chain managers in the companies who were responsible for managing their companies' supply chains. In expressing their views on the application of TQM principles to SCM, the informants were asked to illustrate the application with an example of their supply chains

and they were prompted by the researcher with open-ended questions according to a pre-prepared question checklist.

5.10 FINDINGS OF THE THREE CASES

5.10.1 Case No. 1: a railway company

Company Information

The railway company operates a three-line metro system, comprising 43 route-kilometres with 38 stations. The system was opened in stages between October 1979 and August 1989. Today, it keeps 2.4 million passengers on the move every weekday. In mid-1998, it opened the Airport Railway providing a dedicated express service linking the new air port at Chek Lap Kok to Hong Kong Station at Central; and a separate domestic service between Lantau Island and Central. The company has adopted the concepts of Total Quality Management in early 1990s. Many sections of the company have got ISO9000 certificates. It has remarkable success when compared with other railway systems in the world. In a benchmarking exercise conducted in 1996, the railway company got `Best in Class' results in 15 items out of an 18 items assessment. The items of assessment include finance management, efficiency, asset management, capacity utilisation, reliability and service quality etc.

An example of the company's supply chain

The company placed a contract with a supplier in China for the supply of cargo trains and maintenance trains in 1995. They were for the use of the Airport Link which were at that time under construction. The contract lasted for about one year and three months with a contract sum of HK$20 million. It was awarded to the Chinese supplier after tendering.

In general, the performance of the Chinese manufacturer in the supply of cargo and maintenance trains was satisfactory. The Chinese manufacturer was big in size and was a State Owned Enterprise established in ZhuZhou in Hunan province. The quality level of the factory was acceptable. It had its quality system GB19000 which was very similar to ISO9000. "GB" in full is "*Guo Biao*" which means national standard.

Application of Total Quality Management principles on Supply Chain Management

Delight the customer

The railway company was satisfied with the performance of the Chinese manufacturer. The contract had been completed and delivery was more or less according to schedule with only minor slippage in some stages. The users were also satisfied with the quality of the trains. The Chinese manufacturer was also satisfied as it could have a chance of participating in a prestigious project in Hong Kong, i.e., the new Airport Railway Line.

Management by fact

There was information sharing between the railway company and its Chinese manufacturer. Liaison was very close at different levels of both companies. The manufacturer was given performance specification of the trains required by the company. Then the factory provided their design based on the performance specification for the company's approval. The railway company would make comments on the design for amendments and provide technical support to the Chinese manufacturer. Frequent visits by the company's staff were paid to the factory at various stages of the contract to closely monitor the performance of the factory. In monitoring the progress of the contract, the company required the factory to submit a monthly report on its progress.

People-based management

Cooperation between the company and the Chinese manufacturer was good. Engineers and staff of both companies work together in different parts of the project. The railway company had good operating systems with detailed procedures documented. It had to comply with the requirements of ISO9000. On the other hand, since the Chinese side was a State Owned Enterprise, it also had its quality system which was similar to ISO9000. Therefore, the existence of some quality systems in both companies facilitated work between their staff.

Continuous improvement

The staff of the company found that the Chinese partner did not quite understand the customers' actual requirements. They were not so customer oriented as companies in Hong Kong. The quality level they could accept was lower than the requirement of the company. Therefore, the company had to teach the Chinese manufacturer how to be more customer oriented and to convince the Chinese staff the

need for a higher quality level. However, the Chinese manufacturer could still contribute to the project by providing some improvement suggestions based on their expertise.

Leadership

The top management of both companies paid much attention to ensure successful completion of the contract. The company had got much financial benefit from the contract as the cost of getting the goods from China was a quarter of the contract sum of the UK supplier and half of the South Korea supplier. Therefore, the company tried every means to enlist the support of the top management of the Chinese manufacturer to commit to the contract. In China, the top - down approach in getting things done is very effective. The leader can very much inspire the workers to do their best. On the side of the Chinese management, as they knew the trains were to be used in Hong Kong, they had to do it well because they did not want to lose face in such a highly publicised project.

Lessons from the case

Some integration and cooperation can be found in the relationship between the company and its Chinese manufacturer. It will help the Chinese manufacturer know better the requirements of the railway company. However, improvements on quality cannot be obtained if the mindset of the Chinese manufacturer is not transformed by the message of total quality management. Lastly, leadership commitment to the business is seen to be very important.

5.10.2 Case No.2: a buying agent

Company information

It was a buying agent of an American firm whose principal activity was in the selling of stationaries and office supplies. There were several product managers in the company responsible for the purchase of different items. Many of their purchases were from China.

An example of the company's supply chain

For the supply of paper clips and double clips which were handled by one of the product managers of the company, the company got them through four to five suppliers in China. The annual order value on these items was about US$10 million. The suppliers were Chinese local enterprises, generally not big in size, with the scale of

200 to 300 workers. They were in different parts of China, some of them were in NingPo. In fact, the suppliers had been doing business with the company for six to seven years. The size of the company's order was often 70 % to 80% of the factories' capacities. The company hesitated to find some other factories because it would take time to find a suitable factory and would take even more time to build up the experience of working together. In general, the performance of the supply partners in China for the products of paper clips and double clips were acceptable.

Application of Total Quality Management principles on Supply Chain Management

Delight the customers

The factories were eager to cooperate with the company as they were more or less captive suppliers of the company. They were willing to listen to the instruction of their Hong Kong customer. On the other hand, the company had to rely on the suppliers in China as the company was hard - pressed by its headquarters in the States to control costs and it was only by sourcing from China that it could meet with the budget. However, the staff of the company found that the factories in general were not very customer oriented.

Management by fact

There was no system in the factories. Objective information was not available for the management of the factories. The company had to monitor closely the performance of the factories. Inspectors from the company had to visit the factories very often, about once a week at some time.

People-based management

The factories were cooperative and willing to follow the company's instructions. On the other hand, staff from the company would give advice to the factories to improve their performance. However, the factories did not have a good system to facilitate the work of their employees.

Continuous Improvement

The company would take the lead to initiate improvements in the products. The company would at times carry out value analysis / value engineering on its products so as to improve the function and lower its costs. The factories were passive in this aspect. Moreover, their quality awareness was not high. They did not understand the need for quality work.

Leadership

The Headquarters of the company had a policy of developing long - term relationship with its suppliers. Therefore, the buying agent also did the same towards their Chinese suppliers. They maintained good relationship with them so as to have more influence on them.

Lessons learned from the case

Supply chain cooperation is observed in the case. Good relationship is useful for getting one's requirements when proper system is not there. Moreover, because there is no quality system, and the quality awareness of the factories is low, performance has to be ensured through close monitoring and guidance. However, a best performing supply chain should not depend on inspection and close monitoring by the customer rather the supplier should have initiatives and the systems to do the best. In this case, it requires a raise in the quality awareness of different factories.

5.10.3 Case No. 3: a large construction company

Background information

It was a large construction company which was listed in Hong Kong's Stock Exchange Market in January 1997. There were about 1200 staff in the company in 1996. This company principally undertook construction projects that involved building housing projects for the Housing Authority and the Housing Society in Hong Kong. Other construction works undertaken by the company included the construction of hospitals, universities, schools, homes for the elderly, and fire, ambulance and police stations and their staff quarters for the Architectural Services Department and other Government departments and institutional entities and, to a lesser extent, private sector renovation and fitting-out works. As at 30th November, 1996, the company had contracts on hand with a gross contract value of approximately HK$9.5 billion, with remaining works of approximately HK$6.3 billion. As stated in its prospectus, it was the market leader in the construction of public housing in Hong Kong in 1996.

The company won the Housing Authority's "Contractor of the Year" award in 1995, 1996 and 1997 and numerous safety awards over the years. The company was also the first construction company in Hong Kong to have secured the accreditation of ISO9002 in 1992.

An example of the company's supply chain

In the construction of Government Housing Projects, the company required a lot of construction materials such as aluminium windows, wooden doors and precast concrete products. Since the volume required was very large, the materials were difficult to obtain from Hong Kong as the local factories were not big enough because of the high land price. Moreover, it was also costly as production cost in Hong Kong was rather high. Therefore, the company had formed several joint-ventures in China to supply these kinds of construction materials. Up to 1996, there were four joint venture companies in China. Two were for the manufacture of wooden doors, one for aluminium window frames and another one for precast concrete products. The partners were also Hong Kong companies. They were selected based on their cooperativeness with the construction company, their expertise in the particular field and their connection in China. The company did not involve in the management of the joint-venture businesses. All the management of the factories in China was entrusted in the hands of its partners. The performance of these joint venture businesses in China had been generally good except for one wooden door joint-venture business. Late delivery often occurred with this factory and it finally led to the purchase of all the shares by the company.

Application of Total Quality Management principles to Supply Chain Management

Delight the customers

The supply chain partners were given orders by the company. On the other hand, the company got its supply at a very low cost. For example, the costs of producing a precast concrete sink bench was just about 40% of the market price. Better quality and more punctual delivery had been obtained by the company from its partners than from the market. The company also provided management and technical support to its partners.

Management by fact

The company had designed some operation procedures for the joint-venture businesses. The operation procedures had helped the factories work smoothly. The company maintained quality control through inspection of the production processes and the finished products. A checklist had been compiled for this purpose. Although the factories in China were managed by its partners, the company maintained accounting control over its partners. It would further monitor the costing of the joint-venture

businesses through comparing the unit prices of the products supplied by its partners with the market prices.

People-based management

The company had helped its partners to obtain the ISO9000 certificates. All four joint-venture companies were ISO certified companies. Therefore, it provided a good system for the operations of the four companies. With the exception of a wooden door joint-venture business, the partners could work together well with the company.

Continuous Improvement

The company had a strong management team and a strong technical team. They provided advice and improvement ideas from time to time to its partners. The company took a more active role in initiating improvements. On the contrary, the partners in China were rather passive in initiating changes.

Leadership

The company's top management believed in long-term relationship with its partners and therefore was very committed to improving its partners. On the contrary, the partner of its wooden door joint-venture business was not committed to the relationship. It did not take the interest of the company as its first priority and took up many orders from other construction companies in Hong Kong. Hence, deliveries to the company were often late. It finally led to the purchase of all the shares and complete management of the factory by the construction company.

Lessons from the case

The company strongly believed in developing long-term relationship with its partners and supporting its partners to produce the best performance. The company also had good management and quality system and it had helped its partners to develop its systems. However, all these measures of Supply Chain Management were not enough in the case of the wooden door joint-venture business. In this business, the partner was passive in initiating improvements and the commitment of the partner was not enough to the relationship. Hence, it led to the failure of the joint-venture business.

5.11 DISCUSSIONS ON THE FINDINGS OF THE THREE CASES

There are both similarities and differences between the three cases. Besides, the

three cases provide some examples on the application of the different Total Quality Management principles in Supply Chain Management and document their impacts on supply chain performance. They are discussed as follows:

5.11.1 Similarities

The principles of the traditional supply chain management model have been applied in different cases. Both parties in the three cases want to have close working relationship between them. There is also information sharing between both parties in the cases. However, just the application of traditional Supply Chain Management principles is not enough to ensure supply chain performance. The Total Quality Management principles can also be applied to enrich Supply Chain Management in the three cases.

The main focus of the various supply partners in China is in meeting the quantity requirement of the Hong Kong companies. Quality aspect is often not an emphasis of the supply partners. Quality awareness among the Chinese manufacturers is low. They often do not understand very well why certain quality measures have to be carried out in their work. Moreover, with the exception of the cargo train manufacturer, the quality system in the two other suppliers is rather weak or nonexistent.

5.11.2 Differences

The Hong Kong companies in the cases are different in size. The construction company and the railway company are big companies employing over a thousand staff while the buying agent is a small company, employing less than a hundred staff. Again, their partners in China are also more or less in the same situation with some big companies and some small companies.

The second difference lies in the nature of business of different companies. The nature of business of the Hong Kong companies include transportation, construction, and buying agent.

Another difference concerns with the quality system of different companies. The construction company and the railway company are companies which have better quality systems. They have adopted TQM and they would like to spread the quality message to their supply chain partners. For the buying agent, it does not adopt TQM

and does not attempt to impose any quality system on its suppliers in China. However, it is conscious of the quality of the end product and quality is ensured by inspection on the finished product. Regarding the supply chain partners in China, the cargo train manufacturer has developed its own quality system which is similar to ISO9000, while the quality system of the wooden door supplier was imposed by the construction company.

The last difference is that the different TQM principles have been applied to different extent in the three cases. The difference has led to different supply chain performances in the three cases which are discussed in the following section.

5.11.3 Performance of the three companies' supply chains

The application of Total Quality Management principles and performances of the three companies' suppliers have been evaluated under the criteria of Total Quality Management and results are summarised in table 5.1. In the table, those TQM principles that have not been applied are indicated by a "X". Principles that have been applied are represented by a "✓". Principles that have been applied partially are represented by a "∅". By "partially", it means either one side of a supply chain has not applied the principles or some aspects of the principles have not been applied.

Table 5.1: *Performance of the three companies' supply chains evaluated under the TQM principles*

Application of TQM principles to the supply chains of the HK companies	Railway Co. (Cargo trains)	Buying Agent (Clips)	Construction Co. (Wooden Door)
Delight the customers	√	√	∅
Management by fact	√	**X**	√
People-based management	√	∅	∅
Continuous improvement	√	∅	∅
Leadership	√	√	∅
Result	Good	Acceptable	Poor

The railway company had obtained very good results from its supply partner as all TQM principles had been applied. The principle of `leadership' had especially facilitated good performance from this supply chain. Even though the quality awareness of the cargo train supplier was not as high as the railway company, it was sufficient for the provision of the cargo trains. However, if the manufacturer wants to improve its quality so as to enable it to produce acceptable passenger train to the railway company, the principle of continuous improvement has to be reinforced.

The buying agent had obtained acceptable performance from its paper clip suppliers. Even though some TQM principles had either not been applied or just partially been applied, the commitment of the top management of the buying agent and its supplier had helped solve the resulting problems of a poor quality system and low quality awareness among the workers of the supplier. Suppliers depended on the buying agent for their businesses and thus were willing to make any changes to meet the requirements of the buying agent. Moreover, the buying agent could get what it wanted through inspection and the items did not require advanced production technology.

In the case of the construction company, nearly all TQM principles had only been partially applied. As a result, the construction company could not get satisfaction from the wooden door supplier. The overall performance of the supplier was poor. Even though the supplier had established some quality system with the help of the construction company, it did not benefit the construction company much as the supplier did not put the construction company's interest in the first priority. The lack of commitment by the supplier resulted in late deliveries to the construction company and the final acquisition of all of the supplier's shares by the construction company.

In general, all the suppliers were often cooperative in working with the three companies, which reflected the most essential principle of the traditional, supply chain management model, i.e., supplier partnership. However, the way to develop and maintain effective supplier relationship was not well handled by the traditional supply chain management model. Especially, just close control or integration with the suppliers is not enough to ensure performance of the supply chain. If the suppliers are not motivated to do a quality work, or if they are not aware of the importance of quality, or do not have the ability to do a quality job, then their quality is still not satisfactory. In the cases, the main focus of the various suppliers was in meeting the quantity requirement of the three companies, while the quality requirement of customers was not so much

emphasized. In order to meet the needs of customers, quality awareness has to be inculcated on the suppliers and some quality system has to be established. In other words, if companies want to improve the quality performance of their supply chains, the principles of management by fact and continuous improvement have to be promoted.

Another important point is that leadership is essential to providing support and guidance to the operation of a supply chain. The lack of commitment by the top management of either the customer and supplier may affect seriously the supply chain relationship. This is especially true in the case of the construction company as its supplier did not commit to serving the company's needs.

5.12 IMPLICATIONS OF THE CASE STUDIES

The case information showed that the three Hong Kong companies had applied to different extent the principles of Total Quality Management on managing their supply chains. Results supported that companies that had applied the Total Quality Management principles more fully tended to be more satisfied with their suppliers' performances regardless of their size and technology level. Besides, certain themes can also be arrived at from the case information:

1. The principles of the traditional Supply Chain Management model are not enough to ensure satisfactory performance from the supply chains.
2. By adopting the Total Quality Management principles to managing suppliers, companies can minimise those quality and delivery problems and obtain satisfactory performance from their supply chains.
3. Close monitoring by the companies on their suppliers is not enough to ensure their quality performance.
4. Top management commitment by both sides is essential to pave the way for closely integrating the work of both Hong Kong companies and their Chinese suppliers.
5. Close linkage between employees at different levels of both companies in the supply chain makes operation smoother.
6. Having a good quality management system is helpful to achieving quality performance but the suppliers should also be more customer focused.
7. Hong Kong companies can play a bigger role in supporting their Chinese supply

partners to continuously improve their performance.

There is a limitation to the exploratory case study. The above themes are drawn from a limited sample of supply chains. They have to be tested with a larger sample of supply chains. However, since the purpose of the exploratory case studies is to understand the application of TQM principles to supply chain management so as to provide some input for the development of a new SCM model, therefore, sample size should not be a big issue.

The seven themes that are embedded in the three case studies suggest that companies should consider certain factors in order to best manage their supply chains. Theme 1 suggests partnering relationship is one of the factors for effective Supply Chain Management. However, attention should also be devoted to ways of developing that relationship. Theme 2 proposes that enriching the traditional Supply Chain Management model should enable companies achieve business excellence. Theme 3 and theme 5 concern with the factor of Management By Fact which will help improve the supply chain operations. Theme 6 indicates that suppliers need to meet the needs of the customers, i.e. the factor of Customer Focus. Theme 7 suggests that satisfactory performance requires the supply chain partners to continuously improve themselves, i.e. the factor of continuous improvement. Theme 4 is about the factor of leadership which lays down the foundation for all other factors. These various factors will be refined and incorporated into the new SCM model as outlined in the chapter seven.

5.13 CONCLUSIONS

In this chapter, the background information of supply chain management in Hong Kong has been examined and its importance to Hong Kong has been discussed. It also reports on the findings and analysis of three case studies on the application of TQM principles to SCM. The findings support that TQM principles can be applied to SCM and hence the cases provide valuable input for the development of a new SCM model, i.e., using TQM principles to enrich the traditional SCM model.

CHAPTER 6

RESEARCH DESIGN AND METHODOLOGY

6.1 INTRODUCTION

This chapter discusses briefly the various research design and methodology issues relevant to this study and explains the plan selected for conducting the study and the methods used in collecting and analysing data for the study.

This study attempts to find ways to best manage the supply chains of companies so as to improve their performances. It constitutes a piece of research work because it is different from other non-research activity in the way it finds solutions to the problems. To qualify to be called a research work, it has to meet some requirements. They are specified out by Grinnell (1993) :

> The word research is composed of two syllables, re and search. The dictionary defines the former as a prefix meaning again, anew or over again and the latter as a verb meaning to examine closely and carefully, to test and try, or to probe. Together they form a noun describing a careful, systematic, patient study and investigation in some field of knowledge, undertaken to establish facts or principles.

Grinnell (1993) also states that "research is a structured inquiry that utilises acceptable scientific methodology to solve problems and creates new knowledge that is generally applicable." Burns (1994) defines research in short as "a systematic investigation to find answers to a problem."

Hence, this study also adopts a systematic investigation to the problem of Supply Chain Management. The details of conducting the study are outlined in the chapter.

6.2 TYPES OF RESEARCH

Kumar (1998) classifies the types of research from three perspectives :

6.2.1 The application of the research study

There are two broad categories: pure research and applied research. According to Bailey (1978):

> Pure research involves developing and testing theories and hypotheses that are intellectually challenging to the researcher but may or may not have practical application at the present time or in the future. Thus such work often involves the testing of hypotheses containing very abstract and specialised concepts.

However, most of the research in the social sciences is applied. Kumar (1998) explains applied research as the application of research techniques, procedure, and methods that form the body of research methodology to the collection of information about various aspects of a problem so that information gathered can be used in other ways.

This study is an applied study. For instance, the construction of the American Consumer Satisfaction Index (ACSI) developed by Fornell et al. (1996) is being applied to Hong Kong and also being extended to the development of satisfaction index at the business to business level, i.e., between companies and their suppliers.

6.2.2 The objectives in undertaking the research

As summarised by Kumar (1998), there are four types of research study classified according to the perspective of research objectives:

Descriptive research

The purpose of descriptive research is to describe a phenomenon under study. It often reports frequencies, averages, and percentages.

Correlational research

The main emphasis of a correlational research study is to discover or establish

the existence of a relationship/association/interdependence between two or more aspects of a situation.

Explanatory research

It tries to find out why and how there is relationship between two aspects of a situation or phenomenon.

Exploratory research

When a researcher wants to explore areas about which he or she has little or no knowledge, this type of research study will be used.

Kumar (1998) points out that although a research study can be classified in one of the four perspectives, most studies usually are a combination of the first three categories. In fact, this study also contains elements of descriptive, correlational and explanatory research.

6.2.3 Type of information sought

According to the type of information sought through research activity, Kumar (1998) suggests two broad types of research studies. They are quantitative and qualitative studies. The quantitative-qualitative classification is dependent on three criteria:

- the purpose of the study;
- how the variables are measured; and
- how the information is analysed.

Kumar (1998) further explains on a qualitative study: "if the purpose of the study is primarily to describe a situation, phenomenon, problem or event; the information is gathered through the use of variables measured on nominal or ordinal scales (qualitative measurement scales); and if analysis is done to *establish the variation* in the situation, phenomenon or problem *without quantifying it*."

On the other hand, a study is classified as a quantitative study "if you want to *quantify the variation* in a phenomenon, situation, problem or issue, if information is gathered using predominantly quantitative variables, and if the analysis is geared to ascertain the *magnitude of the variation*" (Kumar, 1998).

The present research study adopts both of the qualitative and quantitative approaches. For instance, the adoption of in-depth interviews in this study, with the

objective of describing and explaining the supply chain situation represents the qualitative approach; while the questionnaire survey and the later model testing which helps to quantify the relationships between supply chain success factors and supply chain management excellence signify the quantitative approach.

6.3 PARADIGMS OF RESEARCH

According to Layder (1988), traditionally, there is a gulf between qualitative and quantitative research, with each belonging to distinctively different paradigms.

Brannen (1992) discusses three important differences between the two paradigms. She considers that the most important difference is the way in which each tradition treats data. She points out that "In theory, if not in practice, the quantitative researcher isolates and defines variables and variable categories. These variables are linked together to frame hypotheses often before the data are collected, and are then tested upon the data. In contrast, the qualitative researcher begins with defining very general concepts which, as the research progresses, change their definition. For the former, variables are the vehicles or means of the analysis while, for the latter, they may constitute the product or outcome..." (Brannen, 1992).

A second difference is on data collection. Brannen (1992) further points out that "In the qualitative tradition, researchers must use themselves as the instrument, attending to their own cultural assumptions as well as to the data." On the other hand, in the quantitative tradition, "the instrument is a pre-determined and finely-tuned technological tool which allows for much less flexibility, imaginative input and reflexivity" (Brannen, 1992). An example of the instruments given for the quantitative and qualitative approaches are questionnaire survey and in-depth interviewing respectively.

The third difference concerns the question of extrapolation and generalisability. Brannen (1992) conceives that quantitative research adopts the process of enumerative induction. It aims to infer a characteristic or a relationship between variables to a parent population. She points out that qualitative methods have been associated with analytic induction. It is the "concepts and categories, not their incidence and frequency, that are said to matter" (Brannen, 1992). On the issue of generalisability, she further elaborates that quantitative studies concern with how far the findings can be generalised to a general or parent population, while in qualitative research, the concern is about the replication of

the findings in other similar cases or sets of conditions. Moreover, inferences are usually theoretical or causal instead of statistical.

The above differences seem to suggest that these two paradigms are greatly different from one another. Many researchers identify themselves as belonging to one or other paradigm. However, there are other researchers who happily combine these two approaches. These researchers adopt a "methodologically pluralist" position (Gill & Johnson, 1997). Trow (1957, p.33) proposes that

> different kinds of information about man and society are gathered most fully and economically in different ways, and the problem under investigation properly dictates the methods of investigation... This view seems to be implied in the commonly used metaphor of the social scientists' "kit of tools" to which he turns to find the methods and techniques most useful to the problems at hand.

H.W. Smith (1975) argues that different kinds of complementary data about a "problem" may be acquired by using different research techniques in the same empirical study. This "methodological triangulation" is thought to overcome the bias inherent in a single-method approach (Campbell and Fiske, 1959; Denzin, 1970, p. 313; Jick, 1979). Denzin (1970, p.297) defines triangulation, as "the combination of methodologies in the study of the same phenomenon". Triangulation is also described as multimethod/multitrait (Campbell and Fiske, 1959) or convergent validation, and for the most part shares the notion of complementary qualitative and quantitative methodologies rather than competing approaches (Jick, 1979; Fielding and Fielding, 1986).

Besides, Greene et al. (1989) advanced five purposes for combining methods in a single study:

- triangulation in the classic sense of seeking convergence of results
- complimentary, in that overlapping and different facets of a phenomenon may emerge
- developmentally, wherein the first method is used sequentially to help inform the second method
- initiation, wherein contradictions and fresh perspectives emerge
- expansion, wherein the mixed methods add scope and breadth to a study

Therefore, because of the advantages of combining methods, this study adopts a multimethod approach in investigating the Supply Chain Management problem.

6.4 RESEARCH DESIGN

There are many authors providing their definitions to the term of "research design". Some of them are listed out as follows:

A research design is essentially a plan or strategy aimed at enabling answers to be obtained to research questions (Burns, 1997, p. 139).

A research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems. The plan is the complete scheme or program of the research. It includes an outline of what the investigator will do from writing the hypotheses and their operational implications to the final analysis of data (Kerlinger 1986: 279).

A traditional research design is a blueprint or detailed plan for how a research study is to be completed - operationalising variables so they can be measured, selecting a sample of interest to study, collecting data to be used as a basis for testing hypotheses, and analysing the results (Thyer 1993: 94).

Kumar (1998) stated that there are two main functions of a research design. Through a research design you:

- conceptualise an operational plan to undertake the various procedures and tasks required to complete your study; and
- ensure that these procedures are adequate to obtain valid, objective and accurate answers to the research questions. Kerlinger calls this function the "control of variance" (1986:280).

The study design is a part of the research design. It is the design of the study per se, whereas the research design also includes other details related to the carrying out of the study, such as the method of data collection, and the method of data analysis. The research design for this study will be given in details in later sections of this chapter.

6.5 THE RESEARCH PROCESS

According to Bechhofer (1974, p.73) "the research process is not a clear-cut sequence of procedures following a neat pattern but a messy interaction between the conceptual and empirical world, deduction and induction occurring at the same time".

Nevertheless, the seven-step sequence proposed by Howard and Sharp (1983) which builds on earlier work by Rummel and Ballaine (1963), may be found particularly useful. The seven steps are :

- Identify broad area
- Select topic
- Decide approach
- Formulate plan
- Collect Information
- Analyse Data
- Present findings

Basically, this study also follows the above sequence of activities.

6.6 RESEARCH DESIGN OF THE PRESENT STUDY

A detailed scheme of work of the present study is given in Table 6.1. It puts special emphasis on the process of developing and validating the new SCM model, which is called as the Supply Chain Management Excellence Model, and the data collection and analysis stages.

6.6.1 Exploratory stage

Literature on TQM and SCM would be widely reviewed to identify the inadequacies of the traditional Supply Chain Management model and the ways that TQM principles could be used to enrich the traditional SCM model. Besides, the inadequacies were reflected by some in-depth interviews with some companies.

6.6.2 Model building stage

The Supply Chain Management Excellence (SCME) Model aims to eliminate the inadequacies of the traditional SCM model and help companies to achieve business excellence through Supply Chain Management. In developing the SCME Model, literature review on business excellence models incorporating TQM success factors

would be conducted. In the process, Kanji's (1998) Business Excellence Model has been selected as a basis to build up the SCME Model. The TQM success factors of Kanji's model would be used to enrich the traditional SCM model. However, the TQM success factors would be applied in the context of Supply Chain Management.

Table 6.1: *Scheme of work for the present study*

Stages	Research Activities	Outcomes
Exploratory Stage	◆ Literature Review on Total Quality Management and Supply Chain Management ◆ Exploratory Case Studies through in-depth interview	◆ Identification of inadequacies of the traditional Supply Chain Management model
Model Building Stage	◆ Literature review on business excellence models incorporating TQM success factors ◆ Enriching the traditional SCM model with the TQM success factors of the chosen business excellence model	◆ The building of the Supply Chain Management Excellence (SCME) Model
Model Testing Stage	◆ Develop the questionnaire for assessing Supply Chain Management excellence based on literature review and review by practitioners ◆ Survey on the companies in Hong Kong ◆ Testing the data with EQS programme to identify the goodness of fit of the model	◆ The goodness of fit of the SCME Model
Model Application Stage	◆ Using PLS to calculate the Supply Chain Management Excellence Indices and the parameter estimates based on the tested model	◆ SCM Excellence Indices and parameter estimates for the 139 companies
Model Validation Stage	◆ Interview some companies using the critical incident method to assess the validity of the success factors for the SCME Model ◆ Apply the model to assess the Supply Chain Management Excellence Indices of a construction company	◆ Confirmation of the validity of the success factors of the model ◆ Goodness of fit of the model for the company ◆ The Supply Chain Management Excellence Indices for the company

6.6.3 Model testing stage

The model would be tested through conducting a questionnaire survey on the companies in Hong Kong. The different success factors of the Supply Chain Management Excellence Model were operationalised into different items of a questionnaire based on literature review and validated by practitioners. The application of different success factors of the model would be linked up with the performance the companies obtained from their supply chains to find out the causal relationships between them. The data obtained from the survey would be tested by using the EQS program (Bentler & Wu, 1995) to identify the goodness of fit of the model.

6.6.4 Model application stage

Based on the tested model, the Supply Chain Management Excellence (SCME) indices and parameter estimates of the model constructs would be calculated using the Partial Least Squares (PLS) method. This study extends Fornell's (1996) American Customer Satisfaction Index (ACSI) to the business to business level, i.e. it constructs an index for companies' satisfaction with their Supply Chain performances.

6.6.5 Model validation stage

In-depth interviews would be conducted with the key informants of some companies in order to further assess the validity of the success factors of the model. Informants would be asked to provide critical incidents on their relations and operations with their suppliers. It is expected that through these incidents, it would help clarify and explain the detailed application of the success factors of the Supply Chain Management Excellence Model. Information from the critical incidents would complement the quantitative findings in getting a better understanding of the model.

Besides, the model would also be used to assess the Supply Chain Management Excellence Indices for a construction company so as to validate the model at the company level instead of at the industry level.

6.7 DATA COLLECTION METHOD

6.7.1 In-depth interview

In the exploratory stage of the study, the supply chain managers of three companies would be interviewed in-depth to obtain information on their supply chain performance. Through the interviews, it also aims to identify the inadequacies of the traditional Supply Chain Management model. An interview guide would be used in the process of conducting the interview so that the interviewer would know the general topics to be asked instead of having to follow closely a list of interview questions. The flexibility allowed to the interviewer in what he asks of a respondent is valuable as it can elicit extremely rich information.

6.7.2 Questionnaire Survey at the industry level

The questionnaire would solicit from the respondents information about the application of the success factors of the Supply Chain Management Excellence Model to their major suppliers or supply chains. The major supplier is defined as the supplier with which the company does the most business. It is used as a frame of reference because it is believed that respondents' recall of the largest supplier would be more accurate and meaningful.

Participants

As Supply Chain Management is something about how a company manages its supply chain, therefore, it is essential to investigate the views of the buying company on its supply chain and the Supply Chain Management practices it has adopted. A key informant will be selected for answering the questionnaire. The key informant will be one who is responsible for the management of the company's supply chains or one who knows the company's supply chains well. Questionnaires have been sent to managers with significant responsibility for working with suppliers. From 1050 number of 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 organisations and been dealing with the

supplier they reported on for an average of 5.69 years. Most of the respondents were senior managers, followed by the group of middle managers.

Sampling design

Companies that make a lot of purchases are targets of this study. They include manufacturers, importers, exporters and wholesalers. There is a convenient and often used directory compiled by the Federation of Hong Kong Industries (1997). All members contained in the FHKI Members' Directory 1997, with the exception of the finance companies were included in this survey. The finance companies were excluded in the survey because these companies, in general, do not purchase a lot of goods or services in their operations to serve their customers. Therefore, they may not provide a good context for the study of Supply Chain Management.

Ways to contact respondents

It involves a choice between sending, probably by post, a questionnaire which the respondent self-administers, or the use of an interviewer to administer the questionnaire. This may either be administered face to face or in some cases may be economically conducted by telephone (Frey, 1989).

Since postal questionnaires are generally less expensive and time consuming than those administered by an interviewer, this method is adopted in the present study.

6.7.3 Questionnaire Survey at the company level

To further validate the Supply Chain Management Excellence Model at the company level, the same questionnaire is administered to all the staff of the contracts department of a large construction firm. Each of the staff was asked to fill in questionnaire for three most important suppliers or subcontractors that each of them deals with. Altogether, questionnaires were filled in for forty-eight most important suppliers or subcontractors of the company.

6.7.4 In-depth interview through the Critical Incident Method

In order to gain an interpretative insight into the topic, an intensive rather than extensive research strategy was adopted (Sayer,1984). Therefore, in-depth interviews

with some selected companies have been carried out in examining the application of the success factors of the Supply Chain Management Excellence Model in the model validation stage. These companies have been approached for the provision of examples of their relationships with their suppliers. Data and opinion were sought from the key informants of these case companies. They are managers that are responsible for managing the relationships with their supply partners. Data were gathered using an adaptation of the critical incident technique developed by Flanagan (1954). A critical incident is defined as any observable human activity that is "sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act" (p. 327). Each manager was asked to think of a prominent example of a good supplier and a bad supplier. They were then prompted by the interviewer to discuss on the interactions between the company and its suppliers that led to the good or the bad relationships with its suppliers. In doing so, the managers were asked to tell a story in which they were to describe the surrounding circumstances of the incident, the specific interactions between both parties in the incident, and the consequences of the incident.

6.8 DATA ANALYSIS METHOD

6.8.1 EQS

In order to evaluate the goodness of fit of the overall model, the linear structural equation modeling provided by EQS (Windows Version 5.6) was employed (Bentler & Wu, 1995). The programme generates some indices, i.e., the Normed Fit Index (NFI) and the Comparative Fit Index (CFI), which indicate the degree of fit of the model. Values for both the NFI and CFI range from zero to 1.00 and according to Bentler (1992), a value greater than .90 indicates an acceptable fit to the data.

6.8.2 Partial Least Squares (PLS) Method

According to Igbaria et al. (1995), "PLS is a second generation multivariate analysis technique used to estimate the parameters of causal models. PLS embraces abstract and empirical variables simultaneously, and recognises the interplay of these two dimensions of theory development. The causal modeling technique, often termed

structural equation modeling, accommodates a priori knowledge derived from theory and / or previous empirical findings, and because these methods can combine as well as confront theory with empirical data, they offer a potential for scientific explanation that goes far beyond description and empirical association."

Fornell of the University of Michigan has pioneered the use of this PLS method in calculating Customer Satisfaction Index for Sweden (Fornell, 1992). Since then, the compilation of Customer Satisfaction Index has been spread to other countries in Europe and the States. This is the first time that this index method is applied to business to business level i.e. to assess companies' satisfaction with their supply chains, in Hong Kong.

Based on the Supply Chain Management Excellence Model, PLS estimates weights for the critical SCM success factors or SCM constructs that maixmise their ability to explain Supply Chain Management excellence as the ultimate endogenous or dependent variable. The estimated weights are used to compute index values for Supply Chain Management Excellence and the other model constructs.

Advantages of PLS method

PLS is a rather robust statistical method which has been applied in many areas of research and technology. It aims to identify the underlying factors, or linear combination of the X variables, which best model the Y dependent variables. According to Talbot (1997), PLS can deal efficiently with data sets where there are very many variables that are highly correlated and involving substantial random noise. Moreover, size dimensions do not matter so much in PLS, e.g. there can be more variables than observations.

Research studies are very often hampered by the problem of skewness which is very common for the indicators of certain constructs, such as satisfaction construct (see Hunt 1977; Michalos 1986; Oliver 1981; Westbrook 1980). Fornell (1992, 1996) uses the PLS method and a multiple-indicator approach to handle the problem of skewness. Therefore, in this study, the PLS method and the multiple-indicator approach are also used.

Initialisation of the PLS programme

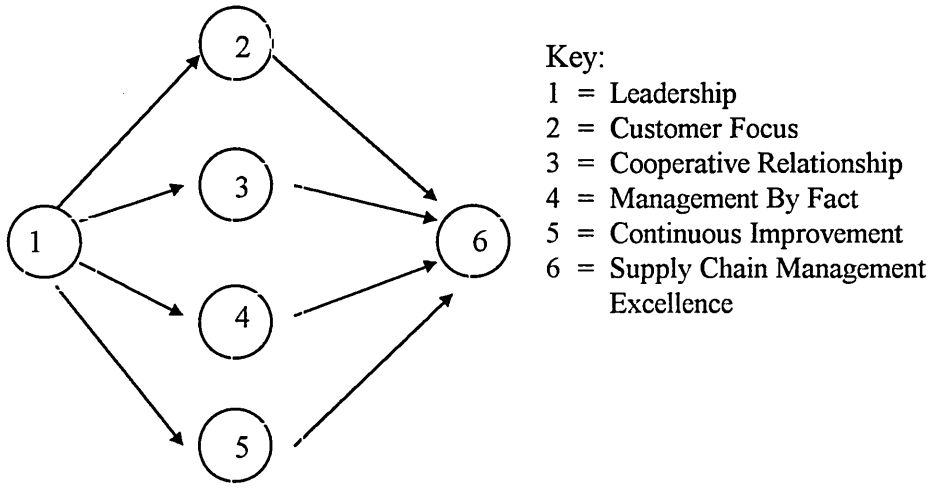
The PLS programme is run within the SAS statistical package and is used to calculate the weights which are then used for calculating the index scores. After the PLS programme is called into the SAS programme editor, there are a number of lines that

needed to be changed in order to run the programme. The first line of the programme has to be changed to include the name of the data set that the programme is going to run. The structural equation model has to be defined at the end of the programme. These lines have to be changed to fit with the model we are using. An example of the lines basing on the Supply Chain Management Excellence Model is as follows:

```
n       =   {3 8 3 4 8 4};
ir      =   {2 1 3 1 4 1 5 1 6 2 3 4 5};
irn     =   {2 2 2 2 5};
io      =   {1 1 1 1 1 0};
ssize   =   139;
maxnoit =   100;
criterio =  0.000001;
fpopt   =   0;
fpcrit  =   0.000001;
nfpit   =   100;
```

To demonstrate the meaning of these lines, the figure below shows the Supply Chain Management Excellence Model and the relationships among the latent variables in the model. The lines 'ir' and 'irn' defines the model structure, while line 'n' specifies the input data, and line 'io' indicates whether or not a latent variable influences 'in' or 'out'.

Figure 6.1: *Supply Chain Management Excellence Model for the PLS programme*



The different commands of those lines at the end of the PLS programme, specifies different parts of the model. They are explained as follows:

n	this line specifies the number of variables that will feed into each dimension or latent variable of the structural equation model. For example, 3 variables into dimension 1, 8 variables into dimension 2 etc.
ir	it defines which variables are dependent and independent variable for each inner relation. For instance, the first part of the line (2 1 3 1 4 1 5 1) means that dimensions 2, 3, 4 and 5 are fed by dimension 1.
irn	it indicates the number of variables in the inner relation. For example, the 5, means that there are four dimensions feeding into `dimension 6' plus the dimension itself making 5 together.
io	it shows whether the outer indicators go in or out for each variable in the inner relations. One (1) means in, while zero (0) means out.
Ssize	It is the sample size, i.e., the number of completed questionnaires contained in the data set.
maxnoit	It is the maximum number of iterations for the PLS procedure to carry out before it stops.
citerio	It is the converge criterion. Iteration ceases when all coefficients estimates converge to with CITERIO.
fpopt	When the inner relations form an interdependant system, there are the following options: fpopt = 0 The fix point is not exercised fpopt = 1 The first step in the FP iteration is OLS fpopt = 2 The first step in the FP iteration is 2SLS

Source: PLS.SAS documentation

Critical Success Factors and Manifest Variables in the Supply Chain Business Excellence Model

Table 6.2 shows the corresponding items for each latent variable in the Model. Since latent variables: Leadership, Cooperative Relationship, Management By Fact and Supply Chain Management Excellence are complex, they therefore consists of a large number of items in their measurement scales. In practice, Structural Equation Modeling (SEM) has a difficult time identifying the measurement model if too many indicators are used to represent a single latent variable (Garver & Mentzer, 1999). However, Garver & Mentzer (1999) also suggest that partial disaggregation is a practical SEM application

that allows the use of a large number of indicators to represent a latent variable. In partial disaggregation, the researcher combines items into composites. In this study, for example, items for Leadership are grouped into three composites, i.e. I, II, and III representing Cooperative Culture, Commitment to Relationship and Commitment to Quality respectively. Each composite actually consists of four items which are summed together to form the composite. The latent variable of Cooperative Relationship consists of three composites, i.e. VI, VII and VII which represent Supplier dynamics, Cooperative Goals and Constructive Controversy respectively. On the other hand, the latent variable Management By Fact consists of four composite variables, i.e. IX, X, XI and XII, which represent Seamless Operation, Integrated Structure, Performance Measurement and Information Exchange respectively. It is likewise for the latent variable, Supply Chain Management Excellence, which consists also of four composite indicators, i.e. XV, XVI, XVII, and XVIII, representing Supplier Satisfaction, Supplier Contribution, Customer Satisfaction and Business Results respectively. All of these composite indicators would be entered into the measurement model as multiple indicators to estimate the above four latent variables. For the advantages of using composites and partial disaggregation, random error is reduced (composite indicators are more reliable than single item indicators), a complex model is simplified, and the concept of multiple indicator measurement is maintained (Garver & Mentzer, 1999).

Table 6.2: *Critical Success Factors and Number of Manifest Variables in the SCME model*

Code	Critical Success Factors	Number of Manifest Variables (Item No. in questionnaire)
A.	Leadership	3 (I; II; III)
B.	Customer Focus	8 (IV.1, IV.2, IV.3, IV.4; V.1, V.2, V.3, V.4)
C.	Cooperative Relationship	3 (VI; VII; VIII)
D.	Management By Fact	4 (IX.; X; XI; XII)
E.	Continuous Improvement	8 (XIII.1, XIII.2, XIII.3, XIII.4; XIV.1, XIV.2, XIV.3, XIV.4)
F.	SCM Excellence	4 (XV; XVI; XVII; XVIII)

Data Entry and Computation

The PLS.SAS programme is called in SAS and run on the data set to obtain weights (w_is) of individual manifest variables for all latent variables (CSF and SCM

excellence).

Critical success factor (CSF) indices and SCM excellence index is calculated using the following formula:

$$\text{Index} = \frac{\Sigma w_i x_i - \Sigma w_i}{(n-1)\,\Sigma w_i} * 100$$

where n = number of divisions in item scale.

Importing Data

Data is imported into the programme in the log mode. The steps involve:

Click File + Import + tab delimited text file + Next + Browse for *filename.txt* + next + enter filename in MEMBER BOX without extension.

A message will be displayed indicating whether the data import process was successful or not.

Programme Execution

The PLS programme is called in by opening the relevant PLS programme file name. It is run in the programme editor mode by clicking "Submit" under the Local menu.

Programme Output

The PLS.SAS programme provides several types of outputs:

Outer coefficients	They are the unstandardised structural weights of manifest indicator variables. Outer coefficient should have a value of 0.1 or more in order for the relevant manifest variable to be useful. Otherwise, the manifest variable has to be deleted from the model and the programme is run again to get a new output.
Inner coefficients (Structural Parameters)	They are the coefficients of functional equations linking latent variables. They reflect the strengths of causal relationships among variables. Each structural parameter shows the amount of change in an effect (endogenous) variable that results from a unit of change in a cause (exogenous or preceding endogenous) variable. A positive inner coefficient is desirable for all causal relationships in the Supply Chain Management Excellence Model. It signifies that there is a positive correlation between independent variable and dependent variable, hence corresponds with the direction of causation.

Correlation Matrix	It is the Pearson correlation, r, matrix among all exogenous and endogenous variables in the model. They indicate the strength of relationship among the variables.
Standard Deviation	It provides information on spread of the parameter estimate from the mean.
Coefficient of Determination (r^2)	It represents the proportion of regression sum of squares for corresponding latent variables that is explained by the regression model.
Pearson Correlation Coefficient (r)	It is the correlation of latent variables that have causal relationship. The higher the value, the stronger is the relationship between the variables.
Cronbach coefficient (α)	This value indicates the internal consistency of latent variables, which serve as common factors that are being empirically reflected by manifest variables. According to Nunnally (1978), coefficient α should have a value greater than .7 in order for the latent variable to be a reliable measure.

6.9 CONCLUSIONS

In this chapter, the research design and methodology of the present study has been briefly discussed. To summarise, the study has adopted a systematic investigation into the research problem. It is an applied research in that the American Customer Satisfaction Index is not only applied but extended to the business to business level. The objectives of the study contain elements of descriptive, correlational and explanatory research. Both the qualitative and quantitative approaches were adopted in conducting the research. The chapter also outlines in details the process of developing and validating the Supply Chain Management Excellence Model. Besides, it explains the methods of collecting and analysing data for the study.

CHAPTER 7

DEVELOPING A BUSINESS EXCELLENCE MODEL FOR SUPPLY CHAIN MANAGEMENT

7.1 INTRODUCTION

Supply Chain Management (SCM) has been increasingly adopted by companies worldwide so as to better utilise their supply chain activities for competitive advantages. This chapter develops a Business Excellence Model for Supply Chain Management based on literature review on models relating to business excellence and supply chain management and the in-depth interviews with supply chain managers. The author selected Kanji's Business Excellence Model which uses Total Quality Management principles and concepts to help companies achieve business excellence, to fulfill the inadequacies of the existing SCM model and create a new structured model for Supply Chain Management. The chapter outlines the principles and concepts of the Business Excellence Model for Supply Chain Management, which will be called as **Supply Chain Management Excellence (SCME) Model**. In the following chapter, the SCME Model is tested with the data of the supply chain activities of 139 companies in Hong Kong.

Companies worldwide recognise the importance of meeting customers' needs to succeed in the competitive marketplace. They realise that optimising 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 is advocated as a means to help companies utilise their suppliers' resources in improving their own competitive edges (Cavinato, 1991; Ellram and Cooper, 1990; Houlihan, 1985; Jones and Riley, 1985; Towill et al., 1992). However, the author found that there are inadequacies in the existing SCM model which hamper its effectiveness (see chapter two). Therefore, the Supply Chain Management Excellence Model is being developed in this chapter so that organisations can make use of this new model to achieve business excellence. Here Business Excellence is defined by Kanji (1999) as "the simultaneous measurement of customers', employers', and shareholders' delights within

an organisation to provide overall business success." Total Quality Management principles have been incorporated into the existing SCM model to form the Supply Chain Management Excellence (SCME) Model. The aim of the SCME Model is to help companies achieve business excellence through better managing their supply chains.

7.2 RELATIONSHIP BETWEEN TQM, SCM AND PARTNERING

Based on 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 (Tjosvold, 1993, Scholtes, 1992), strategic leadership (Kanji, 1996, Edgeman & Dahlgaard, 1998, Tribus, 1998), systems thinking (Senge, et al. 1994), continuous improvement (Imai, 1986) and scientific management advocated by Frederick Taylor, ... etc. For a company to perform well, it requires the blending together of these various management principles. In fact, Total Quality Management (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 Management 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 & Davis (1997).

On the other hand, in order to perform well, a company has to rely on the performance of its upstream and downstream organisations, i.e. there is a quality chain or value chain linking these organisations together with the customers. This is the Supply Chain Management 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 like 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 & Davis

(1997). Hence, partnering is the key element of SCM, while SCM is the horizontal view or part of a company's TQM system.

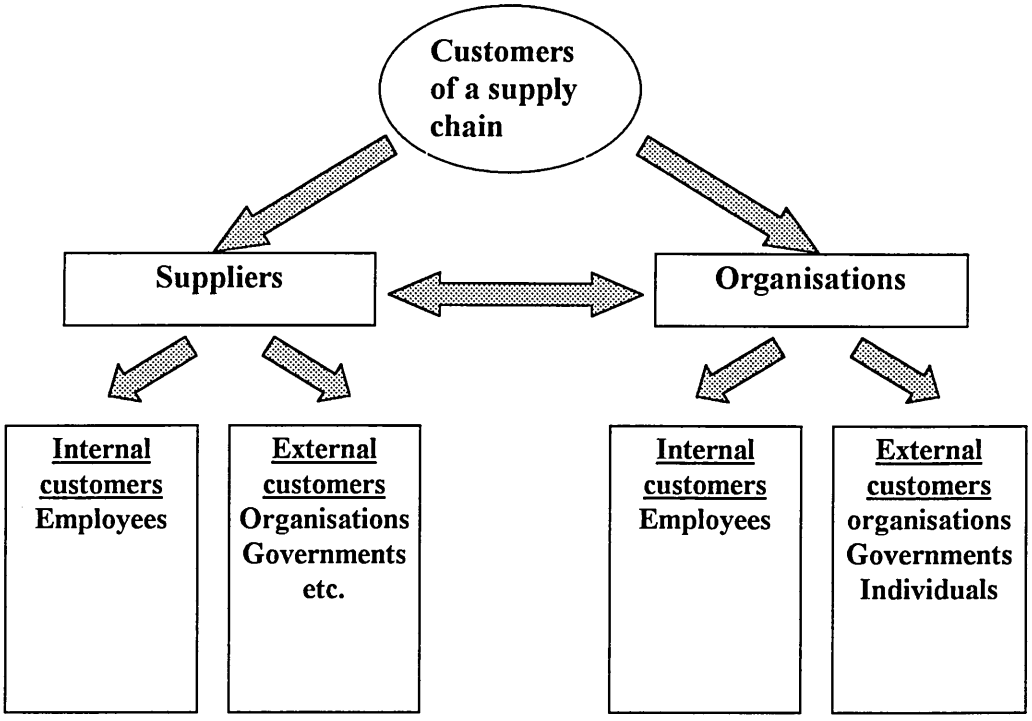
7.3 CUSTOMERS OF A SUPPLY CHAIN

There are two parties in a supply chain: supplier and organisation. The organisation provides information on its requirements to the supplier, and the supplier produces goods or services to meet the organisation's needs. The organisation should try to develop good relationships and close operation with the supplier for it can better meet the needs of its customers with the supplier's support . These two parties of the supply chain have both internal and external customers (Fig. 7.1). The internal customers of the supplier are mainly its employees and the external customers of the supplier refer to organisations, governments, etc. that purchase goods or services from it. Regarding the organisation, its internal customers are its employees and its external customers are organisations, 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 organisation 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 its output will be endangered and hence organisations obtaining supply from the supplier will not be satisfied if they get its defective goods. If the organisation 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 dissatisfaction of external customers. It is believed that a supplier that has satisfied internal customers should be able to best serve 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 Supply Chain Management model should take into consideration simultaneously the supplier's satisfaction on its relationships and operations with the organisation, the organisation's satisfaction with the contribution of the supplier, the competitive position of the organisation and the satisfaction of its external customers. The Supply Chain Management Excellence Model has taken these

factors into consideration when developing its Supply Chain Management Excellence construct.

Figure 7.1 : *Customers of a Supply Chain*



7.4 THE PURPOSE OF THE SUPPLY CHAIN MANAGEMENT EXCELLENCE MODEL

The existing Supply Chain Management model focuses mainly on working closely with suppliers in providing 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.

The purpose of the Supply Chain Management Excellence (SCME) Model is to fulfill the inadequacies of the existing SCM model. Moreover, companies can make use of the SCME Model to understand, better manage and fully utilise their supply chains to achieve organisational effectiveness. This latter purpose of the SCME Model is somewhat similar to the purpose of adopting TQM by a company, which is also for

achieving organisational excellence. However, the SCME Model focuses on achieving organisational excellence through better managing and fully utilising the resources of the supply chain. Organisational excellence or business excellence for the supply chain is reflected by the satisfaction of different stakeholders, such as the organisation, its suppliers and its customers. Hence, the SCME Model would also take into consideration the satisfaction of different stakeholders in the supply chain.

Hackman & Wagerman (1995) suggest that 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 it is being practised in various organisations. 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 organisations (Juran, 1986, cited in Sitkin, 1994). Hence, TQM can be applied generically. TQM implementation is influenced by certain Total Quality Management principles and core concepts that are critical for organisations' success (Kanji and Malek, 1999). It is believed that the generic Total Quality Management principles that are useful to a company would also be useful to the supply chain. What it differs is that the principles would be viewed from an inter-organisational 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 Total Quality Management principles and concepts so as to help companies achieve excellent performance from their supply chains.

7.5 PRINCIPLES AND CONCEPTS OF THE SUPPLY CHAIN MANAGEMENT EXCELLENCE MODEL

In the development of the Supply Chain Management Excellence (SCME) Model, the managers responsible for managing the supply chains of two large companies and one small company had been interviewed in-depth to explore on the various salient variables relating to managing the supply chain. The general findings from the managers was that the existing SCM model was not sufficient for achieving best results.

The SCME Model has a role of improving the performance of a supply chain. There are a set of core principles and concepts underpinning the SCME Model. These

core principles and concepts were adopted from the Business Excellence Model (Kanji, 1998), and adapted with special focus on the supply chain level instead of on overall business level of individual organisation. These core principles and concepts also reflect the author's work in literature review in Chapters two and three and the in-depth interviews with supply chain managers in chapter five. These core principles and concepts are essential for utilising supply partners' resources in achieving excellent business performance. In other words, they are the critical success factors for Supply Chain Management.

7.5.1 Adopting the condensed version of Kanji's Business Excellence Model

In adopting Kanji's Business Excellence Model to enrich the existing Supply Chain Management model, Kanji's principles and core concepts are condensed together to suit the use of the SCME Model. The prime factor of the SCME Model is the construct of "Leadership" which is similar to Kanji's model though the indicators are more tuned to supply chain management. In the SCME Model, "Leadership" lays down the groundwork for four SCM success factors. They are "Customer Focus", "Cooperative Relationship", "Management by Fact" and "Continuous Improvement". They are similar to Kanji's principles of "Delight the customer", "People-based management", "Management by fact" and "Continuous Improvement", though they are again fine-tuned to the context of Supply Chain Management. Moreover, the SCM success factors also include the essence of the core concepts of the different principles of Kanji's model. In turn, these four factors will influence companies' business excellence through their supply chains. Hence, the SCME Model has adopted a condensed version of Kanji's model, which is more suitable to the context of supply chain management. The different constructs of the SCME Model are discussed as follows:

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 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 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 to ensuring quality output to ultimate customers (Kanji and 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. In sum, they lay down the foundation for developing cooperative relationship and close linkages with their suppliers. This construct is similar to Kanji's "Leadership" principles.

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, then it would affect its performance towards its 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 and its core concepts.

Cooperative relationship

Members in a supply chain have to work closely together in order to better coordinate their work and obtain some 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, the 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 cooperative relationship in the model which in fact

relates to Kanji's "People Based Management" principle and its core concepts.

Management by Fact: Integrated process & 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 involve themselves in various processes. As processes often cut across organisational boundaries, they may be broken or disrupted by lack of communication, and coordination between organisations. 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 channeled 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 and its core concepts.

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 supply chain process so as to make it more integrated. Process improvement may be a result of benchmarking or going through a close study by the parties themselves on their operations.

The need to continuously improve has to be cultivated in the mind of different chain members. They have to be conscious of preventing problems to happen 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 together to further improve their operations. Improvements may require joint planning and discussion between members. This construct builds on Kanji's "Continuous Improvement" principle and its core concepts.

Supply Chain Management Excellence

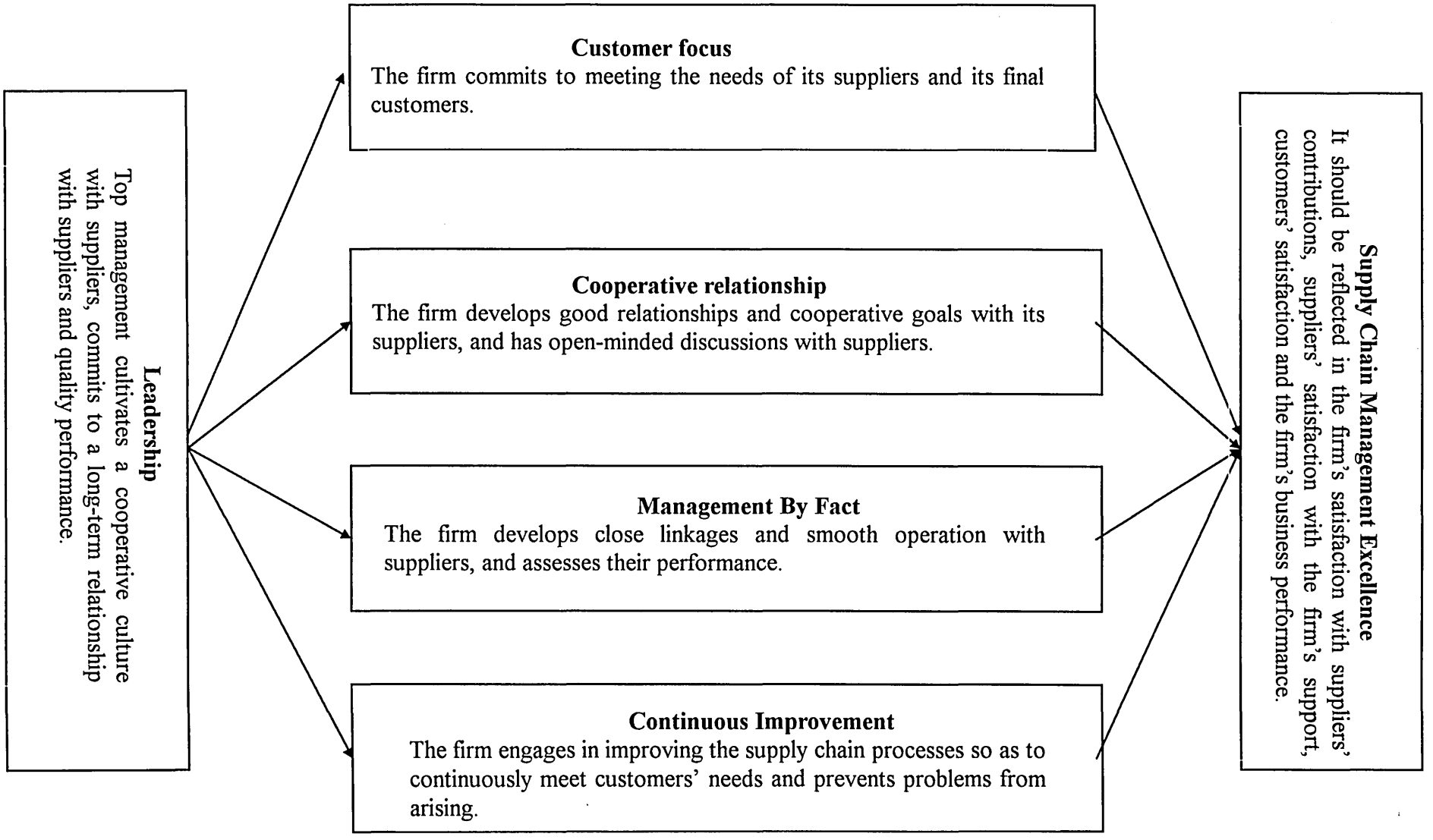
The application of the principles and their related concepts should enable the whole supply chain achieve lower cost, better quality, and quicker delivery of products or services to customers. These performance achievements are the combined efforts of different members of the supply chain. Therefore, the SCME Model can provide an effective way for managing the supply chain for business results. The Model should enable the partners to be satisfied with their relationship, and have smooth operation processes. As a result, each supply chain partner will continuously contribute 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, they will be loyal to the company and the company can achieve good business results.

7.6 CONCLUSIONS

These six constructs that have incorporated the principles and concepts of both Kanji's Business Excellence model and the existing SCM model are combined to represent a structural Supply Chain Management Excellence (SCME) Model (Figure 7.2). Through literature review, the SCME 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 affect 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 will result

in high contributions to business excellence for companies. These propositions are also strongly supported by the views of practising supply chain managers obtained through in-depth interviews. In spite of its content validity, the Supply Chain Management Excellence Model is further tested with the data of the supply chain activities of 139 companies and the results are reported in the following chapter. The results also support that the SCME Model fits with the data of the 139 companies.

Figure 7.2 : *Supply Chain Management Excellence (SCME) Model*



CHAPTER 8

VALIDATION AND RELIABILITY OF SUPPLY CHAIN MANAGEMENT EXCELLENCE MODEL

8.1 INTRODUCTION

The previous chapter has developed the Supply Chain Management Excellence (SCME) Model based on literature review and in-depth interviews with some supply chain managers. The SCME Model has incorporated Total Quality Management principles into the existing SCM model so as to fulfill its inadequacies. The SCME Model should therefore be a better model for companies to adopt in managing their supply chains. This chapter will try to validate the SCME Model with the data of the supply chain activities of 139 companies in Hong Kong. Structural analysis was used to examine the underlying relationships as theorised among the different constructs in the SCME Model, i.e. leadership, customer focus, cooperative relationship, management by fact, continuous improvement and business excellence. The results support that the theorised structured model provides a good fit for the data of the supply chain activities.

8.2 SURVEY ON THE SUPPLY CHAIN MANAGERS OF COMPANIES IN HONG KONG

Questionnaires were sent to managers with significant responsibility for working with suppliers. From 1050 number of questionnaires distributed, 145 managers completed and mailed back their questionnaires, resulting in 139 usable responses.

8.2.1 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 supply chain management excellence. These measures were subjected to a formal pre-test by managers responsible for managing their supply partners. Some minor modifications had been carried out to make the meaning of some items more understandable. A sample of the questionnaire containing the different measures is attached in the Appendix.

8.2.2 Internal Consistency of the different SCM constructs of the SCME Model

An internal consistency analysis was performed separately for each variable in the theorised SCME Model by calculating the Cronbach Alphas i.e. the reliability alphas α. Results in Table 8.1 showed that the Cronbach Alphas for all the variables in the model were above the critical value of .7 (Nunnually, 1978). Hence, the author concluded that all the items had been appropriately assigned to each variable. The developed instrument also had content validity, since the selection of measurement items was based on a comprehensive review of 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

It 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 the author's previous studies (Wong, et. al. 1999). Four items were used to measure each variable under leadership. Subjects were asked to respond on a 5-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"; and "Our top management supports long-term quality improvement process". Reliabilities (coefficient alphas) of the three variables were .73, .83 and .80 respectively.

Customer focus

Customer focus consists of 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"; and "Our firm commits to providing high quality products or services to our customers". Coefficient alphas for the two variables were .82 and .84 respectively.

Cooperative relationship

It 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. The variable of Cooperative Goals measures 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, Andrews & Struthers, 1991; Tjosvold, Wedley & Field, 1986). 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 .80,.83, and .84 respectively.

Management By Fact: Integrative process and Information Management

Integrative process includes the variables of Seamless Operation (OPERAT) and Integrated Structure (STRUCT). In order to have best performance from utilising the resources of a company's supplier, operation between them should be seamless and smooth which also requires an integrated 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, and boundary spanning roles, et. 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"; and "Tight operating linkages are planned for and implemented between our firm and this supplier". Reliability alphas for the two variables were .73 and .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 & 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" and "Our firm and this supplier share work improvement suggestions with each other". Reliability alphas for the two variables were .85 and .76 respectively.

Continuous improvement

It includes the variables of Process Improvement (processim) and Planning and Prevention (PREVEN). Process improvement is always necessary in streamlining the supply chain processes to continuously meet 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 included "We continuously work at integrating the process between our company and this supplier" and "Our company has measures to prevent problems arising from our relationship with the supplier".

Reliability alphas for the two variables were .77 and .70 respectively.

Supply Chain Management Excellence

It includes Customer Satisfaction (CUSAT), Business Results (BUSRESU), Supplier Contribution (SUPCONTR), and Supplier Satisfaction (SUPSAT). It is believed that the SCME Model should lead to Supply Chain Management 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, it will also try to help the company to best meet its customer's needs. 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 .79, .82, .85, and .77 respectively.

Table 8.1 : *Constructs for the Supply Chain Management Excellence (SCME) Model*

Constructs & variables	reliability α	no. of questions	Sample questions
Leadership dimension	.85	12	----------
*Cooperative Culture (CULTURE)	.73	4	Our top management perceives that we and this supplier seek compatible goals.
*Commitment to relationship (LONGTM)	.83	4	Our top mgt. considers that maintaining a long-term relationship with this supplier is important to us.
*Commitment to quality (COMQU)	.80	4	Our top management supports long-term quality improvement process.
Customer Focus dimension	.83	8	----------
*Commitment to supply partner satisfaction (COMSU)	.82	4	We want our supplier satisfied with the information we give them to facilitate their work.
*Commitment to customer satisfaction(COMCU)	.84	4	Our firm commits to providing high quality products or services to our customers.
Cooperative relationship dimension	.90	12	----------
*Supplier Dynamics (SUPDY)	.80	4	An atmosphere of cooperation exists between our firm and this supplier.
*Cooperative Goals (COOP)	.83	4	The supplier and we want each other to succeed.
*Constructive Controversy (CC)	.84	4	This supplier and we listen carefully to each other's opinions.
Management By Fact dimension	.90	16	----------
*Seamless operation (OPERAT)	.73	4	Our firm meets with this supplier's senior management on a regular basis to discuss problems.
*Integrated Structure (STRUCT)	.75	4	Tight operating linkages are planned for and implemented between our firm and this supplier.
*Performance Measurement (MEASURE)	.85	4	Our firm assesses the supplier's performance through a formal evaluation programme.
*Information Exchange (INFOEX)	.76	4	Our firm and this supplier share work improvement suggestions with each other.
Continuous Improvement dimension	.83	8	----------
*Process Improvement (processim)	.77	4	We continuously work at integrating the process between our firm and this supplier.
*Planning & Prevention (PREVEN)	.70	4	Our firm has measures to prevent problems arising from our relationship with the supplier.
Supply Chain Management Excellence dimension	.88	16	----------
*Customer Satisfaction (CUSAT)	.79	4	Customers are satisfied with the quality of our product which has incorporated the input of this supplier.
*Business Results (BUSRESU)	.82	4	Our product quality is very competitive in the market.
*Supplier contribution (SUPCONTR)	.85	4	The supply partner helps us reach our quality objectives.
*Supplier Satisfaction (SUPSAT)	.77	4	Our supplier is satisfied with the information we supply them to facilitate their work.

8.3 RESULTS ON THE MODEL TESTING

8.3.1 Descriptive statistics from the survey

Means of different variables

The means of the different variables are discussed as follows according to the different dimensions (Table 8.2):

Leadership

The means on a 5-point scale (1=strongly disagree; 5 strongly agree) of the three variables under leadership were 3.92, 4.21 and 4.19 for Cooperative Culture, Commitment to Relationship and Commitment to Quality respectively. It indicated that the respondents believed that their top management or their company committed itself to the long-term relationship with the supplier partner and also committed itself to pursuing quality initiatives. The respondents also agreed that there was a cooperative culture between their company and its supply partner.

Customer focus

The responses indicated high means of Commitment to Supply Partner Satisfaction (COMSU) and Commitment to Customer Satisfaction (COMCU) which were 4.21 and 4.45 respectively. It revealed that the respondents very much agreed that their company committed itself to the needs of its supply partner and customers.

Cooperative relationship

Concerning the relationship between respondents' companies and their suppliers, the respondents agreed that there was good Supplier Dynamics, with a mean of 4.01. 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, with a mean of 3.9. Respondents also agreed that the supply chain partners had open-minded interaction with each other, with a mean of 3.9.

Management by Fact: Integrative Process and Information Management

The mean of Seamless Operation was 3.29. It indicated that the respondents were more or less neutral when considered under the 5-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 of Integrated

Structure was 3.5. It suggested that the respondents somewhat agreed that there was structural linkage between their companies and their suppliers.

The means of Performance Measurement and Information Exchange were 3.24 and 3.39 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 had objective ways to measure the performance of their suppliers.

Continuous Improvement

The means of Process Improvement (PROCESSIM) and Planning and Prevention (PREVEN) were 3.69 and 3.57 respectively. The results suggested that the respondents somewhat agreed that their companies and their suppliers continuously worked at improving or streamlining the operations and processes between them. The respondents also somewhat agreed that there was some mechanism set up to prevent problems from arising in the relationship with their suppliers.

Supply Chain Management Excellence

The means of Customer Satisfaction, Business Results, Supplier Contribution, and Supplier Satisfaction were 3.83, 3.71, 3.86, and 3.82 respectively. The results indicated that the suppliers were satisfied with the assistance given to them by the companies. The respondents somewhat agreed that their suppliers could have various contributions to their companies. The respondents also somewhat agreed that their customers were satisfied with their companies' products. Moreover, the respondents also somewhat agreed that the overall performance of their companies was very competitive in the market.

Table 8.2 : *Means and Correlation Among Variables*

	Variable	mean	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	.64**	1.00																
3	COMQU	4.19	.38**	.32**	1.00															
4	COMCU	4.45	.33**	.33**	.53**	1.00														
5	COMSU	4.21	.39**	.45**	.26**	.38**	1.00													
6	SUPDY	4.01	.65**	.48**	.21**	.30**	.51**	1.00												
7	COOP	3.90	.69**	.66**	.35**	.36**	.56**	.66**	1.00											
8	CC	3.90	.51**	.46**	.29**	.29**	.49**	.54**	.61**	1.00										
9	OPERAT	3.29	.33**	.23**	.28**	.28**	.12	.34**	.33**	.39**	1.00									
10	STRUCT	3.50	.38**	.35**	.30**	.28**	.31**	.45**	.47**	.51**	.68**	1.00								
11	MEASURE	3.24	.22**	.12	.46**	.36**	.12	.23**	.23**	.27**	.49**	.51**	1.00							
12	INFOEX	3.39	.32**	.22**	.26**	.27**	.20*	.33**	.39**	.44**	.66**	.56**	.56**	1.00						
13	PROCESSIM	3.69	.40**	.42**	.42**	.40**	.36**	.35**	.44**	.40**	.49**	.58**	.35**	.40**	1.00					
14	PREVEN	3.57	.48**	.38**	.38**	.40**	.34**	.40**	.51**	.41**	.44**	.54**	.51**	.46**	.65**	1.00				
15	SUPSAT	3.82	.60**	.46**	.23**	.25**	.56**	.64**	.53**	.55**	.30**	.34**	.20*	.36**	.31**	.46**	1.00			
16	SUPCONTR	3.86	.51**	.44**	.31**	.29**	.42**	.63**	.62**	.50**	.35**	.45**	.32**	.38**	.51**	.41**	.47**	1.00		
17	CUSAT	3.83	.52**	.45**	.35**	.50**	.36**	.48**	.47**	.39**	.28**	.33**	.37**	.27**	.39**	.42**	.41**	.44**	1.00	
18	BUSRESU	3.71	.40**	.31**	.17**	.45**	.30**	.42**	.26**	.24**	.29**	.32**	.29**	.27**	.32**	.38**	.35**	.23**	.65**	1.00

- means are from a 5-point scale (1=strongly disagree; 5=strongly agree)
- *. Correlation is significant at the 0.05 level (2 -tailed).
- **. Correlation is significant at the 0.01 level (2 -tailed)

Correlation between variables

Table 8.2 shows correlation between different variables and the level of significance (p). They are discussed as follows:

Leadership

Under leadership, the three variables had significant correlation with each other. It suggested that companies having cooperative culture with their suppliers were able to commit themselves to the long-term relationship with their suppliers ($r=.649, p<.01$), and commit themselves to quality initiatives ($r=.386, p<.01$). Companies that committed themselves to quality initiatives would also commit themselves to supplier relationship. ($r=.322, p<.01$).

Besides, the three variables had also high correlation with other variables. The results indicated that companies which had cooperative culture with their suppliers were able to develop cooperative goals ($r=.699, p<.01$), smooth operations ($r=.657, p<.01$) and open-minded interactions with their suppliers ($r=.518, p<.01$). Cooperative culture would also help companies prevent problems from arising in the relationship with suppliers ($r=.486$, $p<.01$). Cooperative culture would also lead to the contribution of suppliers ($r=.515$, $p<.01$). The end result of cooperative culture would be customer satisfaction ($r=.527$, $p<.01$) and competitive business results ($r=.4$, $p<.01$).

Customer Focus

The two variables (Commitment to Supplier Satisfaction, Commitment to Customer Satisfaction) in the construct of customer focus were related to one another ($r=.387$, $p<.01$). Companies which committed themsevles to customer satisfaction also committed themselves to quality ($r=.534$, $p<.01$). In order to meet customers' needs, companies would improve the supply chain's processes ($r=.402$, $p<.01$), prevent problems from occurring ($r=.402$, $p<.01$). Commitment to customer satisfaction would lead to customer satisfaction ($r=.5$, $p<.01$) and business results ($r=.455$, $p<.01$).

Companies that committed themselves to supplier satisfaction would develop long-term relationship ($r=.456$, $p<.01$), and cooperative goals ($r=.565$, $p<.01$), and had smooth operations ($r=.516$, $p<.01$) and open-minded interactions($r=.497$, $p<.01$) with their suppliers. Commitment to supplier satisfaction would also result in supplier satisfaction ($r=.565$, $p<.01$) and supplier contribution ($r=.422$, $p<.01$).

Cooperative Relationships

Companies with good supplier dynamics would have cooperative goals with

their suppliers (r=.668, p<.01), and open-minded interactions with suppliers (r=.54, p<.01). Companies that have cooperative goals with their suppliers would have open-minded interactions with their suppliers (r=.618, p<.01).

Companies having good supplier dynamics committed themselves to supplier satisfaction (r=.516, p<.01). They were able to develop an integrated structure with their suppliers (r=.45, p<.01), and prevent problems arising in the relationship with their suppliers (r=.46, p<.01). In return, the companies would have higher satisfaction with suppliers' contributions (r=.635, p<.01). Good supplier dynamics would also lead to customer satisfaction (r=.486,p<.01) and business results(r=.42, p<.01).

Management By Fact: Integrative Processes and Information Management

The two variables, i.e. seamless operation and integrated structure, in the construct of Integrative Processes were closely related to each other (r=.689, p<.01). Companies that had developed seamless operation with their suppliers also had objective information to measure suppliers' performance (r=.511, p<.01). They would have good information exchange with their suppliers (r=662, p<.01), and emphasise on improving the processes (r=.496, p<.01) and preventing problems arising (r=.444, p<.01) between companies and their suppliers.

Performance Measure and Information Exchange were related to each other (r=.56, p<.01). Companies that had performance measures on their suppliers were also committed to quality (r=.469, p<.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=.651, p<.01). They were also very closely related to the variables in Integrative Processes and Information Management. Companies that paid attention to continuous improvement were also having cooperative culture, long-term relationship with their suppliers. These companies also committed themselves to quality.

Supply Chain Management Excellence

Contributions of suppliers would lead to customer satisfaction (r=.447, p<.01). Supplier contribution was closely related with companies having cooperative culture with suppliers (r=.515, p<.01), long - term relationship with suppliers (r=.447, p<.01), and commitment to suppliers (r=.422, p<.01). Supplier contribution was also closely related with companies having good relations with suppliers, i.e. supplier dynamics

(r=.635,p<.01), cooperative goals with suppliers (r=.623, p<.01), open-minded interactions with suppliers (r=.509, p<.01), and with preventing problems from arising with suppliers (r=.412, p<.01).

Customer Satisfaction was closely related to Business Results (r=.655, p<.01), development of a cooperative culture with suppliers (.527, p<.01), commitment to customers (r=.5, p<.01), relations with suppliers (r=.486, p<.01). The companies that had satisfied suppliers also had satisfied customers (r=.419, p<.01). Supplier Satisfaction was closely related with companies having cooperative culture with suppliers (r=.6, p<.01), and commitment to suppliers (r=.565, p<.01). Supplier Satisfaction was also closely related with companies having good relations with suppliers, i.e. Supplier Dynamics (r=.646, p<.01), cooperative goals with suppliers (r=.537, p<.01), open-minded interactions with suppliers (r=.554, p<.01), and with preventing problems from arising with suppliers (r=.463, p<.01).

Business results was closely related to customer satisfaction (r=.655, p<.01), commitment to customers (r=.455, p<.01), relations with suppliers (r=.42, p<.01), and cooperative culture with suppliers (r=.4, p<.01).

8.3.2 Structural analysis results

Path analysis was used to examine the underlying relationships among company leadership, customer focus, cooperative relationship, management by fact, continuous improvement and supply chain management excellence. The path analysis of the inter-relationships among these constructs was analysed using the EQS for Windows program (Bentler & Wu, 1995).

Structural equation analyses were used to examine possible causal relationships among the variables in the SCME Model. Since the variables in the Model are in fact indicators of the six constructs, therefore, 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 .85. Commitment to Supply partner satisfaction (COMSU) and Commitment to Customer satisfaction (COMCU) form the construct of Customer Focus (CUSTOMER), with a reliability alpha of .83. Supplier

dynamics (SUPDY), Cooperative Controversy (CC), and Cooperative Goals (COOP) combine into the construct of Cooperative Relationship (COOPRELA), with an alpha value of .90. Seamless Operation (OPERAT) and Integrated Structure (STRUCT), Performance measurement (MEASURE) and Information Exchange (INFOEX) together form the construct of Management By Fact (MGTBYFCT), with a Cronbach's alpha of .90. Continuous Improvement (CONTIMPR) is composed of the variables of Process Improvement (PROCESSIM) and Planning and Prevention (PREVEN), with an alpha of .83. Supply Chain Management 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 .88. All the reliability alphas of the six constructs indicated that they had good internal consistency.

The full Supply Chain Management Excellence (SCME) Model developed in the previous chapter is being looked at in two parts. The partial model (Fig. 8.1) relating Leadership directly to Management By Fact and the devotion to Continuous Improvement and these close linkages to Supply Chain Management Excellence had a chi-square χ^2 of 49.44 (d.f.=1) and a Comparative Fit Index (CFI) of .850 and a Normed Fit Index (NFI) of .849.

The other partial model (Fig. 8.2) relating leadership to Cooperative Relationship and Customer Focus and these close relationships to Supply Chain Management Excellence had a χ^2 of 10.46 (d.f. =1) and a CFI of .978 and a NFI of .976. Values for both the NFI and CFI range from zero to 1.00 and according to Bentler (1992), a value greater than .90 indicates an acceptable fit to the data. Therefore, the latter partial model, i.e. the relationship part of the model fits the data well. When it was compared with the former partial model, i.e. the linkages part of the model, it had a better fit. The CFI (.978) reflected a substantial improvement in model fit (Δ=.128).

The two partial models had been modified to look at the direct relationship between Leadership and Supply Chain Management Excellence without the moderating effect of the relationship and linkages factors. Results showed that the two respective direct models were not as good as the original two partial models. Modifications to the first partial model had an χ2 of 110.73 (d.f.=4) and a CFI of .669 and a NFI of .663 (Fig. 8.3). Modifications to the second model had a χ^2 of 202.435 (d.f.=4) and a CFI of .529and a NFI of .526 (Fig. 8.4). The two modified direct models did not fit the data well.

The two partial models were then combined again together to form the full Supply Chain Management Excellence (SCME) Model. It was then analysed as a whole. The SCME Model relates Leadership directly to Management By Fact, 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 in different aspects. The analysis in Table 8.3 showed that the model had a χ^2 of 5.627 (d.f.=1) and a Comparative Fit Index (CFI) of .993 and a Normed Fit Index (NFI) of .991. Since these indices are greater than .90, they indicate that the full SCME Model fits the data very well and it is also better than the two partial models.

Assessment of Parameter Estimates

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

In the SCME Model, nearly all the structural estimates are significant at 5% level, except SCM Excellence, Continuous Improvement which is significant at the 10% level. The results of *z* values using EQS programme are as follows:

Leadership, Customer focus (12.341)
Leadership, Cooperative relation (14.493)
Leadership, Management by Fact (7.583)
Leadership, Continuous Improvement (10.864)
SCM Excellence, Customer Focus (4.398)
SCM Excellence, Cooperative relation (6.086)
SCM Excellence, Management by Fact (2.158)
SCM Excellence, Continuous Improvement (1.791)

Path coefficients

The path coefficients (β) of the theorized SCME Model help to explore the findings more specifically (Table 8.3). Leadership had a significant impact on commitment to suppliers and customers, i.e. Customer Focus (β=.69, $p<.01$), on Cooperative Relationship with suppliers (β=.813, $p<.01$), on Management By Fact (β=.654, $p<.01$), and on Continuous Improvement (β=.739, $p<.01$). Customer Focus in turn had a significant impact on Supply Chain Management Excellence (β= .292, $p<.01$). Cooperative Relationship also had a significant impact on Supply Chain Management Excellence (β=.381, $p<.01$). Management By Fact had an impact on Supply Chain

Management Excellence (β=.107, p<.05). Besides, Continuous Improvement had an impact on Supply Chain Management Excellence (β= .113, p< .10). The path estimates are also shown in the SCME Model (figure 8.5). These findings on path coefficients provide good support for the theorised SCME Model. They along with the analysis of the structural equation models suggest that leadership would lead to customer focus, cooperative relationship, management by fact, continuous improvement that help companies achieve business excellence through supply chain management.

Table 8.3: *Structural Equation Analysis of the Supply Chain Management Excellence Model*

Structural Path	**Path estimates**
Leadership to Customer Focus	.690***
Leadership to Cooperative Relationship	.813***
Leadership to Management By Fact	.654***
Leadership to Continuous Improvement	.739***
Customer Focus to Supply Chain Management Excellence	.292***
Cooperative Relationship to Supply Chain Management Excellence	.381***
Management By Fact to Supply Chain Management Excellence	.107**
Continuous Improvement to Supply Chain Management Excellence	.113*
Model χ^2	5.627
Degree of freedom	1
Comparative Fit Index (CFI)	.993
Normed Fit Index (NFI)	.991

*p<.10
**p<.05
***p<.01

Figure 8.1 : *Partial Model 1 of the SCME Model (relating leadership to management by fact & continuous improvement and these constructs to Supply Chain Management Excellence)*

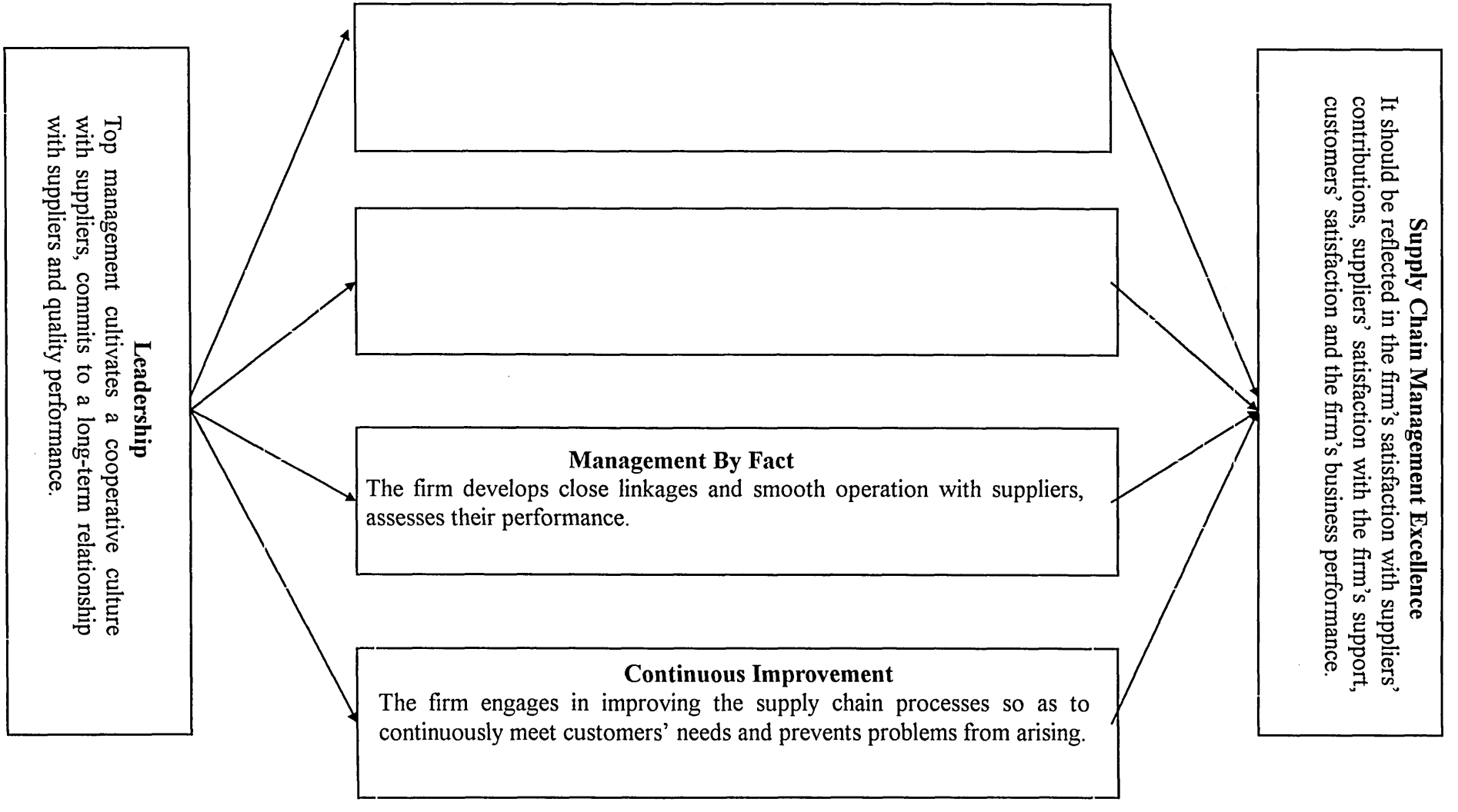


Figure 8.2 : *Partial Model 2 of the SCME Model (relating leadership to customer focus & cooperative relationship and these constructs to Supply Chain Management Excellence)*

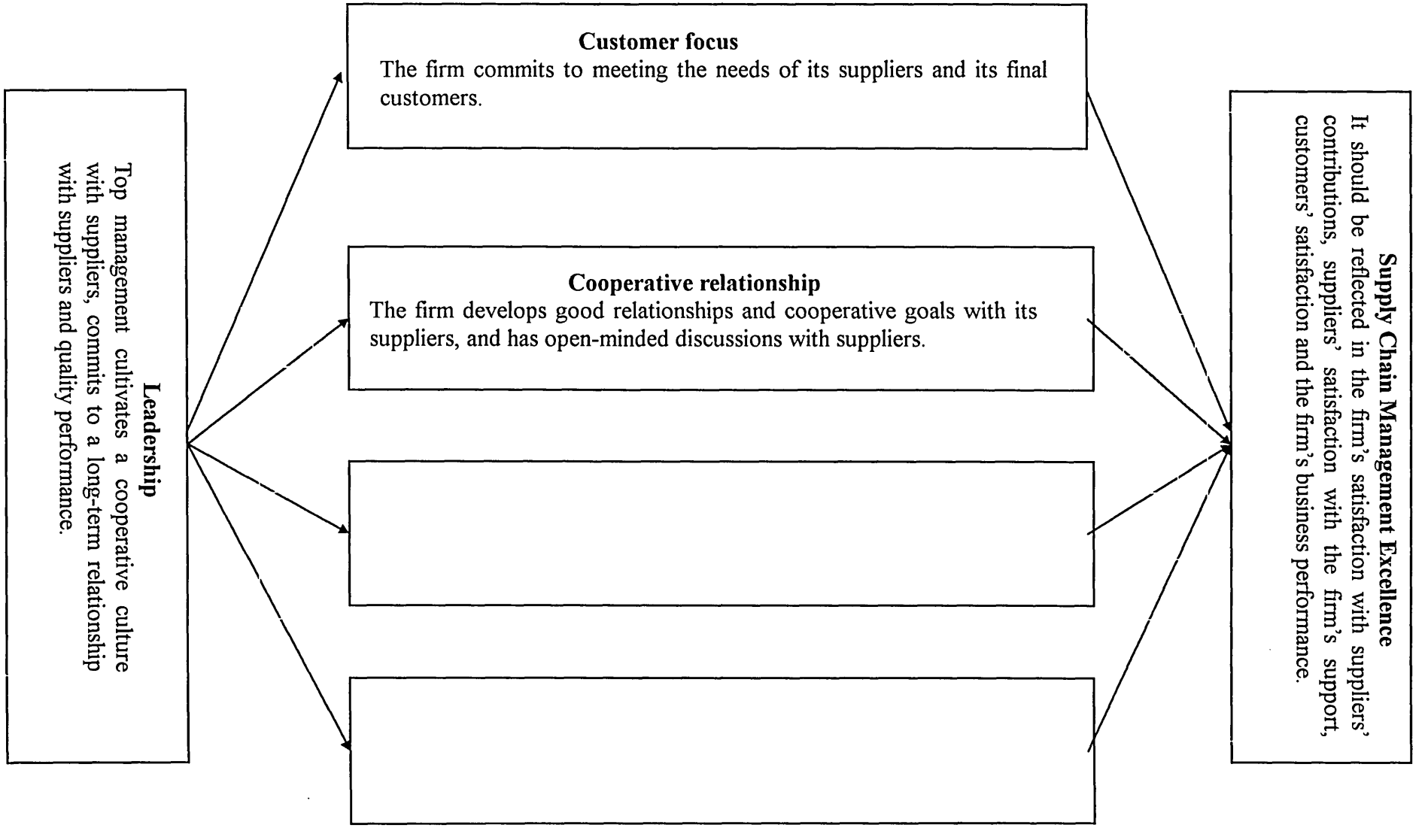


Figure 8.3 : *Direct Model 1 (relating leadership directly to Supply Chain Management Excellence without the mediating factors of management by fact & continuous improvement, i.e., the shaded parts are not considered)*

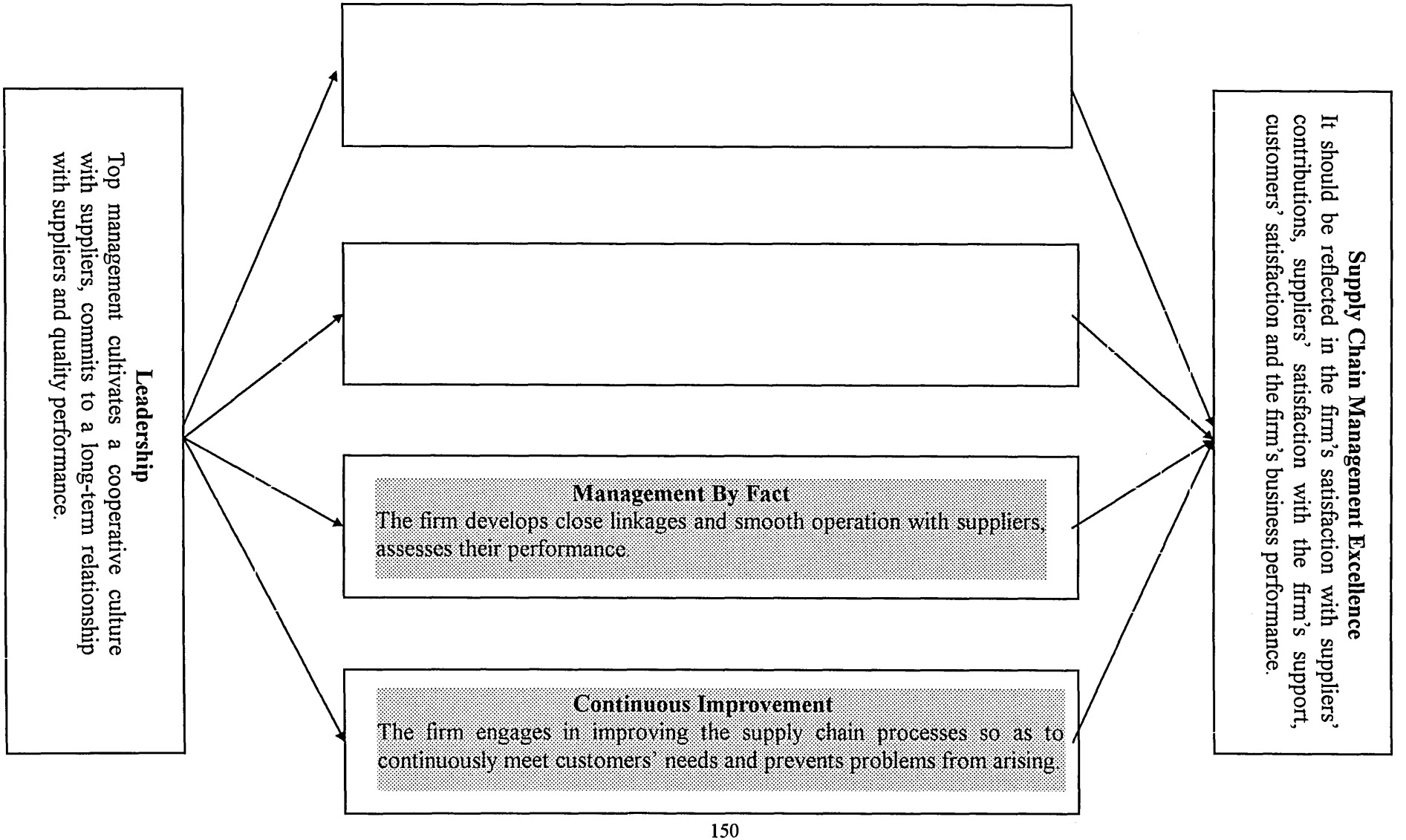


Figure 8.4 : *Direct Model 2 (relating leadership directly to Supply Chain Management Excellence without the mediating factors of customer focus & cooperative relationship, i.e., the shaded parts are not considered)*

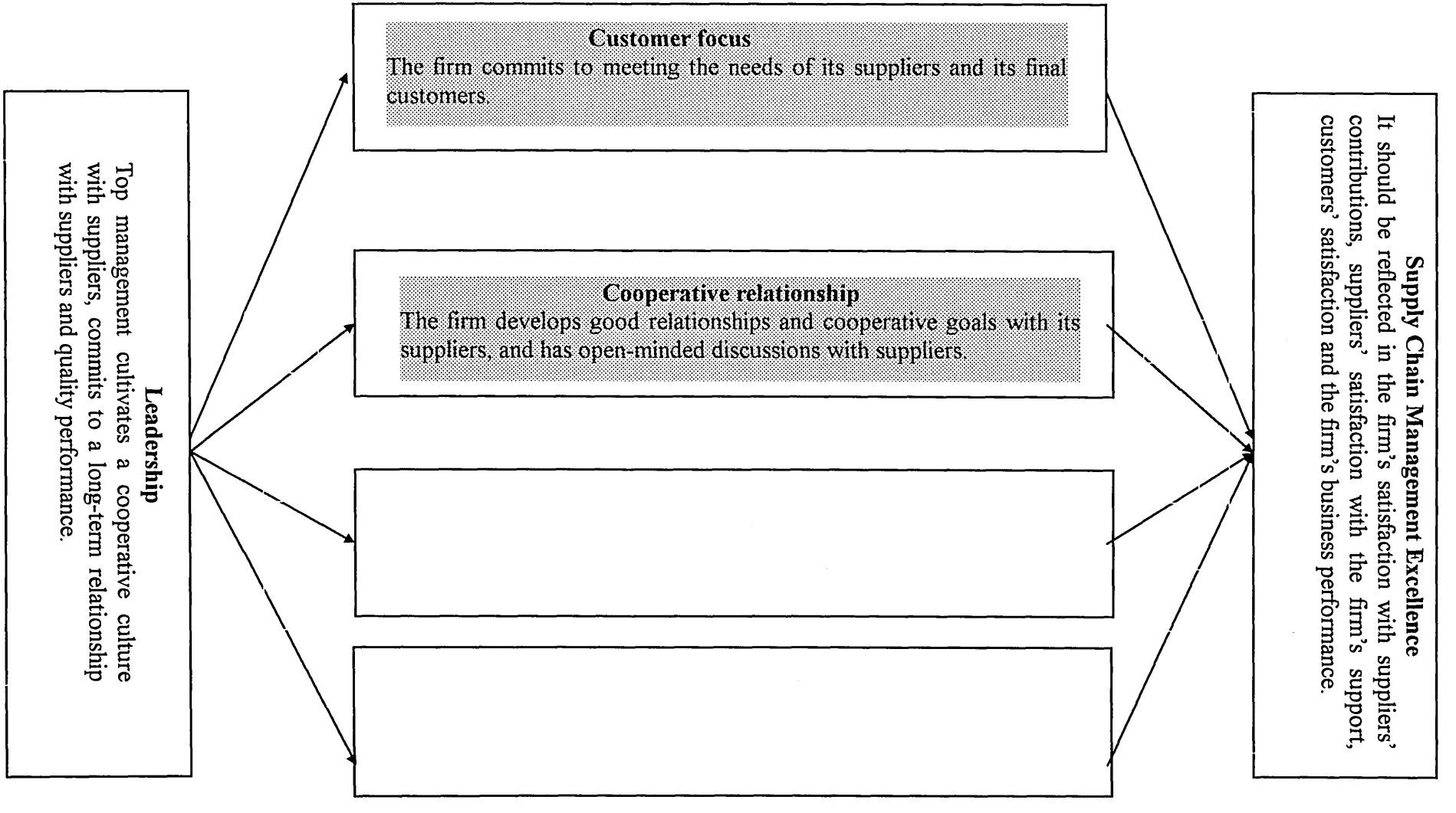
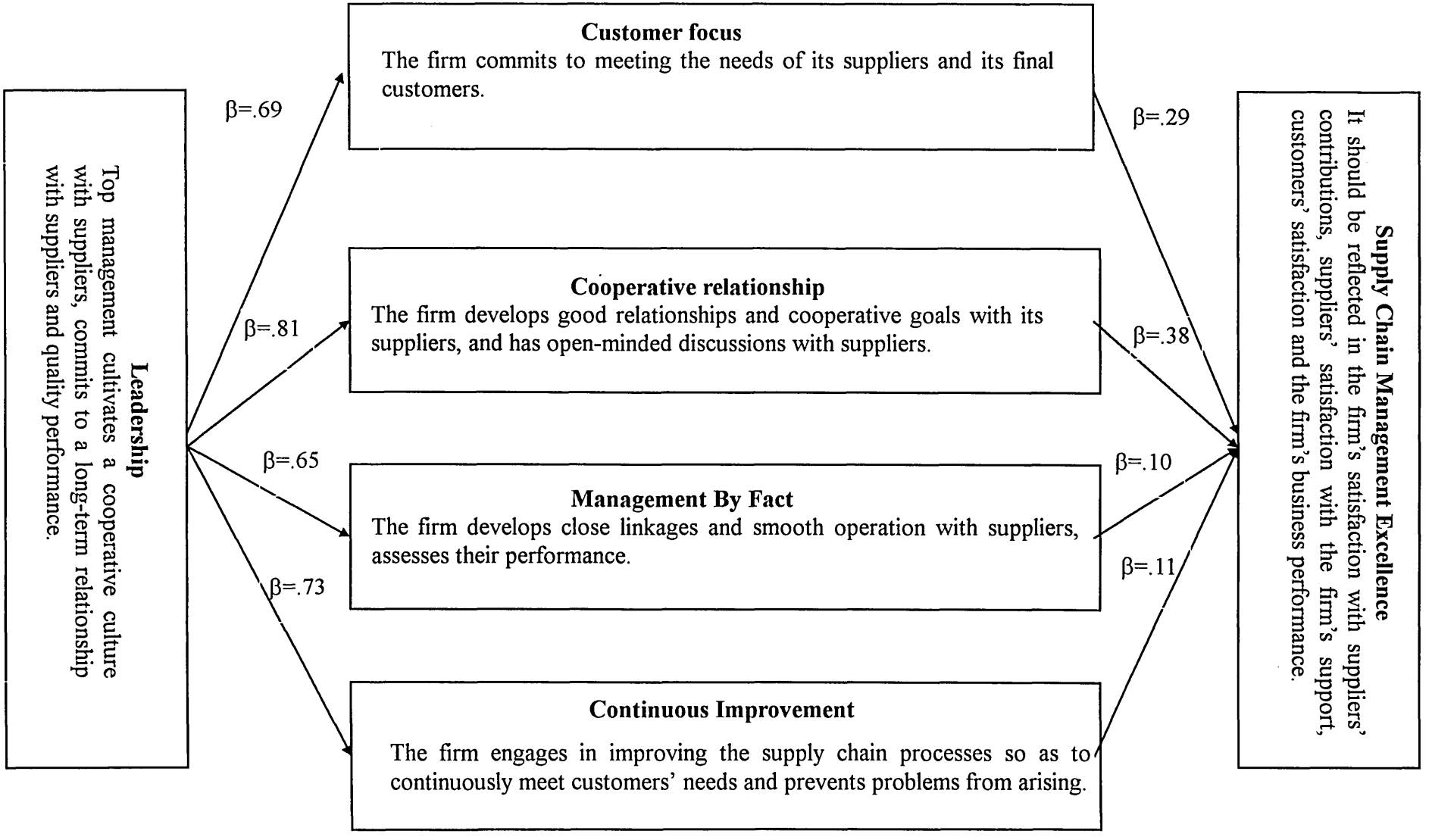


Figure 8.5 : *The Supply Chain Management Excellence Model (path estimates β are indicated in the diagram)*



8.4 DISCUSSION AND CONCLUSION

Results support the theorising that companies focusing on creating cooperative culture with suppliers and commitment to supplier relationship and quality, commit 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, evidence supports that companies that have 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 contribution to the companies which enables companies achieve Supply Chain Management 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 develop effective teamwork with its supply partners, i.e. through cooperative 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 more frequently exchanged, and more efforts 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 better serve its 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 doing their best on their end. Hence, developing cooperative relationship is much more important. The SCME Model also reflects that the "soft" factors i.e., Customer Focus (Customer) and Cooperative Relationship (Cooprela) have a more statistically significant relationship with Supply Chain Management Excellence than the "hard" factors, i.e. Management By Fact and Continuous Improvement.

Regarding the development of cooperative relationship, the Supply Chain Management Excellence Model has also made used of Deutsch's (1973) 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 affects interaction outcomes significantly because these perceptions affect their expectations and actions.

From the results, it confirms 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 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 help contribute to effective and productive relationships. The results have also the support from the findings of another study of the author (Wong et. al. 1999).

From structural analysis, the Supply Chain Management Excellence Model provides a good fit to the data. It implies that the causal relationships of the different constructs or the structure of the model should be valid. This SCME model is better than the existing SCM model because it does not show the causal relationships for the different constructs. Since the SCME Model has incorporated in it the success factors of the Total Quality Management principles and concepts, it can enable companies adopting

this Model to successfully manage and utilise the resources of its suppliers so as to achieve business excellence. Supply Chain Management Excellence (SCME) Index for companies' supply chain management can be further derived from the model using statistical methods. The SCME Index for companies' supply chain management will allow organisations to compare their Supply Chain Management performance against those of different organisations with whom they are competing. This is of particular benefit to organisations who are not doing as well as they might, as it will give them an incentive to do something about their failings.

CHAPTER 9

MEASURING SUPPLY CHAIN MANAGEMENT EXCELLENCE INDEX

9.1 INTRODUCTION

Since the last chapter has shown that the Supply Chain Management Excellence Model has a good fit with the data of the 139 companies, it implies that the model can very well describe the relationships between the different constructs of supply chain management and the performances of organisations' supply chains. Following Kanji's way of measuring the Business Excellence Index (BEI), this chapter uses the newly validated SCM model together with the Partial Least Squares (PLS) method to compute the Supply Chain Management Excellence (SCME) Index for the 139 companies. The PLS results of the 139 companies are outlined in this chapter.

9.2 KANJI'S BUSINESS EXCELLENCE MODEL AND BUSINESS EXCELLENCE INDEX

Kanji (1998) has developed a business excellence model based on his pyramid model. Kanji's Business Excellence Model has incorporated critical success factors of TQM and is a structural model that can be validated using suitable statistical techniques. A business excellence index can be calculated based on Kanji's model using the PLS technique. The index can be used to measure how well different areas of the organisations are performing. It allows direct comparison across each of the different areas, as well as compares the same business in different geographical areas. It also allows a particular business to be measured over time.

According to Kanji (1998), the index monitors a number of different areas which are all combined into the final calculations to present a single number between one and 100. It is this single number that represents a particular business score which makes comparison of business excellence so easy. Moreover, indices for each of the different

areas can also be reported separately. Kanji uses a sophisticated and extremely robust statistical method called latent variable partial least squares to calculate the BEI and the associated indices for different areas.

This study will adopt Kanji's approach in calculating the BEI to the calculation of the Supply Chain Management Excellence Index. Hence, the latent variable partial least squares method is used to produce the Supply Chain Management Excellence Index and the associated indices for the different areas of Supply Chain Management.

9.3 PARTIAL LEAST SQUARES METHOD

Fornell of the University of Michigan has pioneered the use of this PLS method in calculating Customer Satisfaction Index for Sweden (1992). Since then, the compilation of Customer Satisfaction Index has been spread to other countries in Europe and the States. This is the first time that this index method is applied to business to business level i.e. to assess companies' satisfaction with their suppliers, in Hong Kong.

Based on the Supply Chain Management Excellence Model, PLS estimates weights for the critical SCM success factors or SCM constructs that maximise their ability to explain Supply Chain Management Excellence as the ultimate endogenous or dependent variable. The estimated weights are used to compute indices for Supply Chain Management Excellence and other constructs of the SCME Model.

9.4 GENERAL DATA DESCRIPTION

There are 139 companies participating in the survey. These companies can be broken down into 50 large and 89 small companies. Moreover, they can also be classified according to their nature of business into 58 manufacturing companies and 81 non-manufacturing companies which are mainly importers, exporters, and wholesalers. For those manufacturing companies, they are usually large in size and the biggest one has employees over 6000. Their plants are mainly located in China, while maintaining only a small operation in Hong Kong. On the other hand, the non-manufacturing companies are usually small in size. The number of years the respondents worked in their organisations and worked with their suppliers indicate that they should have a deep understanding of the organisations they work for and the suppliers they work with.

Table 9.1: *A Summary of the information of the participants in the survey*

Sample:	**Companies in Hong Kong**
Number of companies:	139 (50 large companies; 89 small and medium companies; 58 manufacturing companies; 81 non-manufacturing companies)
Number of respondents:	139
Size of company:	from 3 employees to over 6000 employees
Av. no. of years respondents worked in their organisations:	7.16 years
Av. no. of years respondents worked with the suppliers:	5.69 years

9.5 PARTIAL LEAST SQUARES RESULTS FOR THE 139 COMPANIES

The results of the means, x_is, and the weights, w_is, of Manifest Variables for each critical success factor and Supply Chain Management excellence and the resulting indices for the 139 companies are shown in the following tables.

Table 9.2a: *Weights (Structural Parameters), w_is of Manifest Variables for Each Critical Success Factor and Supply Chain Management Excellence for the 139 companies*

Code	Critical Success Factors (items in questionnaire)	1	2	3	4	5	6	w_i
A.	Leadership (I; II)	.4741739	.6065336					1.0807075
B.	Customer Focus (V.3,4)	.5589771	.5424195					1.1013966
C.	Cooperative Relationship (VI;VII; VIII)	.2685542	.6145333	.2531271				1.1362146
D.	Management By Fact (X; XII)	.6958889	.4021478					1.0980367
E.	Continuous Improvement (XIII. 2,3,4; XIV.2,3,4)	.2470109	.2308701	.1553668	.3254613	.1486315	.3318983	1.4392389
F.	SCM Excellence (XV; XVI; XVII; XVIII)	.4096178	.391029	.2900155	.2259876			1.3166499

Table 9.2b: *Means, x_is, of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for the 139 companies*

Code	Critical Success Factors	1	2	3	4	5	6
A.	Leadership	3.958	4.185				
B.	Customer Focus	4.194	4.287				
C.	Cooperative Relationship	4.014	3.908	3.904			
D.	Management By Fact	3.559	3.524				
E.	Continuous Improvement	3.539	3.769	3.733	3.41	3.762	3.892
F.	SCM Excellence	3.892	3.867	3.83	3.705		

Table 9.3a: *Weights (Structural Parameters), w_is of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for large companies.*

Code	Critical Success Factors (Items in questionnaire)	1	2	3	4	w_i
A.	Leadership (I; II; III)	.3771429	.2609889	.5642896		1.2024214
B.	Customer Focus (IV.2, 4; V.1)	.5094613	.411623	.3141261		1.2352104
C.	Cooperative Relationship (VII; VIII)	.5961806	.4795416			1.0757222
D.	Management By Fact (X; XII)	.4951887	.5941683			1.089357
E.	Continuous Improvement (XIII.3, 4; XIV.2, 4)	.3227986	.2542012	.1947247	.4440207	1.2157452
F.	SCM Excellence (XV; XVI; XVII; XVIII)	.2847276	.382817	.3735294	.2418237	1.2828977

Table 9.3b: *Means, x_is, of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for large companies.*

Code	Critical Success Factors	1	2	3	4	
A.	Leadership	3.87	4.095	4.12		
B.	Customer Focus	4.38	4.66	4.26		
C.	Cooperative Relationship	4	3.89			
D.	Management By Fact	3.715	3.575			
E.	Continuous Improvement	3.8	3.88	3.38	4.1	
F.	SCM Excellence	3.885	3.94	3.895	3.87	

Table 9.4a: *Weights (Structural Parameters), w_is of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for small and medium companies.*

Code	Critical Success Factors (Items in questionnaire)	1	2	3	4	5	6	w_i
A.	Leadership (I; II)	.4744756	.6271173					1.1015929
B.	Customer Focus (V.3, 4)	.5066744	.5951449					1.1018193
C.	Cooperative Relationship (VI; VII; VIII)	.4903929	.4119633	.3246164				1.2269726
D.	Management By Fact (X; XII)	.6066532	.4868543					1.0935075
E.	Continuous Improvement (XIII. 2,3,4; XIV. 2,3,4)	.2446284	.1526424	.1059401	.3872218	.3259785	.1946804	1.4110916
F.	SCM Excellence (XV;XVI; XVII; XVIII)	.4589329	.3580556	.2619687	.2559125			1.3348697

Table 9.4b: *Means, x_is, of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for small and medium companies.*

Code	Critical Success Factors	1	2	3	4	5	6
A.	Leadership	3.997	4.255				
B.	Customer Focus	4.067	4.19				
C.	Cooperative Relationship	3.989	4.174	3.862			
D.	Management By Fact	3.438	3.437				
E.	Continuous Improvement	3.528	3.741	3.662	3.359	3.707	3.842
F.	SCM Excellence	3.797	3.826	3.794	3.612		

Table 9.5a: *Weights (Structural Parameters), w_is of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for manufacturing companies.*

Code	Critical Success Factors (Items in questionnaire)	1	2	3	4	w_i
A.	Leadership (I; II)	.3520206	.7157361			1.0677567
B.	Customer Focus (V.3, 4)	.6990074	.3358103			1.0348177
C.	Cooperative Relationship (VII; VIII)	.7217029	.3310096			1.0527125
D.	Management By Fact (X; XII)	.696841	.3719379			1.0687789
E.	Continuous Improvement (XIII. 2,3; XIV. 2,4)	.2688659	.4882052	.2307812	.2985451	1.2863974
F.	SCM Excellence (XV;XVI; XVII; XVIII)	,379995	.4241939	.3152388	.2035362	1.3229639

Table 9.5b: *Means, x_is, of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for manufacturing companies.*

Code	Critical Success Factors	1	2	3	4	
A.	Leadership	3.956	4.193			
B.	Customer Focus	4.396	4.396			
C.	Cooperative Relationship	3.918	4.025			
D.	Management By Fact	3.59	3.607			
E.	Continuous Improvement	3.637	3.844	3.448	3.965	
F.	SCM Excellence	3.857	3.875	3.943	3.706	

Table 9.6a: *Weights (Structural Parameters), w_is of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for non-manufacturing companies*

Code	Critical Success Factors (Items in questionnaire)	1	2	3	4	w_i
A.	Leadership (I; II)	.362042	.7025298			1.0645718
B.	Customer Focus (V.3, 4)	.3621435	.7032126			1.0653561
C.	Cooperative Relationship (VI; VII)	.4108001	.6521149			1.062915
D.	Management By Fact (X; XII)	.6466627	.4661337			1.1127964
E.	Continuous Improvement (XIII. 2; XIV. 2,3,4)	.1719614	.2767055	.4268535	.4265525	1.3020729
F.	SCM Excellence (XV; XVI; XVII; XVIII)	.4402092	.3603539	.2730342	.2272312	1.3008285

Table 9.6b: *Means, x_is, of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence for non-manufacturing companies.*

Code	Critical Success Factors	1	2	3	4	
A.	Leadership	3.966	4.191			
B.	Customer Focus	4.197	4.135			
C.	Cooperative Relationship	4.038	3.851			
D.	Management By Fact	3.444	3.483			
E.	Continuous Improvement	3.58	3.419	3.728	3.876	
F.	SCM Excellence	3.808	3.862	3.759	3.712	

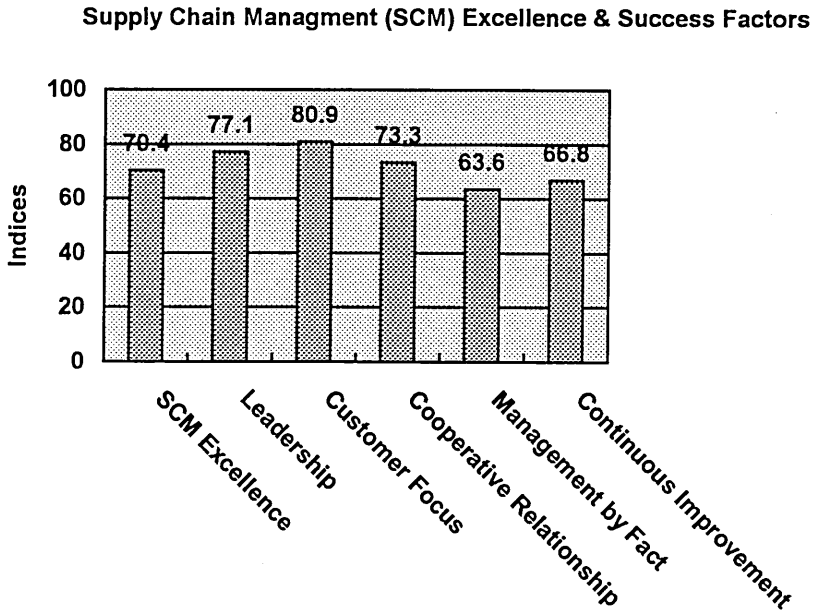
Table 9.7: *A Summary of the indices of the 139 companies*

	All Cos. (139)	Large Cos. (50)	Small Cos. (89)	Manufacturers(58)	Non-Manufacturers(81)
A. Leadership	77.13	75.9	78.59	77.87	77.86
B. Customer Focus	80.99	86.06	78.33	84.9	78.9
C. Cooperative Relation	73.3	73.77	75.43	73.79	73.08
D. Management by Fact	63.65	65.96	60.93	64.89	61.5
E. Continuous Improvement	66.8	71.47	64.98	68.94	67.28
F. SCM Excellence	70.48	72.53	69.21	71.5	69.89

9.5.1 Indices for the 139 companies (see figure 9.1)

The Supply Chain Management Excellence (SCME) Indices for the 139 companies, including large, and small and medium companies, and manufacturing and non-manufacturing companies are given in Table 9.7. The overall Supply Chain Management Excellence (SCME) Index for all the companies is 70.48 which indicates that the companies' overall score on their supply chain performance is satisfactory. Looking at the different elements of the Supply Chain Management Excellence Model, the companies have performed better in Customer Focus, Leadership and Cooperative Relationship with indices of 80.99, 77.13 and 73.3 respectively. On the other hand, the companies have not performed very well in Management by Fact and Continuous Improvement. Indices for these factors are 63.65 and 66.8 respectively. Therefore, these companies should focus more on these two success factors of the SCME Model in order to improve the overall Supply Chain Management Excellence Index.

Figure 9.1: *Indices for Supply Chain Management Excellence & Success Factors for the 139 companies*



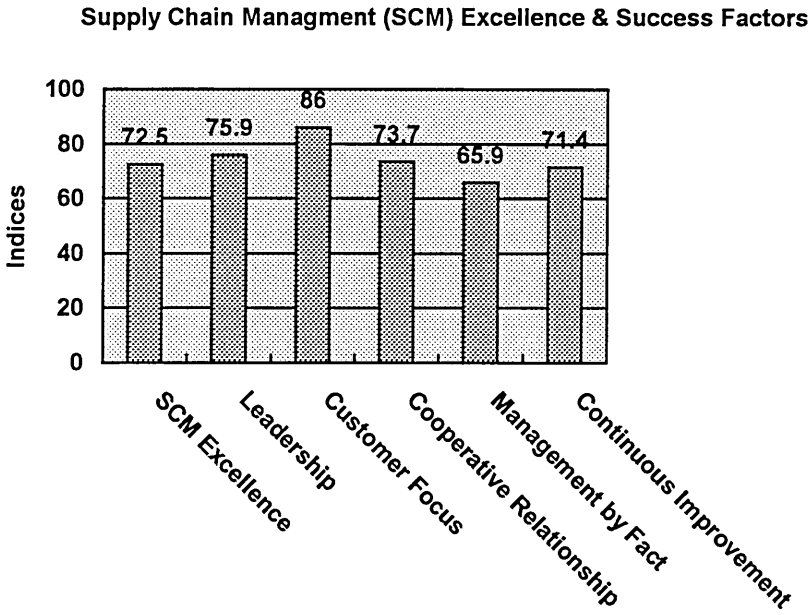
9.5.2 Indices for large companies (see Figure 9.2)

Since the 139 companies consist of both large and small and medium companies, there may be differences in their supply chain performances. In order to find out the differences in supply chain performances between large and small and medium companies, the 139 companies are divided into two categories, i.e. 50 large companies and 89 small and medium companies and indices are calculated for these two groups of companies. According to Industry Department (Industry Department, what_are_smes.htm), "in Hong Kong, manufacturing enterprises employing fewer than 100 persons, and enterprises in other sectors employing fewer than 50 persons are regarded as small and medium enterprises (SMEs)".

The Supply Chain Management Excellence Index for those large companies is better than the small and medium companies, which are 72.53 and 69.21 respectively. The indices for the large companies on the success factors of Customer Focus, Management By Fact, and Continuous Improvement are 86.06, 65.96 and 71.47 respectively. All of them are higher than the respective indices of the small companies which are 78.33, 60.93 and 64.98. The indices of the large companies are in the same

order as the indices of all the companies, i.e. from the highest index of Customer Focus, then Leadership, Cooperative Relationship, Continuous Improvement to the lowest index of Management By Fact. The lowest index i.e. Management By Fact is 65.96 which still seems to be satisfactory. Overall speaking, the large companies are performing satisfactorily in the different success factors of supply chain management and this has enabled the large companies to have higher Supply Chain Management Excellence Index.

Figure 9.2: *Indices for Supply Chain Management Excellence & Success Factors for the large companies*

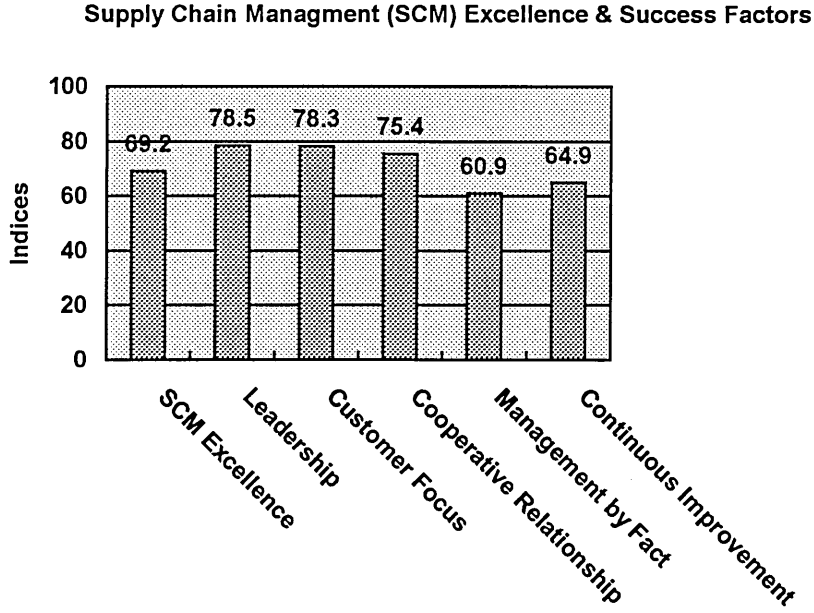


9.5.3 Indices for small and medium companies (see Figure 9.3)

On the other hand, the small and medium companies have higher indices than large companies on Leadership and Cooperative Relationship, i.e. 78.59 and 75.43 versus 75.9 and 73.77 of the large companies. The small companies have the highest index on Leadership, follows by Customer Focus. The rest of the indices are in the same order as the large companies. The small companies are relatively weaker when compared with large companies on Management By Fact and Continuous Improvement. The success factor, Management By Fact has the lowest index, i.e., 60.93 which seems to be not so satisfactory. The second lowest index, i.e. for Continuous Improvement is 64.98.

Although it seems to be satisfactory, it is more than 6 points less than that of the large companies, i.e., 71.47. Therefore, there is room for improvement in these two success factors for the small companies. The weaknesses in these two factors may also account for the lower Supply Chain Management Excellence Index of the small and medium companies.

Figure 9.3: *Indices for Supply Chain Management Excellence & Success Factors for the small & medium companies*



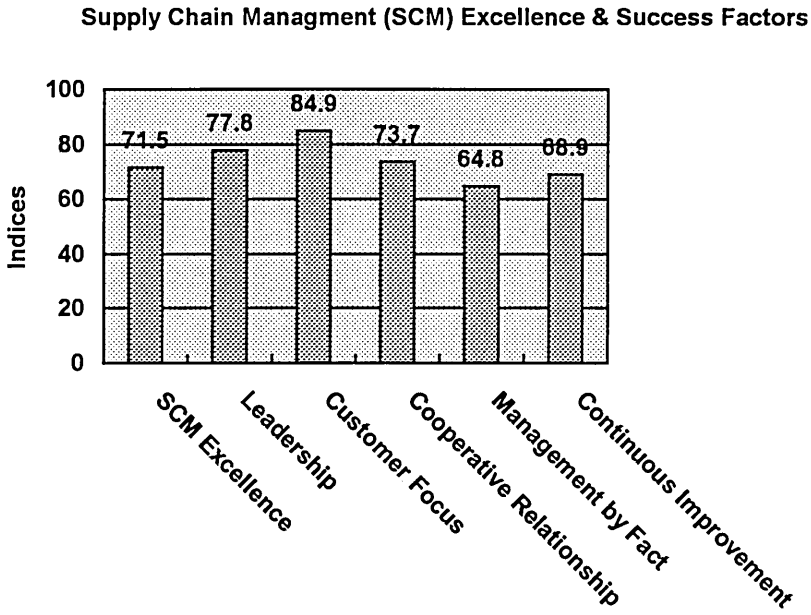
9.5.4 Indices for Manufacturing Companies (see Figure 9.4)

The 139 companies can also be separated into 58 manufacturing companies and 81 non-manufacturing companies. For the non-manufacturing companies, they consist of trading companies, wholesalers, and importers and exporters. All of them are involved in purchasing goods for resale purposes. Of the 58 manufacturing companies, 34 of them are large companies which are more than half of the total number of manufacturing companies. Hence, the indices of the manufacturing companies should be more in line with the large companies than the non-manufacturing companies.

In fact, the results support this reasoning. The manufacturing companies have a higher Supply Chain Management Excellence Index than the non-manufacturing

companies, i.e., 71.5 versus 69.89. Moreover, the indices for all of the different success factors for the manufacturing companies are better than those of the non-manufacturing companies. The order for the different indices for both manufacturing and non-manufacturing companies is the same and it also equals to the order of both the large companies and the overall 139 companies. Of the five critical success factors, the manufacturing companies perform much better than the non-manufacturing companies in Customer Focus and Management By Fact. There is a big difference of 6 points in the index of Customer Focus for manufacturing and non-manufacturing companies, i.e., 84.9 versus 78.9. For Management By Fact, there is also a difference of more than 3 points, i.e., 64.89 versus 61.5.

Figure 9.4: *Indices for Supply Chain Management Excellence & Success Factors for the manufacturing companies*

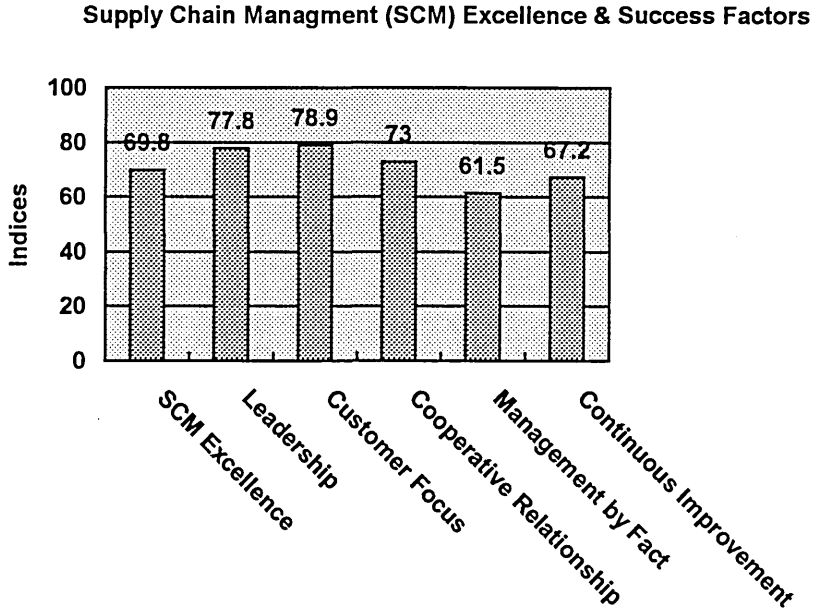


9.5.5 Indices for Non-Manufacturing Companies (see Figure 9.5)

Of the 81 non-manufacturing companies, most of them are small and medium companies. Hence, they should have performance more or less equal to the performance of the small and medium companies.

The results show that the non-manufacturing companies have lower indices than the manufacturing companies and their indices are similar to that of the small and medium companies. Moreover, they are especially weak in Management By Fact and Continuous Improvement with the indices of 61.5 and 67.28 respectively.

Figure 9.5: *Indices for Supply Chain Management Excellence & Success Factors for the non-manufacturing companies*



9.6 DISCUSSION ON THE INDICES OF THE 139 COMPANIES

As pointed out in previous chapter, the SCME Model is composed of the soft and hard factors. Judging from the indices of the companies, the soft factors, i.e., leadership, customer focus and cooperative relationship are all being well taken care of by the companies, no matter they are large or small, manufacturing or non-manufacturing

companies. However, for the hard factors, i.e. Management By Fact and Continuous Improvement, the companies are not doing so well. This shows that the companies are in general aware of the importance of having good relationship with the suppliers, but there are still rooms for improvement by them in the daily operations and linkages with the suppliers. In fact, having good relationship is not enough. In order to get the most from the suppliers, companies have to put the good relationship into work through developing seamless operation and close linkages, having frequent information exchanges with suppliers and helping suppliers to improve performances. So, instead of just "Talk the Talk", companies should also "Walk the Talk".

Regarding the differences in the indices of the large and small and medium companies, it is reasonable that large companies have a higher Supply Chain Excellence Index than the small and medium companies because the large companies should have more competitive advantages. That the large companies have done better in customer focus may be because they have more resources that allow them to commit to the needs of customers and suppliers. In order to grow to a large company, a company needs to develop its systems and streamline its operations. Therefore, it is explainable that the large companies should have done better in Management By Fact, which includes having a smoother operation and a closer linkage with suppliers; having more frequent information exchanges with suppliers; and having a more objective performance measurement on its suppliers. To sustain one's competitive advantages, a company needs to continuously improve. This can explain why large companies have also done better in Continuous Improvement.

On the other hand, because small companies have fewer employees and less hierarchical levels, the roles of the top management in the small and medium companies are more visible than the big companies. This explains why the small companies have a higher index on Leadership. Moreover, because small companies have less resources, they will more likely depend on their suppliers for their requirements, therefore, they tend to pay more attention on cultivating a cooperative relationship with their suppliers. This leads to the result that small and medium companies have a higher index on cooperative relationship with suppliers.

The reason for large companies having higher Supply Chain Management Excellence Index may be that they are more committed to satisfying their customers and their suppliers. This may help the companies achieve higher customer satisfaction and supplier satisfaction. They are reflected in the Supply Chain Management Excellence Index which measures customers', and suppliers' satisfaction simultaneously. Besides, their performances in all the other aspects are also satisfactory, though they do not have as high indices as the small companies on Leadership and Cooperative Relationship. Conversely, the small companies are particularly weak in Management By Fact and Continuous Improvement.

The reason that manufacturing companies have done much better in Customer Focus may be because they have to produce goods according to the requirements of their customers, therefore, they tend to be more customer focused. Moreover, they will also want their suppliers to be satisfied with the relationship with them so as to get their full support in meeting customers' needs. The manufacturing companies have also performed better than the non-manufacturing companies in Management By Fact. It is because the manufacturing companies have to schedule incoming materials from suppliers to fit with their own production schedules, and control the quality of the material inputs. Thus, they would need to manage their operations with the suppliers more closely and base on more updated information in managing their suppliers.

9.7 CAUSAL RELATIONSHIP BETWEEN SUCCESS FACTORS AND SUPPLY CHAIN MANAGEMENT EXCELLENCE FOR THE 139 COMPANIES

Apart from the indices, the PLS method also generates a number of other statistics. Inner coefficients or structural parameters are the coefficients of functional equations linking latent variables. These values reflect the strengths of causal relationships between latent variables. Specifically, each structural parameter reflects the amount of change in an effect (endogenous variable) that results from a unit of change in a cause (exogenous variable or preceding endogenous variable).

Another statistic generated by PLS method is Coefficient of Determination R^2. It represents the proportion of regression sum of squares for corresponding latent variables

that is explained by the regression model. It explains the proportion of the total variation that is explained by the cause variable.

Figure 9.6 shows the SCME Model with the inner coefficient values and the R^2 values for the data sets of the 139 companies, the large companies and the small and medium companies. While figure 9.7 outlines the same two statistics for the data sets of the manufacturing companies and the non-manufacturing companies. The path coefficients that are shown on the figures, i.e. the numbers on the lines, indicate the amount of influence a change of one unit in a latent variable's value would have on the next. For instance, in figure 9.6, the path bearing on supply chain business excellence from continuous improvement for the large companies is 0.39. It means that a `1' - point increase in the cause variable, i.e. continuous improvement, would lead to a '0.39'-point increase in the effect variable, i.e., supply chain business excellence.

The R^2 values (the number above a latent variable) for Supply Chain Management Excellence for the different data sets range from 0.62 to 0.68. The results indicate that the SCME Model can explain from 62 % to 68% of the variation of Supply Chain Management Excellence in different data sets. So, three of them exceed the requirements of the ECSI Technical Committee, i.e. a minimum value of 65% (ECSI Technical Committee, 1998, p. 20) and two of them are very near to the requirement.

9.8 DISCUSSION ON THE CAUSAL RELATIONSHIPS

From figure 9.6 and figure 9.7, it can be observed that the SCM success factor, `Leadership', has strong influence on the other four success factors for all the data sets. The relevant inner coefficients or the path estimates range from .45 to .79 among the different data sets indicating the degree of strong influence. It is reasonable because `Leadership' concerns with the setting of policy and strategies towards the supply chain, hence, it will strongly affect the four SCM success factors which drive the relations and operations of the supply chain.

Among the other four success factors, "Cooperative Relationship" has the strongest influence on Supply Chain Business Excellence with inner coefficients ranging from .16 to .57. Since this success factor concerns with developing cooperative relationships with suppliers through cooperative goals and open-minded discussion, therefore, the suppliers should be satisfied with the relationships and they in turn would

be more willing to help companies meet the needs of their customers and hence achieve Supply Chain Management Excellence. All these outcomes are reflected in the effect variable, "Supply Chain Management Excellence". So, "Cooperative Relationship" should have a strong causal relationship with the effect variable. On the other hand, "Customer Focus" has the weakest influence on the effect variable of "Supply Chain Management Excellence", with inner coefficients ranging from .04 to .14. It can be explained by the fact that all kinds of companies do want to satisfy the needs of the customers and suppliers, however, whether they are actually satisfied or not depends more on the relations and operations they have with the companies. Hence, the influence of "Customer Focus" on the effect variable is not so strong as others.

In general, for both large companies and manufacturing companies, the success factors, "Continuous Improvement" and "Management by Fact" which drive smooth operation with suppliers, together have even stronger influence than the success factor of "Cooperative Relationship" on the effect variable i.e. .50 (.39 & .11) for the large companies and .71 (.32 &.39) for the manufacturing companies for the two operational success factors versus .28 for the large companies and .16 for the manufacturing companies for the relationship success factor. It may be due to the fact that for both large and manufacturing companies, they tend to put more emphasis on structuring and smoothening the operations of the supply chain than on building cooperative relationships. On the other hand, for the small and medium, and non-manufacturing companies, the success factor of "Cooperative Relationship" has a stronger influence than the two operational success factors on the effect variable, i.e. "Supply Chain Management Excellence". This may be due to the fact that for the small companies, they tend to rely more on their suppliers to build up their competitiveness for they do not have so much resource as the large companies. Regarding the non-manufacturing companies, they tend to be not so much influenced by the operational success factors than the manufacturing companies because their nature of business do not require so much sequencing of work between them and their suppliers.

9.9 CONCLUSION

This chapter has shown that the Supply Chain Management Excellence Model can be used to assess the supply chain performances of the 139 companies. It also has

successfully made use of the Partial Least Squares Method to calculate the Supply Chain Management Excellence Indices for the 139 companies. In the chapter, the 139 companies are further classified into four different data sets, i.e. data sets for large companies and small and medium companies, manufacturing and non-manufacturing companies. The data sets show that most of the manufacturing companies are large companies and most of the non-manufacturing companies are small and medium companies. The Supply Chain Management Excellence Indices of the five data sets, ranging from 69.2 to 72.5 indicate that the supply chain performance as a whole is rather satisfactory. However, in general, performance in Management By Fact and Continuous Improvement are less satisfactory than the other success factors. Some other general findings are that the indices of the large companies are similar to the manufacturing companies while the indices of the small companies are on the other hand similar to the non-manufacturing companies.

Regarding the causal relationships among the success factors in the different data sets, Leadership has a strong influence on the other four success factors. In turn, these four success factors, i.e. Customer Focus, Cooperative Relationship, Management by Fact and Continuous Improvement also have strong influence on Supply Chain Management Excellence. The R^2 values of different data sets ranging from .62 to .68 suggest that the four success factors can explain very well the variation in Supply Chain Management Excellence. However, different success factors do have different causal relationships with the effect variable. In general, Cooperative Relationship has the strongest relationship, but Customer Focus has the weakest relationship.

Although the PLS results for the 139 companies are meant for different groups of companies, they can still serve as some benchmarks for individual companies or for future assessment exercises by the same group of companies. The next chapter will further validate the model and the PLS method at the company level.

Figure 9.6 : *How the inner coefficients and R^2 values for the 139 companies, the large companies and the small companies map to the SCME Model*

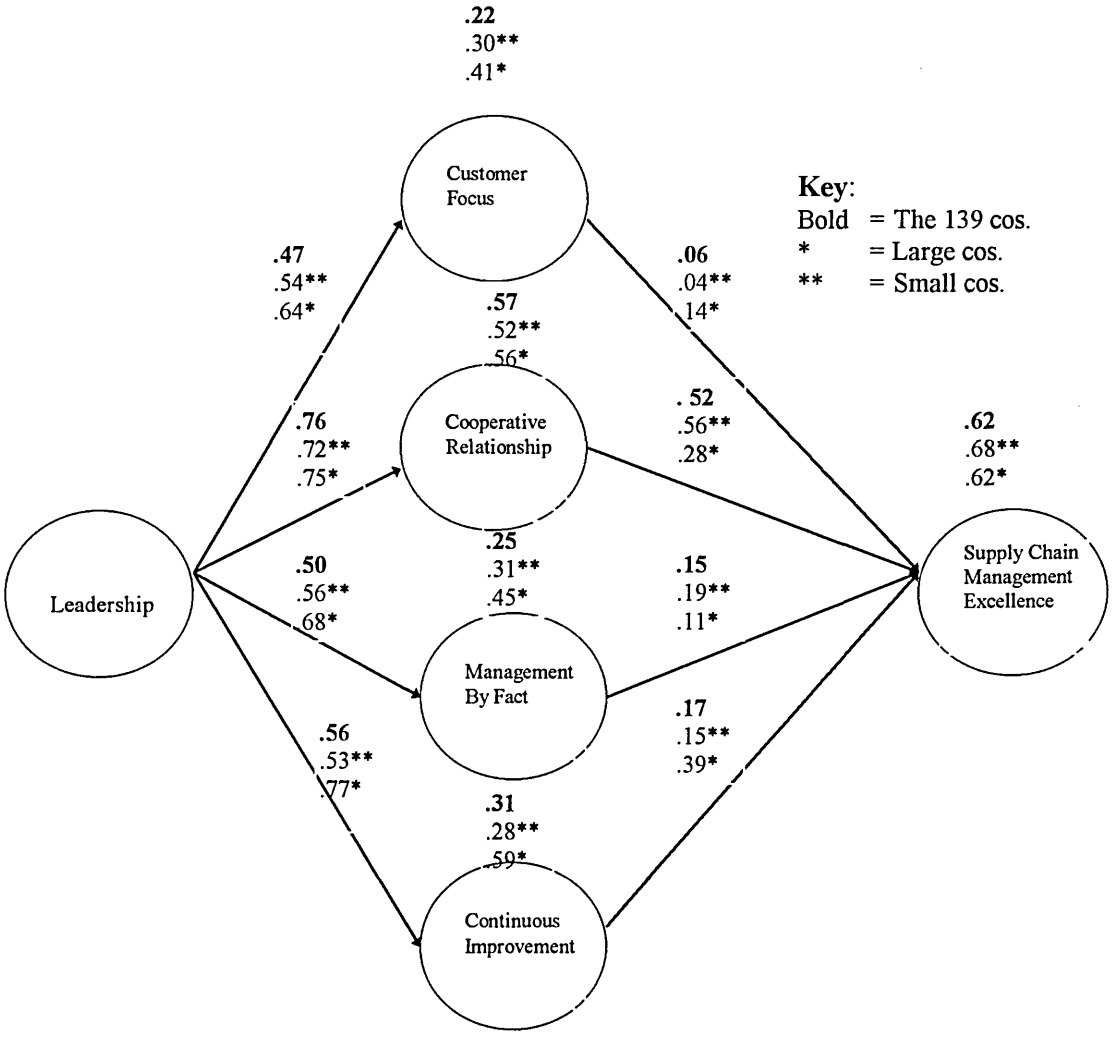
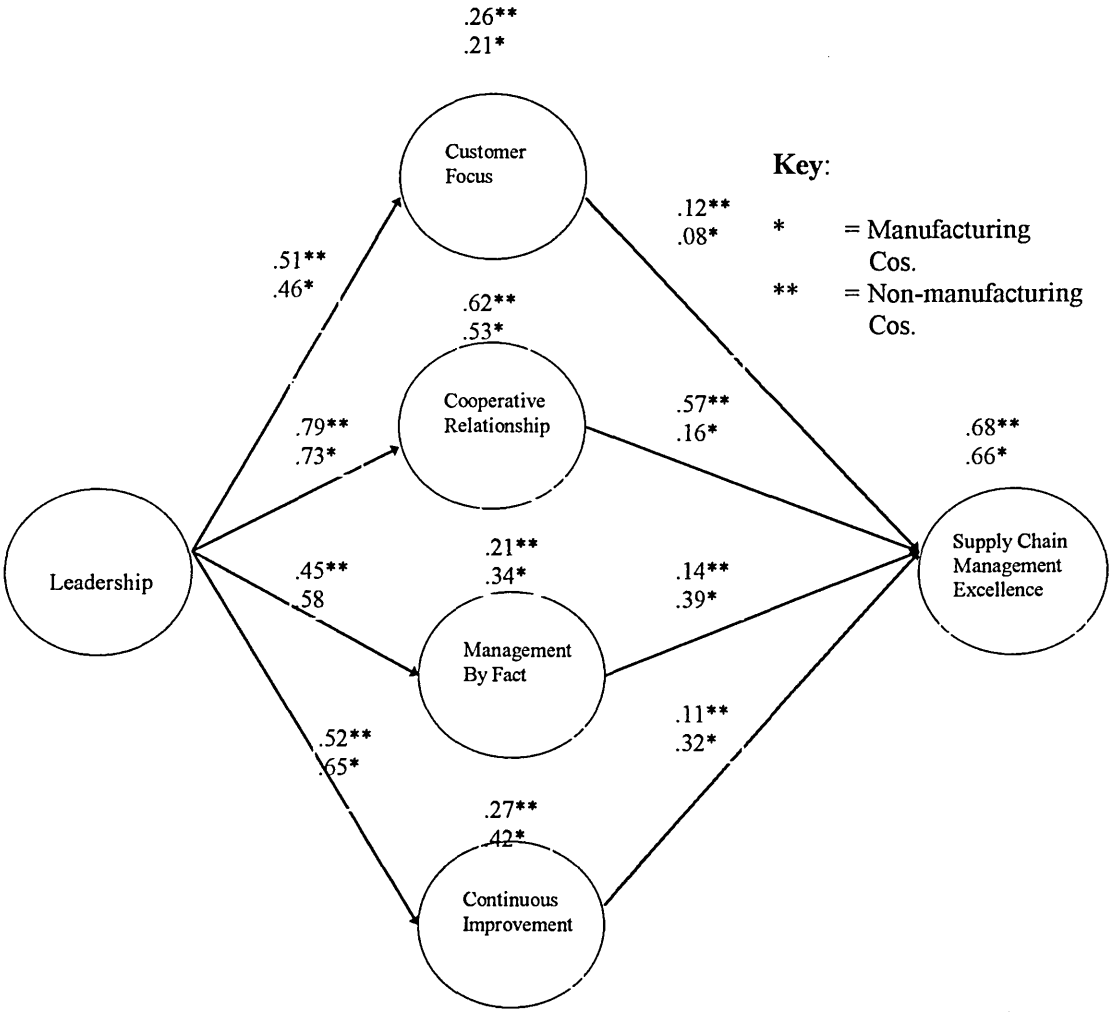


Figure 9.7: *How the inner coefficients and R^2 values for the manufacturing and the non-manufacturing companies map to the SCME Model*



CHAPTER 10
CASE STUDIES ON THE SUPPLY CHAIN MANAGEMENT EXCELLENCE MODEL

10.1 INTRODUCTION

The previous chapter applies the PLS method to measure the Supply Chain Management Excellence Indices for the 139 companies. The Supply Chain Management Excellence Model and the PLS method have also been shown in the previous chapter to work at the industry level. In order to further validate the use of the Supply Chain Management Excellence Model and the PLS method, they are then applied to the company level. A large construction company is selected for the exercise and the results are reported in this chapter. Moreover, the second part of this chapter also elaborates on the validity of the success factors of the SCME Model through discussing some critical incidents of selected companies.

10.2 VALIDATION OF THE SUPPLY CHAIN MANAGEMENT EXCELLENCE MODEL AT THE COMPANY LEVEL: THE CASE OF A LARGE CONSTRUCTION COMPANY IN HONG KONG

To further validate the Supply Chain Management Excellence Model at the company level, the same questionnaire is administered to all the staff of the contracts department of a large construction firm. This department is responsible for managing the company's suppliers and subcontractors. There are a senior manager, an assistant manager, four officers and eleven assistants in the department. With the exception of the senior manager, each of the staff in the department was asked to fill in questionnaires for three most important suppliers or subcontractors that each of them deals with. The senior manager has helped to coordinate the suppliers or subcontractors that each of his staff reports on so that no supplier or subcontractor will be reported by more than one

staff. Hence, a larger number of suppliers or subcontractors have been reported by having each staff reports on his/her unique suppliers or subcontractors. The staff were given two weeks' time to fill in the questionnaires. At the end, all of the sixteen staff have each filled in three questionnaires for three suppliers or subcontractors. Altogether, questionnaires were filled in for forty-eight most important suppliers or subcontractors which should be rather representative of the supply chain situation of the company.

10.2.1 Background of the construction company

The construction company was established in late 1970s. Since then, it has grown from a small company of a few staff to a large company of about fifteen thousand staff. Its major focus is in building works instead of civil engineering works and it is at present one of the market leaders. It has always put much emphasis on providing quality products and services. It first formulated its Mission Statement in the 1980s with the emphasis on providing its clients with quality service and products. The company first embarked on the road to ISO9000 certification in 1990 in response to the requirements of Hong Kong Housing Authority. In 1992, it was the first contractor in Hong Kong to obtain the ISO9002 Certificate which was issued by Hong Kong Quality Assurance Association. Further developed from this basis, the company adopted TQM by end 1993. The top management believes that the continued improvement in the Company's operating results from 1993 is partly due to the successful implementation of TQM. Moreover, its good performance in building government housing projects, assessed under the Performance Assessment Scoring System (PASS), has entitled it to the Housing Authority's "Best Contractor of the Year" award in three consecutive years, 1995, 1996 and 1997. Besides, over the years, it also has obtained numerous Safety Awards from the government. The company is also known for its cooperative relationships with its suppliers and subcontractors. The company is working for win-win situations in its business relationships with its subcontractors and suppliers.

10.2.2 Results: Descriptive statistics

Internal Consistency of the data

An internal consistency analysis was performed separately for each variable in the theorised Model by calculating the Cronbach Alphas i.e. the reliability alphas α.

Results in Table 10.1 showed that the Cronbach Alphas for all the variables in the Model were above the critical value of .7 (Nunnually, 1978). Hence, the author concluded that all the items had been appropriately assigned to each variable. The developed instrument also had content validity, since the selection of measurement items was based on a comprehensive review of literature and subjected to 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.

Means of different variables

The means of the different variables are discussed as follows according to the different dimensions (Table 10.1):

Leadership

The means on a 5-point scale (1=strongly disagree; 5 strongly agree) of the three variables under leadership were 4.17, 4.41 and 4.50 for Cooperative Culture, Commitment to Relationship and Commitment to Quality respectively. It indicated that the respondents very much believed that the top management or the company committed itself to the long-term relationship with its suppliers and also committed itself to pursuing quality initiatives. The respondents also agreed very much that there was a cooperative culture between the company and its suppliers.

Customer Focus

The results indicated high means of Commitment to Supply Partner Satisfaction and Commitment to Customer Satisfaction which were 4.26 and 4.64 respectively. It revealed that the respondents very much agreed that the company committed itself to the needs of its supply partners and its customers.

Cooperative Relationship

Concerning the relationship between the construction company and its suppliers, the respondents agreed that there was good Supplier Dynamics, with a mean of 4.10. For instance, the operations between the construction company and its suppliers were smooth. The respondents agreed that the partners in the supply chain had Cooperative Goals, a mean of 4.10. They also agreed that the supply chain partners had open-minded interaction with each other, with a mean of 3.94.

Management by Fact: Integrative Process and Information Management

The mean of Seamless Operation was 3.47. It indicated that the respondents were more or less neutral when considered under the 5-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 Company. The mean of Integrated Structure was 3.55. It suggested that the respondents somewhat agreed that there was structural linkage between the Company and its suppliers.

The means of Performance Measurement and Information Exchange were 4.10 and 3.64 respectively. The results implied that the respondents somewhat agreed that there was information sharing between the company and its suppliers. On the other hand, they agreed more that they had objective ways to measure the performance of their suppliers.

Continuous Improvement

The means of Process Improvement (PROCESSIM) and Planning and Prevention (PREVEN) were 3.70 and 3.70 respectively. The results suggested that the respondents somewhat agreed that the company and its suppliers were continuously working at improving or streamlining the operations and processes between them. The respondents also somewhat agreed that there was mechanism set up to prevent problems from arising in the relationship with their suppliers.

Supply Chain Management Excellence

The means of Supplier Satisfaction, Supplier Contribution, Customer Satisfaction, and Business Results were 4.00, 4.17, 4.1, and 4.53 respectively. The results indicated that the suppliers were satisfied with the assistance given to them by the companies. The respondents agreed that their suppliers could have various contributions to their companies. The respondents also agreed that their customers were satisfied with their company's products and services. Moreover, the respondents also very much agreed that the overall performance of their company was very competitive in the market.

Table 10.1: *Cronbach's Alphas and the Means for the SCME Model variables*

Code	Critical Success Factors	Alpha	Mean
A	Leadership		
	I. Cooperative Culture	.85	4.17
	II. Commitment to Relationship (with suppliers)	.92	4.41
	III. Commitment to Quality	.84	4.50
B.	Customer Focus		
	IV. Commitment to Customer Satisfaction	.88	4.64
	V. Commitment to Supply Partner Satisfaction	.90	4.26
C.	Cooperative Relationship		
	VI. Supplier Dynamics	.90	4.10
	VII. Cooperative Goals	.93	4.10
	VIII.Constructive Controversy	.85	3.94
D.	Management By Fact		
	IX. Seamless Operation	.90	3.47
	X. Integrated Structure	.87	3.55
	XI. Performance Measurement	.74	4.10
	XII. Information Exchange	.85	3.64
E.	Continuous Improvement		
	XIII.Process Improvement	.89	3.70
	XIV.Planning and Prevention	.83	3.70
F.	Supply Chain Management Excellence		
	XV. Supplier Satisfaction	.93	4.0
	XVI.Supplier Contribution	.90	4.17
	XVII.Customer Satisfaction	.86	4.1
	XVIII.Business Results	.85	4.53

10.2.3 Partial Least Squares Results

The results of the means, x_is, and the weights, w_is, of Manifest Variables for each critical success factor and Supply Chain Management Excellence used in the PLS procedure are shown in table 10.2 and table 10.3.

Table 10.2: *Weights (Structural Parameters), w_is of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence*

Code	Critical Success Factors (Item no. in questionnaire)	1	2	3	4	w_i
A.	Leadership (I; II; III)	.4953302	.3247186	.3121236		1.1321724
B.	Customer Focus (IV.2;V.1;V.4)	.4023745	.1509192	.5736904		1.1269841
C.	Cooperative Relationship (VI; VII; VIII)	.371115	.2408534	.4421076		1.054076
D.	Management By Fact (VIV;X; XI)	.2431154	.5157609	.4096137		1.16849
E.	Continuous Improvement (XIII. 2, 4; XIV.4)	.4804493	.3225072	.3268779		1.1298344
F.	SCM Excellence (XV; XVI; XVII; XVIII)	.4104349	.2399966	.3182533	.3082802	1.276965

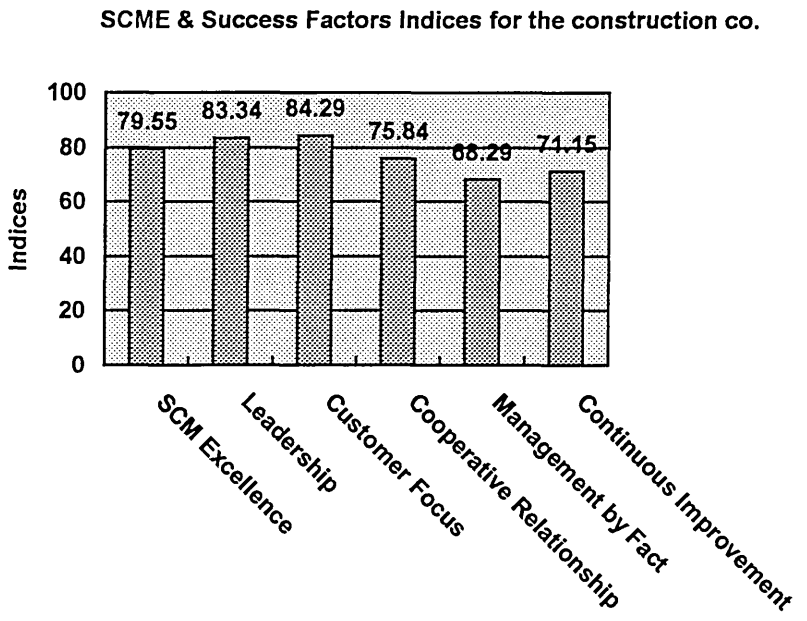
Table 10.3: *Means, x_is, of Manifest Variables for each Critical Success Factor and Supply Chain Management Excellence*

Code	Critical Success Factors (Item no. in questionnaire)	1	2	3	4	
A.	Leadership (I; II; III)	4.172	4.416	4.505		
B.	Customer Focus (IV.2;V.1;V.4)	4.614	4.114	4.27		
C.	Cooperative Relationship (VI; VII; VIII)	4.098	4.104	3.942		
D.	Management By Fact (VIV;X; XI)	3.473	3.554	4.109		
E.	Continuous Improvement (XIII. 2, 4; XIV.4)	3.666	3.854	4.104		
F.	SCM Excellence (XV; XVI; XVII; XVIII)	3.994	4.166	4.1	4.531	

Indices for the company

In general, the indices for the company are very satisfactory. The overall Supply Chain Management Excellence Index for the company is 79.55 out of 100. The indices for the different critical success factors of Supply Chain Management, i.e. Customer Focus, Leadership, Cooperative Relationship, Continuous Improvement and Management By Fact are 84.29, 83.34, 75.84, 71.15 and 68.29 respectively. Figure 10.1 depicts the different indices of the company graphically.

Figure 10.1: *Indices for Supply Chain Management Excellence & Success Factors for the Co.*



The different indices of the company are compared to those of the 139 companies. In Table 10.4, it can be seen that the indices for the different critical success factors for the company are in the same order as those of the 139 companies. Nearly all the indices of the company, including the Supply Chain Management Excellence Index and the indices for the critical success factors of Supply Chain Management, are the highest when compared with the indices derived from the 139 companies. The exceptions are for the indices of Continuous Improvement and Customer Focus, the company's indices are only second to those of the large companies by a very small margin, i.e. 71.15 versus 71.47 for Continuous Improvement and 84.29 versus 86.06 for Customer Focus. On the other hand, the company has done much better in Leadership, Cooperative Relationship and Management By Fact with indices of 83.34, 75.84, and 68.29 than the large companies whose indices for the three factors are 75.9, 73.77 and 65.96 respectively.

Table 10.4 : *Comparison of the indices between the construction company and 139 companies.*

	All Cos. (n=139)	Large Cos. (n=50)	Small Cos. (n=89)	Manufacturers (n=58)	Non-Manufacturers (n=81)	The Co. (n=48)
Leadership	77.13	75.9	78.59	77.87	77.86	83.34
Customer Focus	80.99	86.06	78.33	84.9	78.9	84.29
Cooperative Relation	73.3	73.77	75.43	73.79	73.08	75.84
Management by Fact	63.65	65.96	60.93	64.89	61.5	68.29
Continuous Improvement	66.8	71.47	64.98	68.94	67.28	71.15
SCM Excellence	70.48	72.53	69.21	71.5	69.89	79.55

Causal Relationship between Success Factors and Supply Chain Management Excellence

Apart from the index scores, the PLS method also generates a number of other statistics. Inner coefficients or structural parameters are the coefficients of functional equations linking latent variables. These values reflect the strengths of causal relationships between latent variables, i.e., between the different success factors and supply chain business excellence. Specifically, each structural parameter reflects the amount of change in an effect variable (endogenous variable) that results from a unit of change in a cause variable (exogenous variable or preceding endogenous variable).

Another statistic generated by PLS method is Coefficient of Determination R^2. It represents the proportion of regression sum of squares for corresponding latent variables that is explained by the regression model. It explains the proportion of the total variation that is explained by the cause variable.

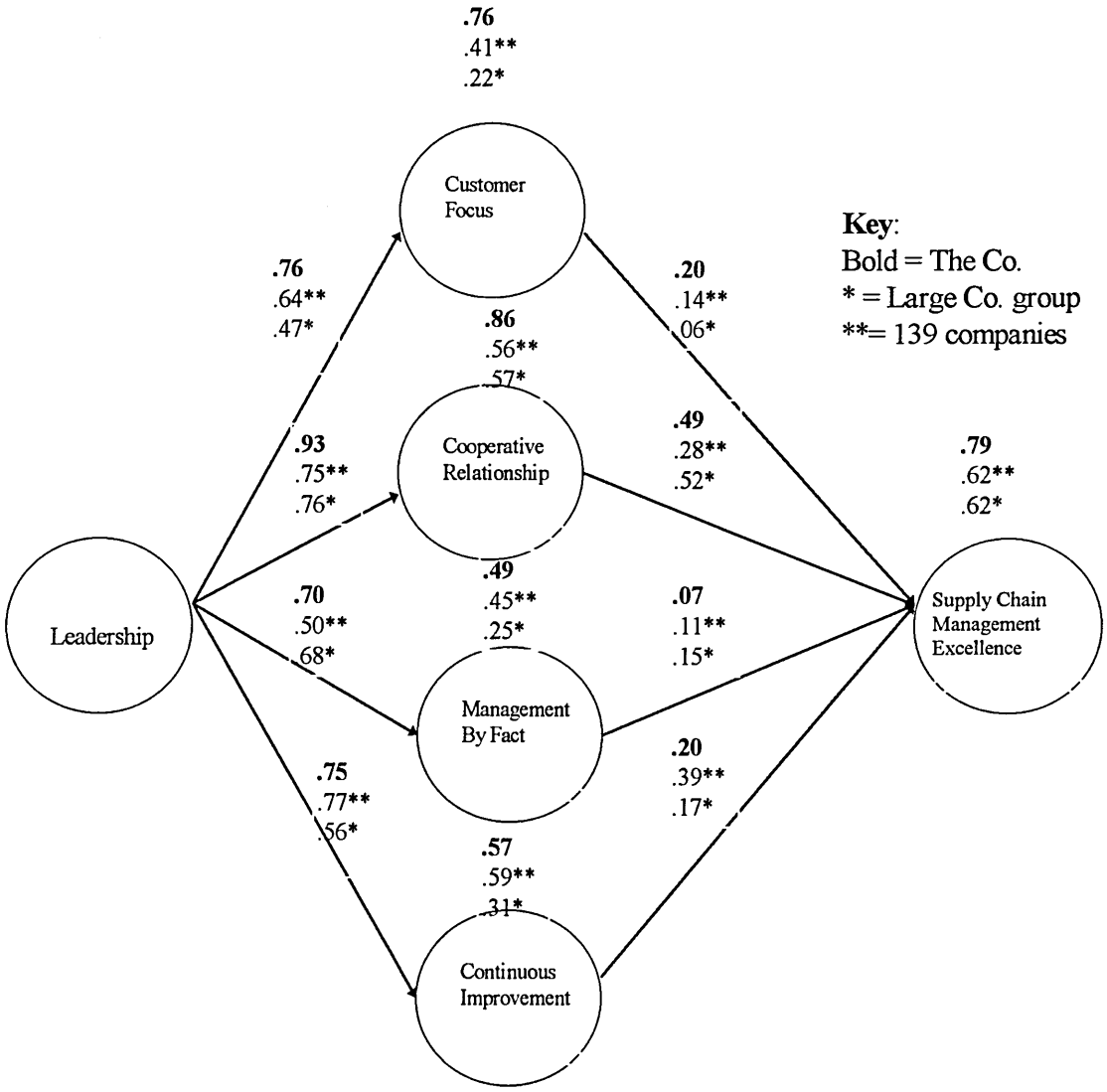
Figure 10.2 compares the inner coefficient values and the R^2 values of the construction company with the values from the data sets of the 139 companies, and the large company group. The path coefficients that are shown on the figures, i.e. the numbers on the lines, indicate the amount of influence a change of one unit in a latent variable's value would have on the next.

The R^2 value (the number above a latent variable) shows the proportion of regression sum of squares for corresponding latent variables that is explained by the

regression model. The R^2 values for Supply Chain Management Excellence for the different data sets range from 0.62 to 0.79. The results indicate that the Supply Chain Management Excellence Model can explain from 62 % to 79% of the variation of Supply Chain Management Excellence in different data sets. The model's explanation power for the construction company is especially strong because it can explain 79% of the variation of the company's supply chain performance. The remaining % of variation is due to randomness and other factors not accounted for by the Model.

Regarding the causal relationships among the latent variables for the construction company, it can be seen from figure 10.2 that Leadership has much influence on the other four success factors, i.e., Customer Focus, Cooperative Relationship, Management By Fact and Continuous Improvement. For instance, a `1' point increase in Leadership would lead to a `0.93' point increase in the index of Cooperative Relationship. In turn, these four success factors together can explain 79% of the variation of the dependent variable, i.e., Supply Chain Management Excellence. In other words, the overall supply chain performance of the construction company depends very much on its performances in these four success factors, although the contributions of the four factors are different.

Figure 10.2 : *How the inner coefficients and R^2 values map to the SCME Model*



10.2.4 The goodness of fit of the Supply Chain Management Excellence Model for the company

In order to assess the goodness of fit of the model to the data obtained from the company, the EQS programme was used (Bentler & Wu, 1995). The programme generates some fit indices. The model relates leadership directly to management by fact, 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 company. The results of the analysis indicate that the model had a χ^2 of 4.055 (d.f.=1) and a Comparative Fit Index (CFI) of .99 and a Normed Fit Index (NFI) of .987. Since these indices are greater than .90, they indicate that the new SCM model fits the data very well.

10.2.5 Discussion

In general, if the company is included into the 139 companies, it should be classified into the groups of large companies and manufacturing companies. It is because the number of employees of the company well exceeds a hundred and the nature of business of the construction firm involves a lot of physical operational activities which make it very similar to manufacturing companies. In fact, the indices of the company also suggest that it should be classified into these two groups which have higher indices than the other two groups, i.e. small and medium companies and non-manufacturing companies.

Besides, the indices of the company show that the company has done very well even when compared with similar groups of companies. It suggests that the company should be one of the best companies in its industry. Based on the construction company's background information collected by the author, indeed, it should be one of the best companies because it is the market leader in terms of market share in the government housing projects. Moreover, information suggests that the top management has a long history of commitment to quality and meeting the needs of customers and suppliers. Therefore, the construction company's performance in Leadership is very good which is better than the manufacturing group by five points and the large company group by seven points. To the knowledge of the author, the construction company is also famous for its partnering relationship with its suppliers and subcontractors which makes its index on Cooperative Relationship with suppliers the highest among all groups. In construction projects, especially for government projects, the clients have close supervision and monitoring on the main contractor's work so as to ensure the progress and quality of the projects. Hence, the construction company has done better than the groups of large and manufacturing companies on the factor of Management by Fact by about three to four points. The construction company's satisfactory performances in all of the different success factors of Supply Chain Management have enabled the company

to achieve a very good Supply Chain Management Excellence Index of 79.55 which is seven points higher than the large company and nine points higher than the 139 companies.

However, judging from the indices of the construction company, it can be observed that there should be room for improvement in the success factors of Management by Fact and Continuous Improvement. They are the two lowest indices of the company. These weaknesses are the same as the 139 companies although it is to a lesser extent for the company. In order to improve the Supply Chain Management Excellence Index, the company should devote more efforts to improving the daily operations with its suppliers. It is not enough to have good relationships with its suppliers, the company should develop seamless operation, and close linkages with suppliers, have frequent information exchanges with suppliers and help suppliers to improve their performances.

The results suggest that Leadership has a strong influence on the four success factors. It can be explained by the fact that the top management of the construction company has long committed to meeting the needs of customers and suppliers, building a cooperative relationship with suppliers, developing an integrated process and effective communication with suppliers and sustaining the process of continuous improvement. On the other hand, the high causal relationship between Cooperative Relationship and Supply Chain Management Excellence may be due to the fact that the construction company is particularly known for its fair deal with its suppliers and customers and its long term relationship with these partners. Hence, the suppliers and customers should be satisfied with the construction company and their satisfaction would also be reflected in the business results. On the other hand, the low causal relationship between Management By Fact and Supply Chain Management Excellence suggests that the construction company does not pay so much attention to Management By Fact than on the other success factors. However, its overall performance in this factor is still satisfactory and better than the 139 companies. Besides, the company does not have to monitor very closely on the operations of its supply partners because most of them are long-term partners and they will do their parts on their ends.

10.2.6 Conclusion on the use of the Supply Chain Management Excellence Model for the Construction Company

The Supply Chain Management Excellence Model helps the construction company to identify the success factors for best managing its supply chains. The construction company has done very well in achieving business excellence through its supply chains which can be reflected in the high index of 79.55. It can be attributed to its very good performances in various critical success factors for Supply Chain Management. When the indices of the construction company are compared to the data sets of the 139 companies already obtained by the author, the construction company comes first in four of the six indices and the remaining two indices are just less than the respective highest indices by a very small margin.

10.2.7 Some suggestions for the construction company

Even though the construction company has done very well in this assessment, it still has to continuously improve itself in order to ever meet the needs of the customers and maintain its competitive advantages. The construction company can choose to strengthen its performances in its two lowest indices, i.e., Management By Fact and Continuous Improvement. These two indices relate to the daily operation between the construction company and its suppliers. Improving on Management By Fact may imply that the construction company can develop a smoother operation and closer linkage with its suppliers, have better performance measurement on its suppliers and more frequent communication with them. Improving on Continuous Improvement may mean that the construction company can keep on improving its operational processes with its suppliers and preventing problems arising from its relationships with its suppliers.

The construction company can also consider monitoring its supply chain performance over time or benchmarking its performance with other construction companies.

10.3 VALIDATION OF THE SUCCESS FACTORS OF SUPPLY CHAIN MANAGEMENT EXCELLENCE MODEL: SOME SELECTED CASE STUDIES

10.3.1 Findings from selected case studies

The following sections report the results from interviews with the supply chain managers of four companies. They include a semiconductor manufacturer, a chemical producer, a toy manufacturer and a catering company. The managers each supplied an incident leading to a good supply chain relationship.

Case Company 1

It is the Hong Kong office of a large international semiconductor manufacturer. This office has obtained many quality awards from local institutions like the Industry Department of Hong Kong and the Hong Kong Management Association.

Critical Incident 1

The supply partner was a Japanese based company, which operated a joint venture factory in Singapore. The supplier supplied lead frame to the company, the performance of which had deteriorated and was rated as poor in 1997. If there was no further improvement, it would be delisted from the supplier list. In fact, this supplier had some strong technology know-how in its own field, however, its performance was adversely affected by its insufficient quality control, which resulted in poor product quality and late delivery. The case company sent people to the factory for a few days to teach and train the workers there on quality control method and system. They had frequent exchange of information.

As a result, the performance of the supplier had improved. It got a rating of over 80 out of a 100 in the company's recent supplier evaluation. It can be considered for supplying to other product lines of the company.

Case Company 2

This is a large international company producing chemicals. Its operations are located globally. They have plants established in China and South East Asia apart from Europe and the States.

Critical Incident 2

The supply chain manager located in Hong Kong office was responsible for

outsourcing the site logistics services for its Thailand plants. There were five plants. Four plants employed their own workers to do the internal logistics services. The manager had decided to contract out the internal logistics services of the other plant to an European based logistics services provider which had business with the company in Europe. However, the concept was new because the logistics services provider was originally responsible for external logistics services. It was the first plant of the company that made use of an external company to operate its internal logistics services. In the negotiation stage, there were three contenders for the services. Two contenders were rejected in the detailed analysis of their quotes. Then, the company had an open discussion with this European based logistics services provider. They compared their cost estimates with each other and looked at the estimates together with the services they covered.

The service provider was finally awarded the contract which amounted to US $0.5 million per year. It got the contract because it was very professional and it had the trust of the company as its other services with the company were good. Shortly after the service provider had got the contract, it even built a warehouse near to the plant on its own account to cope with the problem of not having enough storage space within the plant.

Case Company 3

The company is a small toy manufacturing company. It has a factory in China employing about 500 workers. It mainly manufactures different kinds of plastic robots and dolls.

Critical incident 3

According to the purchasing officer of the company, "Having long term relationship with suppliers would be beneficial to the company." The long-term supply partners were more willing to help and they had the company's interest at heart. They understood that if they could help the company do better, they would have more business in return. The purchasing officer had an experience of working with a long - term plastic raw material supplier. It was very cooperative, and in fact, some personal relationship had been built up between her and the sales representatives of the supplier. They gave her market information such as price changes and supply situations etc. Once, she was able to get a cheap, and close substitute to transparent ABS material with the help of the supplier.

Case Company 4

This company is a very big local catering service company. It operates fast food chains and different types of Chinese restaurants. It purchases a lot of food and non-food items.

Critical incident 4

The purchasing manager had continued orders placed with some of her suppliers, though the company did not have a long term contract with them. In this incident, a long time packaging material supplier had helped her company save some material cost. This supplier gave suggestion to her company to change the design of the polystyrene lunch box so as to reduce the production cost and the price of the lunch box. The original lunch box design was in one piece. The new design adopted by the company was in two pieces, i.e., the cover and the box itself, which served the same functions.

10.3.2 Discussion on the critical incidents

Through the incidents, it can be observed that the more a company applies the SCM success factors, the better is the company's supply chain performance. Examples on the application of the success factors in the incidents cited are given in table 10.5.. They are briefly discussed as follows:

Incidents 1, 2, 3 and 4 are examples whereby the companies involved applied the SCM success factors to managing their supply chains. The factors as shown in the table had been applied very well. As a result, in all the incidents, the companies involved were able to obtain satisfactory results from their supply chains.

In Incident 1, the electronics company committed itself to the long-term relationship with the foreign lead frame supplier and to quality (i.e. Leadership). The leadership's commitment further facilitated the application of the other success factors. It made the company want to provide support to the supplier, and in this case sending technicians to its supplier to help it improve its quality system (i.e. Customer Focus). Because the company had a real intention to help the supplier, it made the supplier become more receptive to the suggestions of the company and develop cooperative goals with the company (i.e. Cooperative Relationship). So, they tended to have more frequent exchange of information (i.e. Management By Fact). Moreover, since the company had a system of performance monitoring on its suppliers, it could give frequent feedback on the

performance of this supplier so that it could always improve whenever its performance fell short of the company's expectation (i.e. Continuous Improvement). The application of all these success factors had contributed finally to the improvement in the quality of the products delivered by the supplier (i.e. SCM Excellence).

In Incident 2, the chemical company committed itself to the cooperative relationship with the logistics service provider because they had a long history of working together though in other place and other services (i.e. Leadership). Because of this commitment, they tended to have open-minded discussion on the cost estimates of the new service, this would help to solve conflicts due to misunderstanding (i.e. Cooperative Relationship). In the design of the new service, i.e. internal logistics service which is usually done in-house, the company had involved the service provider early in the design of the service (i.e. Management By Fact). This shows that they had a good linkage which helped to improve the design of the service. Besides, the investment in the warehouse shows that the service provider committed itself to providing best service to the company (i.e., Management By Fact). This is an example of building an integrated structure between the supplier and the company which should make operation between the company and the supplier quicker and smoother. Again, applications in all of these success factors had helped the company obtain satisfactory performance from the supply chain (i.e., SCM Excellence).

In incident 3, the success factor of Management By Fact had been applied by the toy company. It had frequent information exchange with its supplier. As a result, the company was able to obtain a cheap alternative material with the help of the supplier (i.e., SCM Excellence).

In incident 4, the catering company had applied the success factor of Continuous Improvement. The company had accepted the suggestions of its supplier to make some improvements in the design of its polystyrene foam meal box. As a result, the company paid less for its meal box (i.e., SCM Excellence).

10.3.3 Conclusion on the critical incidents

Practical examples can be found for the application of each SCM success factor through the incidents. As shown through the incidents, the application of the SCM success factors are essential for companies to achieve Supply Chain Management

Excellence. Moreover, the incidents also show that the success factor "Leadership" helps to facilitate the other success factors which contribute to Supply Chain Management Excellence.. To conclude, the incidents support that the Supply Chain Management excellence Model has some content validity, i.e., the model is able to help companies achieve Supply Chain Management excellence.

10.3.4 Conclusions on the case studies on Supply Chain Management Excellence Model

This chapter has made use of a large construction company to validate the Supply Chain Management Excellence Model at the company level. Through this exercise, the Model not only has been validated but also extended from the industry level to the company level. The validation process has shown the way to assess Supply Chain Management excellence at the company level through administering the questionnaire survey among all the staff responsible for Supply Chain Management and analysing the data with the PLS method. Furthermore, the fitness of the model to the data is validated using the EQS programme. Besides, the chapter also provides evidence on the content validity of the SCM success factors of the model by using some selected case studies. With the help of the critical incident technique of Flanagan (1954), examples on the application of the success factors are found from the critical incidents and their causal relationships with Supply Chain Management excellence are also identified.

Table 10.5: *Application of the SCM success factors in four incidents*

Incident	SCM success factors	Examples applying the success factors:
Incident 1	1. Leadership	1a. The electronic co. committed itself to long-term relationship with the supplier, and to quality.
	2. Customer Focus	2a. The co. wanted its foreign lead frame supplier to be satisfied with its support.
	3. Cooperative Relationship	3a. They worked together for the benefits of both parties.
	4. Management By Fact	4a. The co. provided technical support to its lead frame supplier to improve its quality system. 4b. They had information exchange with each other. 4c. The co. had a system to measure the performance of its supplier.
	5. Continuous Improvement	5a. The co. helped its supplier improve its quality system.
	Results:	◆ The supplier's quality had improved and it was considered for supplying to other product lines.
Incident 2	1. Leadership	1a. The chemical co. committed itself to the cooperative relationship with its logistics service provider.
	2. Cooperative Relationship	2a. They had open-minded discussion on cost estimates.
	3. Management By Fact	3a. The co. had involved its supplier early in the design of the service. 3b. The supplier invested in building a warehouse.
	Results:	◆ The logistics service provider performed satisfactorily, and was given more contracts of similar nature.
Incident 3	1. Management By Fact	1a. The toy co. and its supplier had exchanges of market information.
	Results:	◆ The toy co. managed to get a cheap alternative material with the help of the supplier.
Incident 4	1. Continuous Improvement	1a. The catering co. welcomed suggestions from its meal box supplier on changing the box's design.
	Results:	◆ The co. paid less for its meal box.

CHAPTER 11

SUMMARY AND CONCLUSIONS

11.1 INTRODUCTION

This chapter aims to give a brief review of the research problems and the methodology, summarise the major findings and conclusions of the study, discuss the implications of the research study, describe its limitations, and suggest areas of further research.

11.2 A BRIEF REVIEW OF THE STUDY

11.2.1 Research problem

The purpose of this research is to develop a new SCM model that can better help companies manage their supply chains and as a result achieve business excellence. Therefore, the research problems focus on finding the inadequacies of the existing SCM model; using TQM principles to develop a new SCM model that can fulfill the inadequacies of the existing SCM model; and finally on testing and validating the new SCM model.

11.2.2 Research methodology

The study has adopted a systematic investigation into the research problem. It is an applied research in that the Customer Satisfaction Indexing method of Fornell (1992,1996) is not only applied but also extended to the business-to-business level. The present study is divided into different stages: exploratory, model building, model testing, model application and model validation. Both qualitative and quantitative approaches were adopted in conducting the research.

In the exploratory stage of the study, literature on SCM and TQM and their interface has been reviewed (chapters 2, 3 & 4 respectively) to find out the inadequacies of the existing SCM model and the ways TQM principles can enrich SCM. Besides, the

supply chain managers of three companies have been interviewed in - depth to obtain information on their supply chain performance (chapter 5).

Information from literature review and the in-depth interviews form the framework for the development of the new SCM model, which is called as the Supply Chain Management Excellence (SCME) Model. Besides, in building the SCME Model, the condensed version of Kanji's Business Excellence Model is used as a framework (chapter 7).

In the model testing stage, a questionnaire is developed based on the SCME Model and a questionnaire survey is conducted with the supply chain managers of the member companies of Federation of Hong Kong Industries. It solicits their views on their companies' supply chain activities. 139 usable responses have been obtained from 1050 number of questionnaires distributed. The linear structural equation modeling provided by EQS (Windows Version 5.6) is employed to evaluate the goodness of fit of the overall Supply Chain Management Excellence Model (chapter 8). Once the model has been tested to fit the data of the 139 companies, it is then used to calculate the Supply Chain Management Excellence Indices and parameter estimates for the different success factors for the 139 companies with the Partial Least Squares Method (chapter 9).

In the model validation stage, the Supply Chain Management Excellence Model is used to assess the supply chain performance of a large construction company. This attempt is to further validate the model at the company level rather than at the industry level. Moreover, in-depth interviews with key informants of four companies are conducted. The critical incident technique developed by Flanagan (1954) is used. Each supply chain manager has to relay an incident concerning the interactions between his company and its suppliers. This method is used to evaluate the applicability of the success factors of the Supply Chain Management Excellence Model from the perspective of supply chain managers (chapter 10).

11.3 MAJOR RESEARCH FINDINGS

11.3.1 Inadequacies of the existing SCM model

Most of the literature reviewed only focus on a particular aspect of supply chain management, such as supplier partnership, managing the material and information

flow. Hence, despite substantial research on supply chain management, there is a lack of a holistic perspective that basically covers all of the different aspects of Supply Chain Management. The existing Supply Chain Management model focuses mainly on working closely with suppliers in providing 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. Besides, although the benefits of supplier partnership have been widely covered in existing SCM literature, however, the way to develop effective supplier partnership is not well documented (Wong, 1999). Therefore, the SCME Model should take the above considerations together.

11.3.2 Interface between TQM and SCM

From literature review on TQM and SCM, there are similarities and differences between the two concepts. Judging from their differences, TQM is a more holistic approach than SCM in helping companies to achieve business excellence. Hence, the principles of TQM should be able to enrich the existing SCM model.

11.3.3 Selection of Kanji's Business Excellence Model

In enriching the existing SCM model, Kanji's Business Excellence Model is selected. It is because it can address the basic questions a company should encounter in implementing TQM and help a company achieve business excellence. Moreover, it is so comprehensive that its degree of representation and degree of applicability of TQM principles is the highest among different TQM models. Besides, unlike the indicative nature of most TQM models, it is an improvement model which produces business excellence indices that allow companies to compare their performances with others and gives an incentive to companies not doing as well as they might to improve on their shortcomings. It emphasizes on TQM principles, and includes critical success factors and model validation. Kanji's principles include Leadership, Delight the customers, Management by Fact, People-based Management, and Continuous Improvement. There are eight associated concepts, which are Customer satisfaction, Internal customers are real, All work is process, Measurement, Teamwork, People make quality, Continuous

improvement cycle and Prevention. Kanji's model is theory-driven and uses a structural approach.

11.3.4 Application of TQM principles to Supply Chain Management

Results from the three exploratory case studies support that companies that had applied the Total Quality Management principles more fully tended to be more satisfied with their suppliers' performances regardless of their size and technology level. The results show that TQM principles should be useful in enriching SCM.

11.3.5 Constructs of the Supply Chain Management Excellence (SCME) Model

The SCME Model is to fulfill the inadequacies of the existing SCM model, which is derived from the existing SCM literature. The SCME Model has six constructs which are leadership, customer focus, cooperative relationship, management by fact, continuous improvement and business excellence. The six constructs are formed into a structural model, which is a condensed version of Kanji's Business Excellence Model but applied to Supply Chain Management.

11.3.6 Goodness of Fit of the Supply Chain Management Excellence Model

Results support the theorising that companies focusing on creating cooperative culture with suppliers and commitment to supplier relationship and quality, commit to supplier satisfaction and develop cooperative relationships with supply partners. These strong relationships with suppliers or the "soft" factors would lead to suppliers' quality contributions to the companies. Besides, evidence supports that companies that have 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 or the "hard" factors also lead to suppliers' quality contributions to the companies which enable companies achieve

business excellence. The SCME Model consisting of the leadership factor driving both the "soft" and "hard" factors has been tested and proved to be contributing to companies' performance or business results. From structural analysis using EQS programme, the SCME Model provides a good fit to the data of the 139 companies. It implies that the causal relationships of the different constructs or the structure of the model should be valid. The SCME Model has even been tested to see whether the complete model is better than separating it into two partial models, i.e. one only incorporates the "soft" factors or the "relationships" factors and the other only incorporates the "hard" factors or the "operations" factors. The Goodness of Fit of the complete model is better than the two partial models. On the other hand, the partial model consisting of the "soft" factors has a better fit than the other partial model consisting of the "hard" factors. The latter result can be explained by the fact that 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 doing their best on their end.

11.3.7 Supply Chain Management Excellence Indices for the 139 companies

Partial Least Squares Method is used to calculate the Supply Chain Management Excellence Indices for the 139 companies. The overall Supply Chain Management Excellence Index for all the companies is 70.48, which indicates that the companies' overall score on their supply chain performance is satisfactory. Looking at the different elements of the Supply Chain Management Excellence Model, the companies have performed better in Customer Focus, Leadership and Cooperative Relationship with indices of 80.99, 77.13 and 73.3 respectively. On the other hand, the companies have not performed very well in Management by Fact and Continuous Improvement. Indices for these factors are 63.65 and 66.8 respectively. Therefore, these companies should focus more on these two success factors in order to improve the overall Supply Chain Management Excellence Index.

The 139 companies are further classified into data sets for large companies and small and medium companies, and manufacturing and non-manufacturing companies. The Supply Chain Management Excellence Index for those large companies is better than the small and medium companies, which are 72.53 and 69.21

respectively. The indices for the large companies on the success factors of Customer Focus, Management By Fact , and Continuous Improvement are 86.06, 65.96 and 71.47 respectively. All of them are higher than the respective indices of the small companies, which are 78.33, 60.93 and 64.98.

On the other hand, the small and medium companies have higher indices than large companies on Leadership and Cooperative Relationship, i.e. 78.59 and 75.43 versus 75.9 and 73.77 of the large companies. Overall speaking, the large companies are performing satisfactorily in the different success factors of Supply Chain Management and this has enabled the large companies to have higher Supply Chain Management Excellence Index.

The manufacturing companies have a higher Supply Chain Management Excellence Index than the non-manufacturing companies, i.e., 71.5 versus 69.89. Moreover, the manufacturing companies have higher indices for all of the different success factors than the non-manufacturing companies.

Regarding the causal relationships among the success factors in the different data sets, Leadership has a strong influence on the other four success factors. In turn, these four success factors, i.e. Customer Focus, Cooperative Relationship, Management by Fact and Continuous Improvement, also have strong influence on Supply Chain Management Excellence. The R^2 values of different data sets ranging from .62 to .68 suggest that the four success factors can explain very well the variation in Supply Chain Management Excellence. Different success factors do have different causal relationships with the effect variable. In general, Cooperative Relationship has the strongest relationship, but Customer Focus has the weakest relationship.

11.3.8 Application of the Supply Chain Management Excellence Model at the company level

The Model is applied to assess the supply chain performance of a large construction company. First, the Goodness of Fit of the model to the company's data is tested using the EQS program. Results indicate that the model had a χ^2 of 4.055 (d.f. = 1) and a Comparative Fit Index (CFI) of .99 and a Normed Fit Index (NFI) of .987 which suggest that the Model fits the data of the company very well.

Then, the Model is used to compute the indices for the company using PLS method. The overall Supply Chain Management Excellence Index for the company is

79.55 which is very satisfactory. The indices for the different success factors, i.e. Customer Focus, Leadership, Cooperative Relationship, Continuous Improvement and Management By Fact are 84.29, 83.34, 75.84, 71.15 and 68.29 respectively. The company's satisfactory performances in all of the different success factors of Supply Chain Management have enabled the company to achieve a very good Supply Chain Management Excellence Index of 79.55 which is seven points higher than the large company group and nine points higher than the overall 139 companies.

The R^2 value generated by PLS for the company indicates that the model's explanation power is especially strong because it can explain 79% of the variation of the company's supply chain performance.

11.3.9 Validation of the success factors of the Supply Chain Management Excellence Model

To examine the content validity of the success factors of the Model, critical incidents were obtained from four companies. Through the four critical incidents, it shows that the application of the SCM success factors is essential for companies to achieve Supply Chain Management excellence. Moreover, the incidents also support the model structure in that the success factor of "Leadership" helps to facilitate the other success factors, and these factors contribute to Supply Chain Management excellence.

11.4 ANALYSIS AND IMPLICATIONS OF THE STUDY

This work contributes to Supply Chain Management research by building the Supply Chain Management Excellence (SCME) Model, which is enriched by TQM principles. The SCME Model helps companies achieve business excellence through Supply Chain Management. It also contributes to Total Quality Management research by extending TQM principles from the company's level to the business to business level.

The SCME Model has been validated across a range of companies in different industries and also with a construction firm. It is found to be applicable for assessing Supply Chain Management excellence at both the industry level and the company level. Moreover, its results are encouraging in providing a measure of Supply Chain Management excellence for companies. The resulting Supply Chain Management

Excellence Index calculated by the robust Partial Least Squares Method serves as an objective and comprehensive single measure of organizational effectiveness through Supply Chain Management, which is also useful for purposes of comparison across companies.

The Supply Chain Management Excellence Model has successfully incorporated the success factors of TQM into Supply Chain Management. However, it differs from previous mostly indicative TQM models in that it is a structural and improvement model and it extends the TQM principles to Supply Chain Management. Companies can base on this model to self assess their strengths or weaknesses on the different success factors for Supply Chain Management and improve on those factors that they might not be doing very well. Companies can reassess its performance periodically to see whether they have improved over time. They can also benchmark their performances with other similar companies through comparing their individual Supply Chain Management Excellence Index and the associated indices for the different success factors. From the structural relationships between the various success factors and the effect variable of Supply Chain Management Excellence, companies can understand the importance of different factors in helping them achieve Supply Chain Management excellence and so can deploy their strategies to improve accordingly.

The study differs from previous studies in SCM in that it fulfills the inadequacies of the existing SCM model. It is a more comprehensive model which enables companies to achieve business excellence through Supply Chain Management. It also offers a methodology which is so far still lacking in SCM literature for companies to objectively and simply self assess their supply chain performance by the Supply Chain Management Excellence Index. Self-assessment is especially useful to companies which always have to monitor their strengths and weaknesses so as to continuously improve in order to be more competitive in the marketplace. In fact, companies having satisfied with their self-assessment results can also consider applying for some Quality Awards such as the European Quality Award in Europe or the Hong Kong Management Association's Quality Award in Hong Kong.

The work also lends strong support to previous research in supply chain management. It acknowledges the importance for companies to compete with each other not by themselves but by their whole supply chains. It confirms the effectiveness of working cooperatively with suppliers such as in the form of supplier partnership, in bringing out quality performance to the final customers. In addition, the study produces

a comprehensive and integrated SCM model, i.e. the Supply Chain Management Excellence (SCME) Model. The model most notably identify the importance of the leadership of a company in creating a cooperative relationship and in developing close operations with suppliers. Besides, companies should be aware that in order to achieve Supply Chain Management excellence, they have to pay attention to all the different success factors of Supply Chain Management, which are Customer Focus, Cooperative Relationship, Management By Fact and Continuous Improvement even though their degree of importance is different. Companies should know that they have to have cooperative relationship instead of adversarial relationship with their suppliers in order to get their support in meeting the needs of the final customers. Moreover, it is not enough that they just talk about good relationship, they need to have good operations and linkages so as to provide good services or products to the customers. Relatively speaking, companies should devote more effort on the "soft" factors of supply chain management, i.e. Customer Focus and Cooperative Relationship. The "soft" factors, especially Cooperative Relationship, can also help facilitate the development of the "hard" factors though Leadership is the driving force. However, the "hard" factors, i.e. Management By Fact and Continuous Improvement are also important because they help provide a good system for the day to day operations between the company and its suppliers and initiatives for continuously improving the operational processes.

In sum, this research offers a simple, reliable and valid methodology for scientifically examining supply chain performance and identifying areas for improvement. The findings offer a direction to the development of an empirical understanding of applying TQM principles to SCM. Moreover, the study serves as a valuable database for future benchmarking exercises on Supply Chain Management.

11.5 LIMITATIONS

11.5.1 Construct validity

The main thrust of construct validity hinges on whether the variables actually measure what they purport to measure (Kerlinger, 1986). One of the main threats to construct validity is common method variance.

Common method variance

Common method variance refers to the potentially erroneous relationship between two variables when no relationship exists. The error is generally attributed to a biased response facilitated by a common method of data collection (Podsakoff & Organ, 1986). A number of factors may contribute to common method variance. They include a subject's transitory frame-of-mind, systematic response style, bias for social desirability, and overlap in the content of the variables used. Single source bias, a special form of common method variance, is attributed to the collection of data from the same source (Avolio, Yammarino, & Bass, 1991).

The procedural methods used in this study to minimise common method variance were the use of multi-item scales and placement of the dependent variable at the end of the questionnaire. Multi-item scales reduce common method variance by using several questions to address a single construct. When summing the items for each variable, common method variance is reduced (Spector, 1987). Moreover, placing the dependent variable at the end of the instrument guides the respondent to answer more objectively, with less guessing as to the real nature of the study (Podsakoff & Organ, 1986). Besides, using multiple respondents to reduce single source bias would have been counterproductive because the supply chain managers are the key informants for the study.

The use of survey methodology is valid for purpose of this study. Hong Kong offers a rich context for the study of Supply Chain Management for it is the world's 9th largest trading economy in 1996. Much of the research in Hong Kong currently relies on case research. Nomothetic research involving large numbers of respondents, on the other hand, is clearly lacking. Moreover, self-reports are perhaps the most appropriate method for gathering psychometric, demographic, and organisational practices data (Podsakoff & Organ, 1986).

Recent evidence indicates that people often accurately perceive and report their social environment, especially when the purpose is for research rather than their evaluation, and that common method variance may not be as much of an artifact as commonly assumed (Avolio et al., 1991; Balzer and Sulsky, 1992; Crampton and Wagner, 1994; Murphy et al. 1992; Shraguer and Osberg, 1986; Spector, 1987; 1992).

11.5.2 External validity

External validity refers to the extent by which a study's findings can be generalised across different populations and settings. Generalising from a study's sample to the target population is specifically referred to as population validity, while generalising to other environmental factors (settings, tests, etc.) is referred to as ecological validity (Bracht & Glass, 1968).

Although the sample size of 139 is small relative to the total number of companies in Hong Kong, it consists of both large and small and medium companies and manufacturing and non-manufacturing companies but with a higher representation on small and medium companies and non-manufacturing companies. The mix of the sample companies matches with the mix of the population of companies in Hong Kong, which consists of mainly small and medium companies and non-manufacturing companies. Besides, the application of the Model to the company level as in the case of the construction company shows that it has ecological validity.

11.5.3 Sample restrictions

The sample was restricted to Hong Kong. Thus, the study results are limited to the extent that the Hong Kong company population is different from the company population of other countries. However, since Hong Kong company population also consists of many overseas companies, we would not expect there to be large differences from other countries. Nevertheless, we cannot generalise the findings without further research.

11.6 RECOMMENDATIONS FOR FUTURE STUDY

This study should be considered as a pilot study in a field where no previous study has been done before. It is hoped that the study will provide an impetus to employ more "structural equation modeling" in developing and testing models on subjects relating to TQM and SCM. Undoubtedly, future studies with larger samples, carried out periodically, will produce invaluable information for the firms in their search for business excellence through Supply Chain Management. Besides, future research should

be conducted for individual industrial/service sectors to examine differences between industries. Moreover, efforts for coordinated Supply Chain Management Excellence Indices can be taken for sectors and on a city or national basis. The data thus obtained should constitute a basis for competitive studies at company levels. Harmonised measurement procedures are necessary in order to be able to combine individual indices and compare between domains, and as a basis for benchmarking efforts.

This research design is ideal for use in further studies. New items can be added to the questionnaire without distorting the relative values of existing items in the domain. This is an important property for future studies, since the domain of TQM is likely to expand as new practices are developed over time. For instance, the measure of Supply Chain Management Excellence in the model focuses on stakeholders' satisfaction. However, future studies may strive to include more objective data, particularly financial measures of performance.

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APPENDICES

The SAS System 1
15:30 Friday, July 9, 1999

APPENDIX I : PLS OUTPUT FOR ALL COMPANIES

OUTPUT INFORMATION:

outer coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0.4741739	0	0	0	0	0
ROW2	0.6065336	0	0	0	0	0
ROW3	0	0.5589771	0	0	0	0
ROW4	0	0.5424195	0	0	0	0
ROW5	0	0	0.2685542	0	0	0
ROW6	0	0	0.6145333	0	0	0
ROW7	0	0	0.2531271	0	0	0
ROW8	0	0	0	0.6958889	0	0
ROW9	0	0	0	0.4021478	0	0
ROW10	0	0	0	0	0.2470109	0
ROW11	0	0	0	0	0.2308701	0
ROW12	0	0	0	0	0.1553668	0
ROW13	0	0	0	0	0.3254613	0
ROW14	0	0	0	0	0.1486315	0
ROW15	0	0	0	0	0.3318983	0
ROW16	0	0	0	0	0	0.4096178
ROW17	0	0	0	0	0	0.391029
ROW18	0	0	0	0	0	0.2900155
ROW19	0	0	0	0	0	0.2259876

inner coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.4679464	0	0	0	0	0
ROW3	0.7571158	0	0	0	0	0
ROW4	0.5009574	0	0	0	0	0
ROW5	0.5571043	0	0	0	0	0
ROW6	0	0.0648918	0.520164	0.1511008	0.1724164	0

Correlation matrix R[xi,xj]:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	1	0.4679464	0.7571158	0.5009574	0.5571043	0.6889068
ROW2	0.4679464	1	0.6181243	0.4179214	0.4343827	0.5244608
ROW3	0.7571158	0.6181243	1	0.6331817	0.5884002	0.7573993
ROW4	0.5009574	0.4179214	0.6331817	1	0.5936106	0.609927
ROW5	0.5571043	0.4343827	0.5884002	0.5936106	1	0.5963639
ROW6	0.6889068	0.5244608	0.7573993	0.609927	0.5963639	1

SD=

COL1	COL2	COL3	COL4	COL5	COL6

ROW1	0	0	0	0	0	0
ROW2	0.0755044	0	0	0	0	0
ROW3	0.0558135	0	0	0	0	0
ROW4	0.0739423	0	0	0	0	0
ROW5	0.0709495	0	0	0	0	0
ROW6	0	0.0678992	0.0819859	0.0732523	0.0704912	0

T=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0

ROW2	6.1976003	0	0	0	0	0
ROW3	13.565095	0	0	0	0	0
ROW4	6.7749818	0	0	0	0	0
ROW5	7.852126	0	0	0	0	0
ROW6	0	0.9557082	6.3445573	2.0627446	2.4459287	0

inner R squares:

	COL1	COL2	COL3	COL4	COL5
ROW1	0.2189738	0.5732244	0.2509584	0.3103653	0.6229885

inner R

	COL1	COL2	COL3	COL4	COL5
ROW1	0.4679464	0.7571158	0.5009574	0.5571043	0.7892962

number of iterations:
27

coefficients alpha

0.8145523	0.7866514	0.7292312	0.7080315	0.7480475	0.7255069

PLS output for all companies

OUTPUT INFORMATION:

APPENDIX II : PLS OUTPUT FOR LARGE COMPANIES

outer coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0.3771429	0	0	0	0	0
ROW2	0.2609889	0	0	0	0	0
ROW3	0.5642896	0	0	0	0	0
ROW4	0	0.5094613	0	0	0	0
ROW5	0	0.411623	0	0	0	0
ROW6	0	0.3141261	0	0	0	0
ROW7	0	0	0.5961806	0	0	0
ROW8	0	0	0.4795416	0	0	0
ROW9	0	0	0	0.4951887	0	0
ROW10	0	0	0	0.5941683	0	0
ROW11	0	0	0	0	0.3227986	0
ROW12	0	0	0	0	0.2542012	0
ROW13	0	0	0	0	0.1947247	0
ROW14	0	0	0	0	0.4440207	0
ROW15	0	0	0	0	0	0.2847276
ROW16	0	0	0	0	0	0.382817
ROW17	0	0	0	0	0	0.3735294
ROW18	0	0	0	0	0	0.2418237

inner coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.6427067	0	0	0	0	0
ROW3	0.7512696	0	0	0	0	0
ROW4	0.6761305	0	0	0	0	0
ROW5	0.7730612	0	0	0	0	0
ROW6	0	0.1373432	0.2785839	0.1069089	0.3854439	0

Correlation matrix R[xi,xj]:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	1	0.6427067	0.7512696	0.6761305	0.7730612	0.7067985
ROW2	0.6427067	1	0.587785	0.610354	0.6291997	0.6088641
ROW3	0.7512696	0.587785	1	0.6393879	0.6476724	0.6773098
ROW4	0.6761305	0.610354	0.6393879	1	0.6963228	0.6372535
ROW5	0.7730612	0.6291997	0.6476724	0.6963228	1	0.7267344
ROW6	0.7067985	0.6088641	0.6773098	0.6372535	0.7267344	1

SD=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.1105788	0	0	0	0	0
ROW3	0.0952621	0	0	0	0	0
ROW4	0.1063453	0	0	0	0	0
ROW5	0.0915579	0	0	0	0	0

ROW6	0	0.1273846	0.1316587	0.1399696	0.1429574	0

T=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	5.8122054	0	0	0	0	0

ROW3	7.8863402	0	0	0	0	0
ROW4	6.3578784	0	0	0	0	0
ROW5	8.4434182	0	0	0	0	0
ROW6	0	1.0781772	2.1159562	0.7638011	2.6962143	0

inner R squares:

	COL1	COL2	COL3	COL4	COL5
ROW1	0.4130719	0.564406	0.4571525	0.5976237	0.6205544

inner R

	COL1	COL2	COL3	COL4	COL5
ROW1	0.6427067	0.7512696	0.6761305	0.7730612	0.7877527

number of iterations:
62

coefficients alpha

0.7068379	0.7085108	0.8292171	0.8035045	0.7948143	0.765838

PLS Output for large companies

APPENDIX III : PLS OUTPUT FOR SMALL & MEDIUM COS.

OUTPUT INFORMATION:

outer coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0.4744756	0	0	0	0	0
ROW2	0.6271173	0	0	0	0	0
ROW3	0	0.5066744	0	0	0	0
ROW4	0	0.5951449	0	0	0	0
ROW5	0	0	0.4903929	0	0	0
ROW6	0	0	0.4119633	0	0	0
ROW7	0	0	0.3246164	0	0	0
ROW8	0	0	0	0.6066532	0	0
ROW9	0	0	0	0.4868543	0	0
ROW10	0	0	0	0	0.2446284	0
ROW11	0	0	0	0	0.1526424	0
ROW12	0	0	0	0	0.1059401	0
ROW13	0	0	0	0	0.3872218	0
ROW14	0	0	0	0	0.3259785	0
ROW15	0	0	0	0	0.1946804	0
ROW16	0	0	0	0	0	0.4589329
ROW17	0	0	0	0	0	0.3580556
ROW18	0	0	0	0	0	0.2619687
ROW19	0	0	0	0	0	0.2559125

inner coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.5448154	0	0	0	0	0
ROW3	0.7210814	0	0	0	0	0
ROW4	0.5604958	0	0	0	0	0
ROW5	0.5276919	0	0	0	0	0
ROW6	0	0.0417591	0.5598783	0.1885545	0.1547689	0

Correlation matrix R[xi,xj]:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	1	0.5448154	0.7210814	0.5604958	0.5276919	0.7517605
ROW2	0.5448154	1	0.7040466	0.4810489	0.50991	0.6055617
ROW3	0.7210814	0.7040466	1	0.630624	0.539871	0.7917409
ROW4	0.5604958	0.4810489	0.630624	1	0.5203043	0.6422423
ROW5	0.5276919	0.50991	0.539871	0.5203043	1	0.57643
ROW6	0.7517605	0.6055617	0.7917409	0.6422423	0.57643	1

SD=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.0899026	0	0	0	0	0
ROW3	0.0742813	0	0	0	0	0
ROW4	0.0887878	0	0	0	0	0

ROW5	0.0910691	0	0	0	0	0
ROW6	0	0.0891964	0.0997346	0.0828731	0.0780996	0

T=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0

ROW2	6.0600595	0	0	0	0	0
ROW3	9.7074359	0	0	0	0	0
ROW4	6.312758	0	0	0	0	0
ROW5	5.7944132	0	0	0	0	0
ROW6	0	0.4681704	5.6136842	2.2752191	1.9816851	0

inner R squares:

	COL1	COL2	COL3	COL4	COL5
ROW1	0.2968238	0.5199585	0.3141555	0.2784587	0.6788774

inner R

	COL1	COL2	COL3	COL4	COL5
ROW1	0.5448154	0.7210814	0.5604958	0.5276919	0.8239402

number of iterations:
22

coefficients alpha

0.7631935	0.7781672	0.7266378	0.7898895	0.7338369	0.7027439

PLS Output for small and medium cos.

APPENDIX IV : PLS OUTPUT FOR MANUFACTURING COS

OUTPUT INFORMATION:

outer coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0.3520206	0	0	0	0	0
ROW2	0.7157361	0	0	0	0	0
ROW3	0	0.6990074	0	0	0	0
ROW4	0	0.3358103	0	0	0	0
ROW5	0	0	0.7217029	0	0	0
ROW6	0	0	0.3310096	0	0	0
ROW7	0	0	0	0.6969841	0	0
ROW8	0	0	0	0.3719379	0	0
ROW9	0	0	0	0	0.2688659	0
ROW10	0	0	0	0	0.4882052	0
ROW11	0	0	0	0	0.2307812	0
ROW12	0	0	0	0	0.2985451	0
ROW13	0	0	0	0	0	0.379995
ROW14	0	0	0	0	0	0.4241939
ROW15	0	0	0	0	0	0.3152388
ROW16	0	0	0	0	0	0.2035362

inner coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.461249	0	0	0	0	0
ROW3	0.7301239	0	0	0	0	0
ROW4	0.582171	0	0	0	0	0
ROW5	0.6455485	0	0	0	0	0
ROW6	0	0.0761745	0.1579261	0.3854035	0.3232707	0

Correlation matrix R[xi,xj]:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	1	0.461249	0.7301239	0.582171	0.6455485	0.6436236
ROW2	0.461249	1	0.5667966	0.4908213	0.4849183	0.5116106
ROW3	0.7301239	0.5667966	1	0.6301674	0.6341613	0.648976
ROW4	0.582171	0.4908213	0.6301674	1	0.6686007	0.7384504
ROW5	0.6455485	0.4849183	0.6341613	0.6686007	1	0.7180408
ROW6	0.6436236	0.5116106	0.648976	0.7384504	0.7180408	1

SD=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.1185665	0	0	0	0	0
ROW3	0.0913118	0	0	0	0	0
ROW4	0.1086506	0	0	0	0	0
ROW5	0.1020563	0	0	0	0	0
ROW6	0	0.1003816	0.1175697	0.1168007	0.1169968	0

T=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	3.8902123	0	0	0	0	0
ROW3	7.9959448	0	0	0	0	0
ROW4	5.3581961	0	0	0	0	0

ROW5	6.3254164	0	0	0	0	0
ROW6	0	0.7588497	1.3432551	3.2996686	2.7630726	0

inner R squares:

	COL1	COL2	COL3	COL4	COL5
ROW1	0.2127506	0.5330809	0.3389231	0.4167328	0.6581848

inner R

	COL1	COL2	COL3	COL4	COL5
ROW1	0.461249	0.7301239	0.582171	0.6455485	0.8112859

number of iterations:
37

coefficients alpha

0.7276067	0.7972401	0.739155	0.7517506	0.7293036	0.7131479

PLS Output for manufacturing cos

APPENDIX V : PLS OUTPUT FOR NON-MANUFACTURING COS.

OUTPUT INFORMATION:

outer coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0.362042	0	0	0	0	0
ROW2	0.7025298	0	0	0	0	0
ROW3	0	0.3621435	0	0	0	0
ROW4	0	0.7032126	0	0	0	0
ROW5	0	0	0.4108001	0	0	0
ROW6	0	0	0.6521149	0	0	0
ROW7	0	0	0	0.6466627	0	0
ROW8	0	0	0	0.4661337	0	0
ROW9	0	0	0	0	0.1719614	0
ROW10	0	0	0	0	0.2767055	0
ROW11	0	0	0	0	0.4268535	0
ROW12	0	0	0	0	0.4265525	0
ROW13	0	0	0	0	0	0.4402092
ROW14	0	0	0	0	0	0.3603539
ROW15	0	0	0	0	0	0.2730342
ROW16	0	0	0	0	0	0.2272312

inner coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.5075212	0	0	0	0	0
ROW3	0.7874228	0	0	0	0	0
ROW4	0.4539088	0	0	0	0	0
ROW5	0.5160537	0	0	0	0	0
ROW6	0	0.1238588	0.5738002	0.1384374	0.1102612	0

Correlation matrix R[xi,xj]:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	1	0.5075212	0.7874228	0.4539088	0.5160537	0.7019212
ROW2	0.5075212	1	0.615296	0.3458534	0.4812007	0.5778526
ROW3	0.7874228	0.615296	1	0.6157198	0.5790163	0.7990918
ROW4	0.4539088	0.3458534	0.6157198	1	0.5341109	0.5934663
ROW5	0.5160537	0.4812007	0.5790163	0.5341109	1	0.5760428
ROW6	0.7019212	0.5778526	0.7990918	0.5934663	0.5760428	1

SD=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.096942	0	0	0	0	0
ROW3	0.0693519	0	0	0	0	0
ROW4	0.1002507	0	0	0	0	0
ROW5	0.0963701	0	0	0	0	0
ROW6	0	0.0850172	0.1013141	0.0868136	0.0854121	0

T=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	5.2353075	0	0	0	0	0
ROW3	11.354016	0	0	0	0	0
ROW4	4.5277352	0	0	0	0	0

ROW5	5.3549154	0	0	0	0	0
ROW6	0	1.4568685	5.6635755	1.594651	1.290932	0

inner R squares:

	COL1	COL2	COL3	COL4	COL5
ROW1	0.2575777	0.6200346	0.2060332	0.2663115	0.6757643

inner R

	COL1	COL2	COL3	COL4	COL5
ROW1	0.5075212	0.7874228	0.4539088	0.5160537	0.8220489

number of iterations:
34

coefficients alpha

0.750755	0.7486884	0.8119788	0.7290936	0.7062833	0.7335723

PLS output for non-manufacturing cos.

APPENDIX VI : PLS OUTPUT FOR THE CONSTRUCTION CO.

OUTPUT INFORMATION:

outer coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0.4953302	0	0	0	0	0
ROW2	0.3247186	0	0	0	0	0
ROW3	0.3121236	0	0	0	0	0
ROW4	0	0.4023745	0	0	0	0
ROW5	0	0.1509192	0	0	0	0
ROW6	0	0.5736904	0	0	0	0
ROW7	0	0	0.371115	0	0	0
ROW8	0	0	0.2408534	0	0	0
ROW9	0	0	0.4421076	0	0	0
ROW10	0	0	0	0.2431154	0	0
ROW11	0	0	0	0.5157609	0	0
ROW12	0	0	0	0.4096137	0	0
ROW13	0	0	0	0	0.4804493	0
ROW14	0	0	0	0	0.3225072	0
ROW15	0	0	0	0	0.3268779	0
ROW16	0	0	0	0	0	0.4104349
ROW17	0	0	0	0	0	0.2399966
ROW18	0	0	0	0	0	0.3182533
ROW19	0	0	0	0	0	0.3082802

inner coefficients:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.7578004	0	0	0	0	0
ROW3	0.9266254	0	0	0	0	0
ROW4	0.701533	0	0	0	0	0
ROW5	0.7536568	0	0	0	0	0
ROW6	0	0.197606	0.4924744	0.072856	0.1993223	0

Correlation matrix R[xi,xj]:

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	1	0.7578004	0.9266254	0.701533	0.7536568	0.8497391
ROW2	0.7578004	1	0.8242782	0.6417551	0.6699758	0.7838388
ROW3	0.9266254	0.8242782	1	0.7315726	0.779804	0.8640885
ROW4	0.701533	0.6417551	0.7315726	1	0.8289734	0.7251843
ROW5	0.7536568	0.6699758	0.779804	0.8289734	1	0.7761428
ROW6	0.8497391	0.7838388	0.8640885	0.7251843	0.7761428	1

SD=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0
ROW2	0.0962039	0	0	0	0	0
ROW3	0.0554361	0	0	0	0	0
ROW4	0.1050726	0	0	0	0	0

ROW5	0.0969089	0	0	0	0	0
ROW6	0	0.1246789	0.149094	0.129738	0.1409922	0

T=

	COL1	COL2	COL3	COL4	COL5	COL6
ROW1	0	0	0	0	0	0

ROW2	7.8770264	0	0	0	0	0
ROW3	16.715201	0	0	0	0	0
ROW4	6.6766506	0	0	0	0	0
ROW5	7.7769616	0	0	0	0	0
ROW6	0	1.5849199	3.3031132	0.5615624	1.4137119	0

inner R squares:

	COL1	COL2	COL3	COL4	COL5
ROW1	0.5742615	0.8586346	0.4921485	0.5679986	0.7879693

inner R

	COL1	COL2	COL3	COL4	COL5
ROW1	0.7578004	0.9266254	0.701533	0.7536568	0.8876764

number of iterations:
49

coefficients alpha

0.827677	0.7292962	0.9132062	0.7606534	0.8374627	0.7701641	

PLS Output for the construction co.

```
1
  EQS, A STRUCTURAL EQUATION PROGRAM                MULTIVARIATE SOFTWARE,
INC.
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1996.
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APPENDIX VI : EQS OUTPUT FOR ALL COMPANIES

```
    PROGRAM CONTROL INFORMATION

     1  /TITLE
     2  combine
     3  /SPECIFICATIONS
     4   DATA='COMBML.DAT'; VARIABLES= 29; CASES=  139;
     5   METHODS=ML;
     6   MATRIX=RAW;
     7  /LABELS
     8  V1=CULTURE; V2=LONGTM; V3=COMQU; V4=COMCU; V5=COMSU;
     9  V6=SUPDY; V7=COOP; V8=COMP; V9=SUPSAT; V10=SUPCONTR;
    10  V11=OPERAT; V12=STRUCT; V13=MEASURE; V14=INFOEX; V15=CC;
    11  V16=PROCESSI; V17=PREVEN; V18=BUYSAT; V19=INTTEAM; V20=INTCOOP;
    12  V21=INTCOMP; V22=CUSAT; V23=BUSRESU; V24=LEADERSH; V25=CUSTOMER;
    13  V26=COOPRELA; V27=CONTIMPR; V28=BUSINESE; V29=MGTBYFCT;
    14  /EQUATIONS
    15  V25 =  + *V24 + E25;
    16  V26 =  + *V24 + E26;
    17  V27 =  + *V24 + E27;
    18  V28 =  + *V25 + *V26 + *V27 + *V29 + E28;
    19  V29 =  + *V24 + E29;
    20  /VARIANCES
    21  V24 = *;
    22  E25 = *;
    23  E26 = *;
    24  E27 = *;
    25  E28 = *;
    26  E29 = *;
    27  /COVARIANCES
    28  E26 , E25 = *;
    29  E27 , E25 = *;
    30  E27 , E26 = *;
    31  E29 , E25 = *;
    32  E29 , E26 = *;
    33  E29 , E27 = *;
    34  /END


       34 RECORDS OF INPUT MODEL FILE WERE READ
1
  TITLE:   combine
PAGE :  2
  EQS/MAC-PPC 5.4                              SERIAL NUMBER:
a5006771432333□□□□□□□□□□

  SAMPLE STATISTICS
```

UNIVARIATE STATISTICS

VARIABLE	LEADERSH	CUSTOMER	COOPRELA	CONTIMPR	BUSINESE
MEAN	4.0815	4.3031	3.9055	3.6102	3.7830
SKEWNESS (G1)	-2.1846	-2.9779	-1.6452	-.9871	-1.9299
KURTOSIS (G2)	11.4834	17.8750	8.0913	4.5690	10.9273
STANDARD DEV.	.6277	.5983	.6567	.6832	.5910

VARIABLE	MGTBYFCT
MEAN	3.3470
SKEWNESS (G1)	-.7615
KURTOSIS (G2)	1.9004
STANDARD DEV.	.7565

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 24.5810
NORMALIZED ESTIMATE = 14.7891

ELLIPTICAL THEORY KURTOSIS ESTIMATES

MARDIA-BASED KAPPA = .5121 MEAN SCALED UNIVARIATE KURTOSIS = 3.0470

MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA= .5121

CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE KURTOSIS:

CASE NUMBER	1	41	50	58	137
ESTIMATE	1883.8933	99.3830	116.3826	99.3182	513.9624

1

COVARIANCE MATRIX TO BE ANALYZED: 6 VARIABLES (SELECTED FROM 29 VARIABLES)
BASED ON 139 CASES.

	LEADERSH V 24	CUSTOMER V 25	COOPRELA V 26	CONTIMPR V 27	BUSINESE V 28
LEADERSH V 24	.394				
CUSTOMER V 25	.272	.358			
COOPRELA V 26	.320	.285	.431		
CONTIMPR V 27	.291	.257	.291	.467	
BUSINESE V 28	.284	.265	.309	.278	.349
MGTBYFCT V 29	.258	.213	.269	.367	.267

	MGTBYFCT V 29
MGTBYFCT V 29	.572

BENTLER-WEEKS STRUCTURAL REPRESENTATION:

NUMBER OF DEPENDENT VARIABLES = 5
DEPENDENT V'S : 25 26 27 28 29

NUMBER OF INDEPENDENT VARIABLES = 6
INDEPENDENT V'S : 24
INDEPENDENT E'S : 25 26 27 28 29

3RD STAGE OF COMPUTATION REQUIRED 2327 WORDS OF MEMORY.
PROGRAM ALLOCATE 100000 WORDS

DETERMINANT OF INPUT MATRIX IS 0.55232D-04

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

PARAMETER ESTIMATES APPEAR IN ORDER,
NO SPECIAL PROBLEMS WERE ENCOUNTERED DURING OPTIMIZATION.

RESIDUAL COVARIANCE MATRIX (S-SIGMA) :

	LEADERSH V 24	CUSTOMER V 25	COOPRELA V 26	CONTIMPR V 27	BUSINESE V 28
LEADERSH V 24	-.000				
CUSTOMER V 25	-.000	-.000			
COOPRELA V 26	-.000	-.000	-.000		
CONTIMPR V 27	-.000	-.000	-.000	-.000	
BUSINESE V 28	.022	0.000	0.000	-.000	0.000
MGTBYFCT V 29	-.000	0.000	-.000	0.000	0.000

	MGTBYFCT V 29
MGTBYFCT V 29	-.000

AVERAGE ABSOLUTE COVARIANCE RESIDUALS = .0010

AVERAGE OFF-DIAGONAL ABSOLUTE COVARIANCE RESIDUALS = .0014

STANDARDIZED RESIDUAL MATRIX:

	LEADERSH V 24	CUSTOMER V 25	COOPRELA V 26	CONTIMPR V 27	BUSINESE V 28
LEADERSH V 24	-.000				
CUSTOMER V 25	-.000	-.000			
COOPRELA V 26	-.000	-.000	-.000		
CONTIMPR V 27	-.000	-.000	-.000	-.000	
BUSINESE V 28	.058	0.000	0.000	-.000	0.000
MGTBYFCT V 29	-.000	0.000	-.000	0.000	0.000

	MGTBYFCT V 29
MGTBYFCT V 29	-.000

AVERAGE ABSOLUTE STANDARDIZED RESIDUALS = .0028

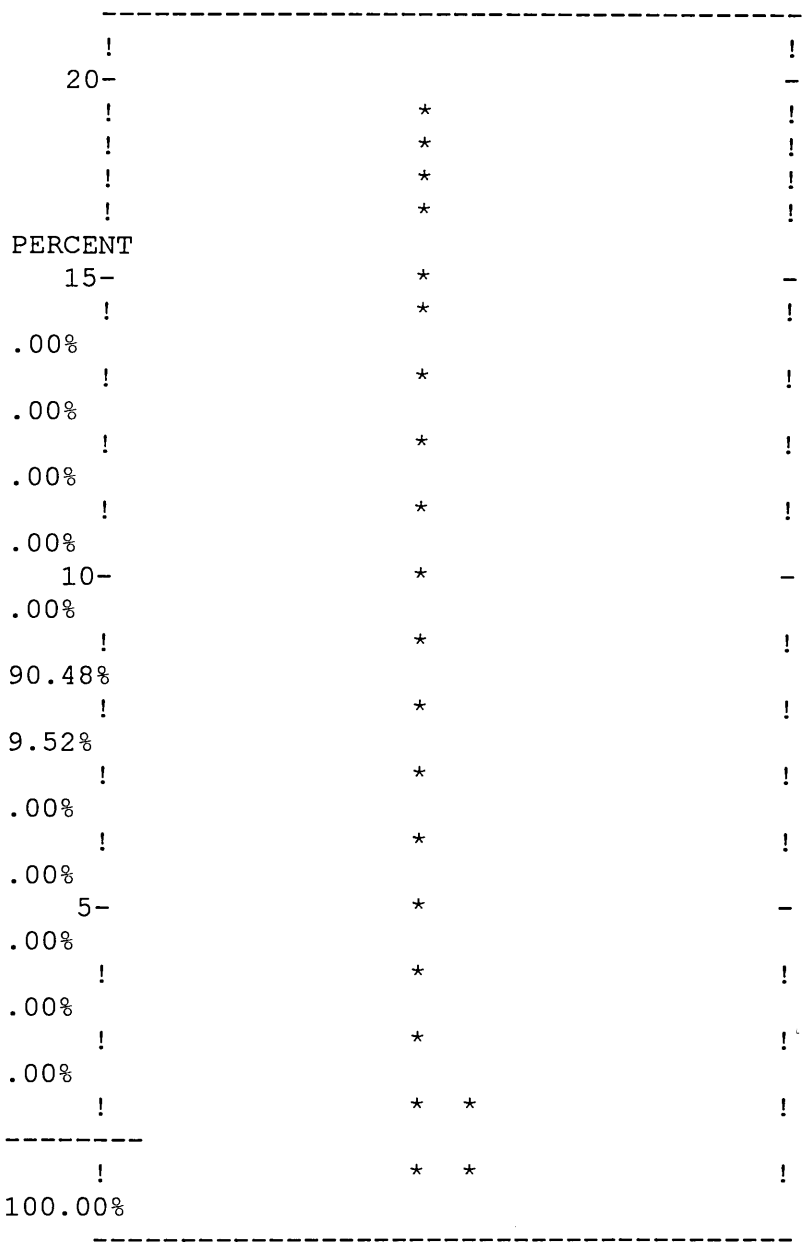
AVERAGE OFF-DIAGONAL ABSOLUTE STANDARDIZED RESIDUALS = .0039

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

LARGEST STANDARDIZED RESIDUALS:

V 28,V 24	V 28,V 28	V 28,V 25	V 28,V 26	V 29,V 28
.058	0.000	0.000	0.000	0.000
V 29,V 27	V 29,V 25	V 27,V 25	V 27,V 26	V 27,V 27
0.000	0.000	-.000	-.000	-.000
V 24,V 24	V 25,V 24	V 25,V 25	V 28,V 27	V 26,V 24
-.000	-.000	-.000	-.000	-.000
V 29,V 24	V 26,V 25	V 29,V 26	V 26,V 26	V 27,V 24
-.000	-.000	-.000	-.000	-.000

DISTRIBUTION OF STANDARDIZED RESIDUALS



		RANGE			FREQ	
1	-0.5	-	--		0	.00%
2	-0.4	-	-0.5		0	.00%
3	-0.3	-	-0.4		0	.00%
4	-0.2	-	-0.3		0	.00%
5	-0.1	-	-0.2		0	.00%
6	0.0	-	-0.1		19	90.48%
7	0.1	-	0.0		2	9.52%
8	0.2	-	0.1		0	.00%
9	0.3	-	0.2		0	.00%
A	0.4	-	0.3		0	.00%
B	0.5	-	0.4		0	.00%
C	++	-	0.5		0	.00%
		TOTAL			21	100.00%

1 2 3 4 5 6 7 8 9 A B C EACH "*" REPRESENTS 1 RESIDUALS

1

TITLE: combine

EQS/MAC-PPC 5.4 SERIAL NUMBER: a5006771432333□□□□□□□□□□

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 639.261 ON 15 DEGREES OF FREEDOM

INDEPENDENCE AIC = 609.26115 INDEPENDENCE CAIC = 550.24404
MODEL AIC = 3.62744 MODEL CAIC = -.30704

CHI-SQUARE = 5.627 BASED ON 1 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS .01768
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 5.514.

BENTLER-BONETT NORMED FIT INDEX= .991
BENTLER-BONETT NONNORMED FIT INDEX= .889
COMPARATIVE FIT INDEX (CFI) = .993

ITERATIVE SUMMARY

ITERATION	PARAMETER ABS CHANGE	ALPHA	FUNCTION
1	.368175	1.00000	2.78284
2	.207008	1.00000	.89179
3	.031600	1.00000	.04198
4	.000238	1.00000	.04078

1
TITLE: combine
PAGE : 7
EQS/MAC-PPC 5.4 SERIAL NUMBER:
a5006771432333□□□□□□□□□□
MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS

CUSTOMER=V25 = .690*V24 + 1.000 E25
.056
12.341

COOPRELA=V26 = .813*V24 + 1.000 E26
.056
14.493

CONTIMPR=V27 = .739*V24 + 1.000 E27
.068
10.864

BUSINESE=V28 = .292*V25 + .381*V26 + .113*V27 + .107*V29
.066 .063 .063 .050
4.398 6.086 1.791 2.158

1.000 E28

MGTBYFCT=V29 = .654*V24 + 1.000 E29
.086
7.583

1
TITLE: combine
PAGE : 8
EQS/MAC-PPC 5.4 SERIAL NUMBER:
a5006771432333□□□□□□□□□□
MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

VARIANCES OF INDEPENDENT VARIABLES

	V		F	
V24 -LEADERSH	.394*I			I
	.047 I			I
	8.307 I			I
	I			I

1
TITLE: combine
PAGE : 9
EQS/MAC-PPC 5.4 SERIAL NUMBER:
a5006771432333□□□□□□□□□□
MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

VARIANCES OF INDEPENDENT VARIABLES

	E		D	
E25 -CUSTOMER	.170*I			I
	.020 I			I
	8.307 I			I
	I			I
E26 -COOPRELA	.171*I			I
	.021 I			I
	8.307 I			I
	I			I
E27 -CONTIMPR	.252*I			I
	.030 I			I
	8.307 I			I
	I			I
E28 -BUSINESE	.094*I			I
	.011 I			I
	8.307 I			I
	I			I
E29 -MGTBYFCT	.404*I			I
	.049 I			I
	8.307 I			I

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

COVARIANCES AMONG INDEPENDENT VARIABLES

	E	D
E26 -COOPRELA	.064*I	I
E25 -CUSTOMER	.016 I	I
	4.144 I	I
	I	I
E27 -CONTIMPR	.056*I	I
E25 -CUSTOMER	.018 I	I
	3.057 I	I
	I	I
E29 -MGTBYFCT	.035*I	I
E25 -CUSTOMER	.023 I	I
	1.563 I	I
	I	I
E27 -CONTIMPR	.055*I	I
E26 -COOPRELA	.018 I	I
	3.000 I	I
	I	I
E29 -MGTBYFCT	.060*I	I
E26 -COOPRELA	.023 I	I
	2.597 I	I
	I	I
E29 -MGTBYFCT	.176*I	I
E27 -CONTIMPR	.031 I	I
	5.689 I	I
	I	I

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

STANDARDIZED SOLUTION:

```
 CUSTOMER=V25 =    .724*V24   + .689 E25
 COOPRELA=V26 =    .777*V24   + .630 E26
 CONTIMPR=V27 =    .679*V24   + .734 E27
 BUSINESE=V28 =    .296*V25   + .424*V26   + .130*V27   + .137*V29   +
.518 E28
 MGTBYFCT=V29 =    .542*V24   + .840 E29
```

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

CORRELATIONS AMONG INDEPENDENT VARIABLES

	E	D
E26 -COOPRELA	.377*I	I
E25 -CUSTOMER	I	I
	I	I
E27 -CONTIMPR	.269*I	I
E25 -CUSTOMER	I	I
	I	I
E29 -MGTBYFCT	.134*I	I
E25 -CUSTOMER	I	I
	I	I
E27 -CONTIMPR	.264*I	I
E26 -COOPRELA	I	I
	I	I
E29 -MGTBYFCT	.227*I	I
E26 -COOPRELA	I	I
	I	I
E29 -MGTBYFCT	.554*I	I
E27 -CONTIMPR	I	I
	I	I

EQS Output for all companies

E N D O F M E T H O D

1

Execution begins at 15:15:53
Execution ends at 15:16:00
Elapsed time = 7.00 seconds

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APPENDIX VII : EQS OUTPUT FOR THE CONSTRUCTION COMPANY

```
PROGRAM CONTROL INFORMATION

 1  /TITLE
 2  so6321
 3  /SPECIFICATIONS
 4   DATA='D:\SHUION\SO6321.ESS';
 5   VARIABLES=  6; CASES=   48;
 6   METHODS=ML;
 7   MATRIX=RAW;
 8  /LABELS
 9  V1=A; V2=B; V3=C; V4=D; V5=E;
10  V6=F;
11  /EQUATIONS
12  V2 =  + *V1 + E2;
13  V3 =  + *V1 + E3;
14  V4 =  + *V1 + E4;
15  V5 =  + *V1 + E5;
16  V6 =  + *V2 + *V3 + *V4 + *V5 + E6;
17  /VARIANCES
18  V1 = *;
19  E2 = *;
20  E3 = *;
21  E4 = *;
22  E5 = *;
23  E6 = *;
24  /COVARIANCES
25  E3 , E2 = *;
26  E4 , E2 = *;
27  E4 , E3 = *;
28  E5 , E2 = *;
29  E5 , E3 = *;
30  E5 , E4 = *;
31  /END

   31 RECORDS OF INPUT MODEL FILE WERE READ

DATA IS READ FROM D:\SHUION\SO6321.ESS
THERE ARE   6 VARIABLES AND    48 CASES
IT IS A RAW DATA ESS FILE
```

SAMPLE STATISTICS BASED ON COMPLETE CASES

UNIVARIATE STATISTICS

VARIABLE	A	B	C	D	E
MEAN	4.3648	4.3472	4.0486	3.6917	3.8750
SKEWNESS (G1)	-0.8004	-0.7179	-0.8421	-0.7400	-0.7333
KURTOSIS (G2)	-0.1166	0.0578	-0.1572	0.4928	0.1295
STANDARD DEV.	0.4973	0.5751	0.7283	0.6671	0.7738

VARIABLE	F
MEAN	4.1982
SKEWNESS (G1)	-0.6357
KURTOSIS (G2)	0.3199
STANDARD DEV.	0.5408

MULTIVARIATE KURTOSIS

MARDIA'S COEFFICIENT (G2,P) = 6.7499
NORMALIZED ESTIMATE = 2.3865

ELLIPTICAL THEORY KURTOSIS ESTIMATES

MARDIA-BASED KAPPA = 0.1406 MEAN SCALED UNIVARIATE KURTOSIS = 0.0403

MARDIA-BASED KAPPA IS USED IN COMPUTATION. KAPPA= 0.1406

CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE KURTOSIS:

CASE NUMBER	12	14	18	29	40
ESTIMATE	74.9646	58.8435	71.3858	40.3977	117.9581

COVARIANCE MATRIX TO BE ANALYZED: 6 VARIABLES (SELECTED FROM 6 VARIABLES)
BASED ON 48 CASES.

		A V 1	B V 2	C V 3	D V 4	E V 5
A	V 1	0.247				
B	V 2	0.221	0.331			
C	V 3	0.334	0.344	0.530		
D	V 4	0.223	0.262	0.353	0.445	
E	V 5	0.292	0.311	0.434	0.393	0.599
F	V 6	0.232	0.247	0.341	0.253	0.326

		F V 6
F	V 6	0.293

BENTLER-WEEKS STRUCTURAL REPRESENTATION:

NUMBER OF DEPENDENT VARIABLES = 5
DEPENDENT V'S : 2 3 4 5 6

NUMBER OF INDEPENDENT VARIABLES = 6
INDEPENDENT V'S : 1
INDEPENDENT E'S : 2 3 4 5 6

NUMBER OF FREE PARAMETERS = 20
NUMBER OF FIXED NONZERO PARAMETERS = 5

3RD STAGE OF COMPUTATION REQUIRED 2329 WORDS OF MEMORY.
PROGRAM ALLOCATED 100000 WORDS

DETERMINANT OF INPUT MATRIX IS 0.41085E-05

TITLE: so6321
07/26/99 PAGE : 4
EQS/EM386 Licensee: wong shiu ho□□□□□□□□□□□□□□□□□□□Serial #: e5720771417991
MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

PARAMETER ESTIMATES APPEAR IN ORDER,
NO SPECIAL PROBLEMS WERE ENCOUNTERED DURING OPTIMIZATION.

RESIDUAL COVARIANCE MATRIX (S-SIGMA) :

		A V 1	B V 2	C V 3	D V 4	E V 5
A	V 1	0.000				
B	V 2	0.000	0.000			
C	V 3	0.000	0.000	0.000		
D	V 4	0.000	0.000	0.000	0.000	
E	V 5	0.000	0.000	0.000	0.000	0.000
F	V 6	0.013	0.000	0.000	0.000	0.000

		F V 6

F V 6 0.000

AVERAGE ABSOLUTE COVARIANCE RESIDUALS = 0.0006
AVERAGE OFF-DIAGONAL ABSOLUTE COVARIANCE RESIDUALS = 0.0009

STANDARDIZED RESIDUAL MATRIX:

		A V 1	B V 2	C V 3	D V 4	E V 5
A	V 1	0.000				
B	V 2	0.000	0.000			
C	V 3	0.000	0.000	0.000		
D	V 4	0.000	0.000	0.000	0.000	
E	V 5	0.000	0.000	0.000	0.000	0.000
F	V 6	0.049	0.000	0.000	0.000	0.000

		F V 6
F	V 6	0.000

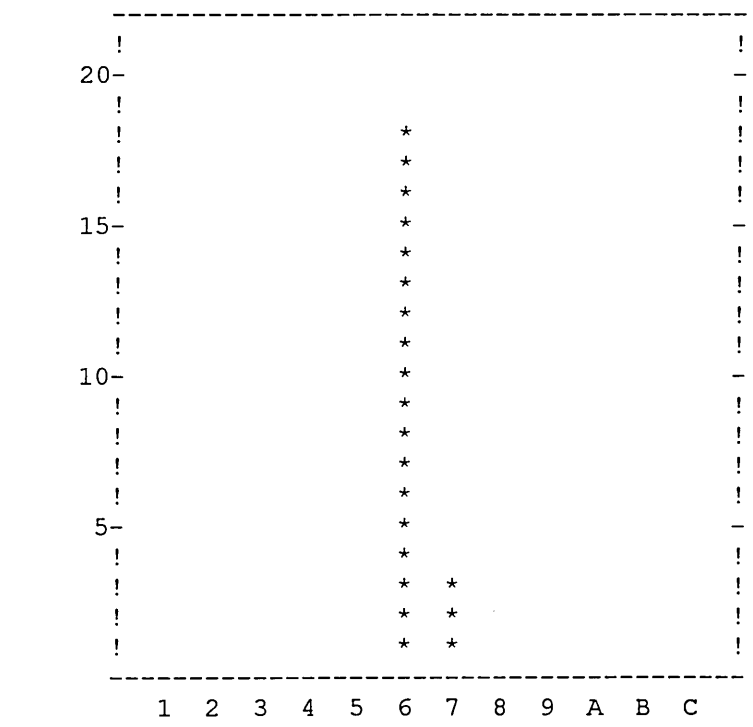
AVERAGE ABSOLUTE STANDARDIZED RESIDUALS = 0.0023
AVERAGE OFF-DIAGONAL ABSOLUTE STANDARDIZED RESIDUALS = 0.0032

TITLE: so6321
07/26/99 PAGE : 5
EQS/EM386 Licensee: wong shiu ho□□□□□□□□□□□□□□□□□□□Serial #: e5720771417991
MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

LARGEST STANDARDIZED RESIDUALS:

V 6,V 1	V 6,V 6	V 2,V 2	V 6,V 4	V 4,V 2
0.049	0.000	0.000	0.000	0.000
V 6,V 5	V 3,V 2	V 5,V 4	V 6,V 2	V 5,V 5
0.000	0.000	0.000	0.000	0.000
V 6,V 3	V 5,V 3	V 5,V 2	V 1,V 1	V 4,V 4
0.000	0.000	0.000	0.000	0.000
V 4,V 3	V 4,V 1	V 3,V 3	V 3,V 1	V 2,V 1
0.000	0.000	0.000	0.000	0.000

DISTRIBUTION OF STANDARDIZED RESIDUALS



	RANGE			FREQ	PERCENT
1	-0.5	-	--	0	0.00%
2	-0.4	-	-0.5	0	0.00%
3	-0.3	-	-0.4	0	0.00%
4	-0.2	-	-0.3	0	0.00%
5	-0.1	-	-0.2	0	0.00%
6	0.0	-	-0.1	18	85.71%
7	0.1	-	0.0	3	14.29%
8	0.2	-	0.1	0	0.00%
9	0.3	-	0.2	0	0.00%
A	0.4	-	0.3	0	0.00%
B	0.5	-	0.4	0	0.00%
C	++	-	0.5	0	0.00%
	TOTAL			21	100.00%

EACH "*" REPRESENTS 1 RESIDUALS

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 315.508 ON 15 DEGREES OF FREEDOM

INDEPENDENCE AIC = 285.50846 INDEPENDENCE CAIC = 242.44044
MODEL AIC = 2.05485 MODEL CAIC = -0.81636

CHI-SQUARE = 4.055 BASED ON 1 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.04404
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 3.885.

BENTLER-BONETT NORMED FIT INDEX= 0.987
BENTLER-BONETT NONNORMED FIT INDEX= 0.848
COMPARATIVE FIT INDEX (CFI) = 0.990

ITERATIVE SUMMARY

ITERATION	PARAMETER ABS CHANGE	ALPHA	FUNCTION
1	0.467180	1.00000	3.45564
2	0.233764	1.00000	0.17404
3	0.013851	1.00000	0.08664
4	0.000082	1.00000	0.08627

TITLE: so6321
07/26/99 PAGE : 7
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MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS

```
B     =V2  =    .892*V1    + 1.000 E2
                 .107
                8.313

C     =V3  =   1.352*V1    + 1.000 E3
                 .082
               16.508

D     =V4  =    .902*V1    + 1.000 E4
                 .145
                6.224

E     =V5  =   1.181*V1    + 1.000 E5
                 .148
                7.985

F     =V6  =    .190*V2    +  .378*V3    +  .013*V4    +  .163*V5
                 .112          .100          .089          .082
                1.696         3.798          .144         1.995

              + 1.000 E6
```

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

VARIANCES OF INDEPENDENT VARIABLES

	V		F	
V1 - A	.247	*		
	.051			
	4.848			

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

VARIANCES OF INDEPENDENT VARIABLES

	E		D	
E2 - B	.134	*		
	.028			
	4.848			
E3 - C	.078	*		
	.016			
	4.848			
E4 - D	.244	*		
	.050			
	4.848			
E5 - E	.254	*		
	.052			
	4.848			
E6 - F	.060	*		
	.012			
	4.848			

MAXIMUM LIKELIHOOD SOLUTION (NORMAL DISTRIBUTION THEORY)

COVARIANCES AMONG INDEPENDENT VARIABLES

	E	D
E3 - C	.046*I	I
E2 - B	.016 I	I
	2.816 I	I
	I	I
E4 - D	.063*I	I
E2 - B	.028 I	I
	2.252 I	I
	I	I
E5 - E	.051*I	I
E2 - B	.028 I	I
	1.826 I	I
	I	I
E4 - D	.051*I	I
E3 - C	.021 I	I
	2.382 I	I
	I	I
E5 - E	.039*I	I
E3 - C	.021 I	I
	1.815 I	I
	I	I
E5 - E	.130*I	I
E4 - D	.041 I	I
	3.171 I	I
	I	I

STANDARDIZED SOLUTION: R-SQUARED

B	=V2	=	.771*V1	+ .636 E2				.595
C	=V3	=	.924*V1	+ .384 E3				.853
D	=V4	=	.672*V1	+ .740 E4				.452
E	=V5	=	.759*V1	+ .651 E5				.576
F	=V6	=	.202*V2	+ .510*V3	+ .016*V4	+ .233*V5	+ .452 E6	.796

CORRELATIONS AMONG INDEPENDENT VARIABLES

	E	D
E3 - C	.450*I	I
E2 - B	I	I
	I	I
E4 - D	.348*I	I
E2 - B	I	I
	I	I
E5 - E	.276*I	I
E2 - B	I	I
	I	I
E4 - D	.371*I	I
E3 - C	I	I
	I	I
E5 - E	.275*I	I
E3 - C	I	I
	I	I
E5 - E	.522*I	I
E4 - D	I	I
	I	I

EQS output for the construction company

E N D O F M E T H O D

1

Execution begins at 21:05:26.47
Execution ends at 21:05:27.51
Elapsed time = 1.04 seconds

Relationship with Supply Partners

與供應商的關係

INSTRUCTIONS提示

APPENDIX VIII:QUESTIONNAIRE

This survey is concerned with how companies in Hong Kong work with their suppliers. Please answer the questions about one major supplier of your company. This supplier can supply goods or services to your company. Make your judgments based on your thoughts about how your company works with this supply partner on a day-to-day basis.

此研究是關於香　公司怎樣與供應商一起工作，請就您與其中一個主要的供應商的關係作答。此供應商可以是您的物料供應商或您的承判商。

Please return the completed questionnaire to the following address or by the prepaid envelope.

請將填妥的問卷寄回以下地址或用附上之回郵信封寄回。

Alfred Wong
Assistant Professor
Department of Management
Lingnan College
Tuen Mun, N.T.

Your Company Name:
貴公司名稱 _____

Your Supplier's Name:
供應商名稱 _____

Please circle the number from "1" to "5" that indicates how well it describes your relationship with the supplier. Use the following 5-point rating system to record your answers:

請在以下每題圈出 "1" 至 "5" 內之數字來表示您對每題所述貴公司與此供應商目前之關係的同意程度。請用下列的量表法去表達您對以下每題的同意程度（請盡可能避免挑選中立的意見）：

1. Strongly disagree極之不同意
2. Disagree頗不同意
3. Neither agree nor disagree中立
4. Agree頗同意
5. Strongly agree極之同意

例:

4. The operations between our firm and the supplier are smooth. 我們與此供應商有暢順的運作。	1 2 3 4 (5)

解釋: 如您圈出5，這代表您極之同意貴公司與此供應商目前有暢順的運作。

	Strongly Disagree 極不同意				Strongly Agree 極同意
I. Leadership: cooperative culture 管理層/公司與此供應商或承判商的合作文化					
1. Our top management perceives that we and this supplier seek compatible goals. 公司管理層相信我們與此供應商彼此尋求可兼容的目標。	1	2	3	4	5
2. Our top management believes that we and the supplier want each other to succeed. 公司管理層相信我們與此供應商彼此希望對方成功.	1	2	3	4	5
3. Our top management considers that our goals and those of the supplier go together.公司管理層認爲我們與此供應商的目標很配合.	1	2	3	4	5
4. Our top management believes that when the supplier and we work together, we usually have common goals. 公司管理層相信我們與此供應商一 工作時彼此通常會有共同目標。	1	2	3	4	5
II. Leadership: Commitment to relationship 公司與此供應商的關係	極不同意				極同意
1. Our company considers that maintaining a long-term relationship with this supplier is important to us. 公司相信與此供應商維持長遠關係對我們是重要的。	1	2	3	4	5
2. Our company believes that over the long run our relationship with the supplier will be profitable. 公司相信長遠來說我們與此供應商的關係是有利的。	1	2	3	4	5
3. Our company focuses on long-term goals in the relationship with the supplier. 與此供應商的關係上，公司著重長遠的目標。	1	2	3	4	5
4. Our company expects the supplier to be working with us for a long time. 公司期望此供應商將會與我們合作一段長時間。	1	2	3	4	5
III. Leadership: Commitment to Quality 公司管理層對品質的支持	極不同意				極同意
1. Our top management supports long term quality improvement process. 公司管理層支持長期的品質改善過程。	1	2	3	4	5
2. Our top management participates in the quality improvement process. 公司管理層參與品質改善的過程。	1	2	3	4	5
3. Our top management sets objectives for quality performance. 公司管理層制定品質表現的目標。	1	2	3	4	5
4. Our top management considers that quality can improve business performance. 公司管理層認爲品質能改善業務的表現。	1	2	3	4	5
IV. Customer Focus: Commitment to customer satisfaction 公司對滿足顧客的承擔	極不同意				極同意
1. Our firm commits to providing high quality products or services to our customers. 我們公司致力於給予顧客高質素的產品或服務。	1	2	3	4	5

	Disagree 極不同意				Agree 極同意
2. Our firm commits to giving customers the best value for money. 我們公司致力於給予顧客物有所值的貨品。	1	2	3	4	5
3. Our firm commits to meeting customers' needs in the shortest time. 我們公司致力於在最短的時間內達到顧客的需要。	1	2	3	4	5
4. Our firm commits to providing the best performance to our customers. 我們公司致力於提供最好的表現給我們的顧客。	1	2	3	4	5

V. Customer focus: commitment to supply partner satisfaction

公司對滿足此供應商的承擔	極不同意				極同意
1. We want our supplier satisfied with the information we give them to facilitate their work. 我們希望此供應商滿意我們爲促進他們的工作所提供的資料。	1	2	3	4	5
2. We want our supplier satisfied with the time they have to process our order. 我們希望此供應商滿意我們給予他們處理訂單的時間。	1	2	3	4	5
3. We want our supplier satisfied with our support. 我們希望此供應商滿意我們對他們的支持。.	1	2	3	4	5
4. We want our supplier satisfied with the relationship with us. 我們希望此供應商滿意與我們的關係。	1	2	3	4	5

VI. Cooperative relationship: supplier dynamics

公司與此供應商的合作關係	極不同意				極同意
1. An atmosphere of cooperation exists between our firm and this supplier. 我們與此供應商有互相合作的氣氛。	1	2	3	4	5
2. Our supplier and we work together for the benefits of both companies. 我們與此供應商一　合作，共同爲對方利益　想。	1	2	3	4	5
3. Communication between our firm and this supplier is effective. 我們與此供應商有有效的溝通。	1	2	3	4	5
4. The operations between our firm and the supplier are smooth. 我們與此供應商有暢順的運作。	1	2	3	4	5

VII. Cooperative relationship: Cooperative Goals

公司與此供應商的合作目標	極不同意				極同意
1. The supplier and we want each other to succeed. 我們與此供應商彼此　希望對方成功。	1	2	3	4	5
2. The supplier and we seek compatible goals. 我們與此供應商尋求相兼容的目標。	1	2	3	4	5
3. Our goals and those of the supplier go together. 我們與此供應商的目標很配合。	1	2	3	4	5
4. When the supplier and we work together, we usually have common goals. 我們與此供應商一起工作時，通常有共同的目標。	1	2	3	4	5

VIII.Cooperative relationship: Constructive Controversy 公司與此供應商的的溝通	Strongly Disagree 極不同意				Strongly Agree 極同意
1. This supplier and we listen carefully to each other's opinions. 此供應商與我們都留心聽對方的意見。	1	2	3	4	5
2. The supplier and we try to understand each other's concerns. 此供應商與我們嘗試去明白彼此的關注。	1	2	3	4	5
3. The supplier and we try to use each other's ideas. 此供應商與我們嘗試去採用彼此的意見。	1	2	3	4	5
4. Even when we and the supplier disagree, we communicate respect for each other.即使我們與此供應商的意見不合，彼此仍能表達對對方的尊重。	1	2	3	4	5

IX. Management By Fact: Seamless Operation 管理方面: 連貫的運作	極不同意				極同意
1. Our company meets with this supplier's senior management on a regular basis to discuss problems. 我們公司與此供應商的管理層有定期相討問題。	1	2	3	4	5
2. Our company and this supplier routinely perform joint cost-reduction/quality improvement programmes我們公司與此供應商慣常地進行聯合減低成本／改進品質的計劃。	1	2	3	4	5
3. Our company involves this supplier at idea-inception stage in design changes/ product variations 在我們商品設計改變的初期，我們便使此供應商參與我們的計劃。	1	2	3	4	5
4. Our company provides this supplier with technical support when supplier experiences a production / quality problem 當此供應商遇上生產／品質問題時，公司會提供技術支援。	1	2	3	4	5

X. Management By Fact: Integrated Structure 管理方面: 連繫的結構	極不同意				極同意
1. Tight operating linkages are planned for and implemented between our firm and this supplier. 我們公司與此供應商計劃及進行密切的工作連繫。	1	2	3	4	5
2. There are people in both our company and this supplier who focus on optimising the relationship between the two companies 我們公司與此供應商彼此有人負責竭力維繫兩 最佳的關係。	1	2	3	4	5
3. This supplier has invested in assets specifically for our company's requirements. 此供應商有投資一些資產來切合我們特別的須要。	1	2	3	4	5
4. We have channels established to facilitate communication between our company and this supplier 我們有建立一些渠道來協助我們與此供應商溝通。	1	2	3	4	5

XI. Management By Fact: Performance Measurement

管理方面: 表現評估

	Strongly Disagree 極不同意				Strongly Agree 極同意
1. Our company assesses the supplier's performance through a formal evaluation programme. 我們公司是通過正式的評估計劃去評定此供應商的表現。	1	2	3	4	5
2. Our company has performance standards for the supplier to meet. 我們公司設有表現標準給此供應商參照。	1	2	3	4	5
3. Our company has objective information on the performance of the supplier. 我們公司對此供應商的表現有客觀性的資料。	1	2	3	4	5
4. Our company has a system to record and analyse complaints from the supplier. 我們公司有系統去記錄及分析此供應商的投訴。	1	2	3	4	5

XII. Management by Fact: Information Exchange

管理方面: 資訊的交流

	極不同意				極同意
1. Our firm and this supplier share work improvement suggestions with each other. 我們公司與此供應商互相分享改善工作的意見。	1	2	3	4	5
2. Our firm routinely advises the supplier of their performance. 我們公司定期告知供應商他們的表現。	1	2	3	4	5
3. Our firm regularly provides this supplier with forecasts of our requirement for their products. 我們公司定期提供我們需求的預計給此供應商。	1	2	3	4	5
4. Our firm shares our own information with this supplier to facilitate the efficient flow of supplies. 我們公司將所擁有的資料與此供應商分享，使他們的供應更有效率。	1	2	3	4	5

XIII.Continuous Improvement : Process improvement

不斷改善: 過程改善

	極不同意				極同意
1. Our company has measures to prevent problems arising from our relationship with the supplier. 我們公司有措施來預防我們與此供應商的關係出現問題。	1	2	3	4	5
2. We continuously work at integrating the process between our company and this supplier. 我們與此供應商不斷地使彼此間之工作程序連結起來。	1	2	3	4	5
3. The supplier and we have established procedures that help us continually improve the quality we give our customer.我們與此供應商所建立的程序有助我們不斷改善提供給顧客的品質。	1	2	3	4	5
4. We continuously simplify the operation between our company and the supplier. 我們不斷地簡化與此供應商的運作。	1	2	3	4	5

XIV.Continuous Improvement : Planning & Prevention
不斷改善: 計劃及預防

	Strongly Disagree 極不同意				Strongly Agree 極同意
1. Our company has measures to prevent problems arising from our relationship with the supplier. 我們公司有措施來預防我們與此供應商的關係出現問題。	1	2	3	4	5
2. Our supplier has measures to prevent substandard materials being delivered to us. 此供應商有措施來預防一些未合水準的物料運送給我們。	1	2	3	4	5
3. Our company is committed to continuous improvement in the operation with the supplier 我們公司致力於不斷改進與此供應商之間的運作。	1	2	3	4	5
4. We solicit and welcome suggestions from the supplier to improve our operation. 我們歡迎此供應商對我們的運作改進提供意見。	1	2	3	4	5

XV. Business Excellence: supplier satisfaction
卓越成效: 供應商的滿意程度

	極不同意				極同意
1. Our supplier is satisfied with the information we supply them to facilitate their work. 此供應商滿意我們爲促進他們的工作所提供的資料。	1	2	3	4	5
2. Our supplier is satisfied with the time given to them to process our order. 此供應商滿意我們給予他們處理訂單的時間。	1	2	3	4	5
3. Our supplier is satisfied with the support we give them. 此供應商滿意我們給予他們的支持	1	2	3	4	5
4. Our supplier is satisfied with their relationship with our firm. 此供應商滿意與我們的關係。	1	2	3	4	5

XVI. Business excellence: supplier contribution
卓越成效: 供應商的供獻

	極不同意				極同意
1. This supply partner helps us be timely in delivering orders to our customers此供應商有助我們準時交貨給顧客。	1	2	3	4	5
2. The supply partner helps us reach our quality objectives. 此供應商有助我們達到品質的目標。	1	2	3	4	5
3. The supply partner helps us estimate costs and revenues accurately. 此供應商有助我們準確地估計成本與收入。	1	2	3	4	5
4. The supply partner contributes to the overall quality of our operations. 此供應商對我們營運的整體品質有貢獻。	1	2	3	4	5

XVII.Business Excellence: Customer Satisfaction

卓越成效: 顧客的滿意程度

	Strongly Disagree 極不同意				Strongly Agree 極同意
The following questions relate to customer satisfaction towards the ultimate product(s) of your company which has incorporated the input of this supplier: 此部份的問題，是您認爲顧客對貴公司與此供應商有關的產品或服務的滿意程度：					
1. Customers are satisfied with the quality of our product(s) 顧客滿意我們該產品的品質。	1	2	3	4	5
2. Customers are satisfied with the price of our product(s) 顧客滿意我們該產品的訂價。	1	2	3	4	5
3. Customers are satisfied with the delivery time of our product(s). 顧客滿意我們該產品之交貨時間。	1	2	3	4	5
4. Customers are satisfied with the performance of our product(s) 顧客滿意我們該產品的表現。	1	2	3	4	5

XVIII. Business Excellence: Business Results

卓越成效: 公司的表現

	極不同意				極同意
The following questions relate to the overall performance of your company : 此部份的問題，是有關貴公司整體上的表現：					
1. Our product quality is very competitive in the market. 我們產品的品質在市場上很具競爭力。	1	2	3	4	5
2. Our response time to customers is very competitive in the market. 我們對顧客在時間上的反應在市場上很具競爭力。	1	2	3	4	5
3. Our product cost is very competitive in the market. 我們產品的成本在市場上很具競爭力。	1	2	3	4	5
4. Our firm's overall performance is better than our competitors. 我們公司整體上的表現都比我們的對手較好。	1	2	3	4	5

XIX. Background information背景資料

The following questions are about yourself and your supplier. Your information will be held completely confidential and used for academic purposes only. Please check the appropriate box and fill in the information.

下列問題有關您及您公司供應商的資料，您所提供的資料，只會由該項研究人員處理，並且只會作整體分析。我們對您所提供的任何資料絕對保密，請放心作答。請在適合的框框中打勾，及填寫。

A. Personal Information: 個人資料

1. Your gender: 您的性別：

☐ Male 男 ☐ Female女

2. Your position您的職位是:

☐ Employee 一般員工 ☐ Middle manager中層主管

☐ Supervisor 基層主管 ☐ Senior manager高層主管

3. Hong long have you worked for this organisation? _____Years年
請問您在此公司工作了多久?

4. How long have you been dealing with this supplier? _____Years年
請問您與此供應商/承判商合作了多久？

B. Supplier's Background information 供應商的背景資料

1. What is the capital base of this supplier此供應商主要資本來源是?

☐ Hong Kong based香港

☐ Foreign based 海外(If yes, please specify) 請註明: _____

2. Please give some comments on this supplier. Your comments may relate to aspects such as the supplier's relationship with your company, its contributions towards your company or problems it brings to your company, etc. Or, you may write down anything you want to say about this supplier.
請您提供一些您對此供應商的意見。例如：此供應商與貴公司的關係、他們帶來貴公司的好處或問題等；或您可以寫下任何有關此供應商的意見。

_____

_____

_____

_____

END OF QUESTIONNAIRE. THANK YOU VERY MUCH FOR YOUR HELP.

<< 全卷完，非常感謝您的參與>>

Request for Summary of findings

I would like to have a copy of the summary of findings. Please send it to the following address.

Company: _____

Address : _____

_____

_____

Attn. : _____