FACTORS AFFECTING
SUPPLIER MANAGED INVENTORY (SMI)
IMPLEMENTATION

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ABSTRAK

Pengurusan kos pembiayaan barangan merupakan masalah utama terhadap keberkesanan rantaian bekalan ini. Konsep Pembekal Mengurus Inventori (Supplier Managed Inventory, SMI) muncul berdasarkan dari keperluan untuk berkesan dalam rantaian bekalan dengan sasaran penyambungan barangan. Namun begitu, kebanyakan penyelidikan adalah menumpu kepada industri-industri runcit dan syarikat-syarikat besar. Masih terdapat kekurangan kajian ke atas faktor-faktor yang mempengaruhi kejayaan rancangan SMI dalam industri pengeluaran. Penyelidikan ini bertujuan untuk menilai keberkesanan atau pencapaian SMI ini, dari sudut pandangan pembekal-pembekal, dalam merangkakan faktor-faktor seperti sumber-sumber fizikal, manusia dan kewangan yang mempengaruhi kerjayaan SMI. Berdasarkan data daripada 96 buah syarikat pengeluaran yang mengguna program SMI di Malaysia, kajian ini menunjukkan bahawa sumber fizikal asas dan sumber fizikal lanjutan adalah penentu positif terhadap kejayaan SMI. Manakala, rintangan terhadap program SMI didapati adalah penentu negatif terhadap kejayaan SMI. Kajian ini tidak berjaya menunjukkan pengaruh penyederhana daripada faktor-faktor persekitaran ke atas hubungan sumber dan pencapaian.

ABSTRACT

A major impediment to efficient supply chain integration is the cost of managing inventory. Due to the need to create efficiencies in the supply chain by targeting this "inventory" link, the concept of Supplier Managed Inventory (SMI) was born. However, most of the research has focused on the grocery industry and large companies. There is a lack of studies on the factors that affect the success of SMI programs in manufacturing industry. This research intends to assess the firm performance with SMI implementation from the suppliers' perspective in relation to the factors such as resources – physical resources, human resources and financial resources that influencing the success. Based on data from 96 manufacturing companies identified purposively that support SMI programs in Malaysia, the study shows that basic physical resources and advanced resources are positive predictors towards SMI success. However, resistance to SMI programs is found to be a negative predictor towards the SMI success. The study does not find any moderating influence of environmental factors on resources – performance relationship.

Chapter 1

INTRODUCTION

1.1 Background

Companies must continuously strive to gain maximum return on their investment in resources in order to become or remain competitive in their markets. The supply chain management process has been identified as an area of opportunity to add value, and further reduce costs and increase efficiencies. Besides, there is a growing recognition that supply chain management can have a strong effect on customer service levels, thereby enhancing revenues (McMullan, 1996).

Supply chain management enables the coordinated management of material and information flows from suppliers to customers throughout the chain and the core objective of supply chain management is to reduce or minimize total cost, improve total quality, maximize customer service, and increase profit (Boubekri, 2001). A supply chain is a dynamic system; it involves all activities in receiving raw material to delivery finished products to the customer. Supply chain management coordinates and integrates all of these activities such as manufacturing, inventory control, distribution, warehousing, and customer service into a seamless process. Supply chain management is viewed as a major solution to cost reduction and profitability with increasing global competition and emergence of e-business (Tyan & Wee, 2003).

Kaipia, Holmström and Tanskanen (2002) contend that one of the most challenging issues for fulfilling customer needs is to manage the order-delivery processes between organizations. The major goal is to minimize the waste of time and enable fast and reliable reactions to demand changes by developing such processes between suppliers, manufacturers, wholesalers and retailers (Kaipia *et al.*,

2002). The lack of demand visibility has been identified as an important challenge for supply chain management and the orders placed by the customers are the only factual demand information that companies access. As shown in both practice and research, order information often gives a delayed and distorted picture of end customer demand and this distortion tends to increase upstream in the supply chain, making demand look variable and unpredictable even the demand is constant from end customer. It easily leads to inefficient capacity utilization, poor product availability, and high stock levels if controlling production and inventories based on this flawed demand information (Småros, Lehtonen, Appelqvist & Holmström, 2003).

Companies have started to develop replenishment methods that operate without orders in order to overcome this problem and to obtain a smoother material flow (Småros *et al.*, 2003). Due to the need to create efficiencies in the supply chain by targeting this "inventory" link, the concept of Supplier Managed Inventory (SMI) was born. In SMI, the supplier is given access to its customer's inventory and demand information and the customer sets the target for availability. Then, the supplier monitors the customer's inventory level and has both responsibility and authority to replenish the customer's stock according to jointly agreed inventory control principles and objectives (Kaipia *et al.*, 2002; Småros *et al.*, 2003). By using SMI, a customer no longer "pulls" inventory from his suppliers, the inventory is automatically "pushed" to the customers as suppliers check their customer inventories online and respond according to pre-established inventory high and low stocking limits. SMI benefits have been described in various published studies and its benefits range from cost reduction to service improvement. From a survey done by Tyan and Wee (2003) in a Taiwanese grocery industry, the inventory level in Distribution Centre of Wellcome supermarket chains stores is 24 days before SMI implementation,

and it drops to 13 days in phase II of SMI implementation. As cited in Tyan and Wee (2003), Vergin and Barr (1999) reported that the surveyed grocery manufacturers achieved an average of 30% inventory reduction and a reduced average of 55% stock outs due to SMI (which the authors term "continuous replenishment program").

SMI was popularized in the late 1980s by Wal-Mart and Procter & Gamble and became one of the key programs in the grocery industry (Waller, Johnson & Davis, 1999). However, SMI in the manufacturing industry is one of the fields that lack research attention. Therefore, there is a need to have a more comprehensive understanding on factors that influence the success of SMI programs implementation.

1.2 Problem Statement

A major impediment to efficient supply chain integration is the cost of managing inventory. Inventory however is a necessary evil. Even the advent of Just-in-Time manufacturing, which tries to achieve zero inventories, has not completely eliminated the need for inventory. The firms would not have a business without inventory, and they will be inefficient in business without good inventory management. In inventory management, SMI is one of the common discussed partnering initiatives for improving multi-firm supply chain efficiency. Dong and Xu (2002) noted that SMI achieved higher penetration than just-in-time (JIT) and stockless methods as shown in one survey of hospital materials management. SMI programs would multiply in the next few years as indicated in another survey of the mass retail industry as cited in Dong and Xu (2002). This recent popularity of SMI has led to the claim that SMI is the wave of the future and the SMI concept will revolutionize the distribution channel (Dong & Xu, 2002).

However, most of the researches such as Disney and Towill (2002), Holmström (1998a & 1998b), Waller *et al.* (1999), Tyan and Wee (2003) have focused on the grocery industry and large companies. There is a lack of studies on the factors that affect the success of SMI programs in manufacturing industry. This research intends to assess the firm performance with SMI implementation from the suppliers' perspective in relation to the factors influencing the success.

1.3 Research Objectives

The objective of this research is to identify resources that influence the implementation success of SMI programs in manufacturing industry from suppliers' perspective. This study is also to assess the moderator effect of environmental factors such as demand distortion and supplier lead-time in mitigating the impact of resources on the success of SMI programs.

1.4 Research Questions

In achieving the above objectives, the basic research questions that this study addressed are:

i. What are the resources affecting the success of SMI programs?
ii. Does the demand distortion moderate the impact of resources on the success of SMI programs?
iii. Does the supplier lead time moderate the impact of resources on the success of SMI programs?

1.5 Scope of Research

The firms in this research will cover the manufacturing industry in the Malaysia. The unit of analysis for this research will be the suppliers of companies that implement SMI programs.

There are a number of factors that determine the success of SMI programs. They are external environmental factors such as social, economic and political; organizational factors like culture, values or norms; resources such as physical resources, human resources and financial resources; and internal environmental factors like demand distortion and supplier lead time. Since the unit of analysis is operating in the same geographical area, which is in the Malaysia, it is subject to the same political, economic and social conditions. Due to these similarities, this research does not consider the external environmental factors. The research strictly focuses on the resources and internal environmental factors that influence the success of SMI implementation.

1.6 Significance of Study

A key issue in supply chain management is managing the order-delivery processes between organizations. However, a lot of problems still remain even though traditional processes such as just-in-time (JIT), lean and agile practices have increased the visibility in supply chains. SMI is a recent alternative for the traditional order replenishment practices and it gives the supplier both responsibility and authority to manage the entire replenishment process. (Kaipia *et al.* 2002)

Since there are a lot of factors affecting SMI performance from different perspectives, this research will only focus on the supplier perspective. The supplier perspective in SMI is unknown due to lack of empirical studies. This study will

increase our understanding of the factors influencing SMI programs towards the firm performance. This information will be useful and can be benchmarked by the companies that going to adopt this SMI program in their inventory management.

1.7 Definitions of Terms

For the purposes of this research study, the following terms need clarification:

Supplier Managed Inventory (SMI) is a supply chain strategy where the vendor or supplier is given both responsibility and authority of managing the customer's stock (Disney & Towill, 2003b) as well as the entire replenishment process (Kaipia *et al.*, 2002). In SMI, the customer company provides the supplier access to its inventory and demand information, and sets the targets for availability (Kaipia *et al.*, 2002).

Resources can include anything that might be thought of as a strength or weakness of a given firm. More formally, a firm's resources could be defined as those (tangible and intangible) assets which are tied semi-permanently to the firm at a given time (Wernerfelt, 1984). More specifically, resources must have four attributes: valuable in exploiting opportunities or neutralizes threats, rare among firm's competition, hard to imitate, and have no direct substitutes (Barney, 1991).

SMI success refers to lower incidences of stock-out situations and hence an increase in the levels of customer services, and cost reduction due to an increase in inventory turns and a decrease in the levels of safety stock (Kuk, 2003).

1.8 Outline of Report

Chapter 1, the current chapter introduces the problem of research and discusses its context. Chapter 2 will review the relevant literature, in particular the supplier management inventory (SMI) and the resource-based theory. This is followed by a proposal of the theoretical framework and development of research hypotheses. Chapter 3 will discuss design of the study, and methodology of research. Subsequently, Chapter 4 will analyze the research hypotheses and present the findings of the study. Finally, the managerial implications and the conclusion of this research will be discussed in Chapter 5.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

There are a lot of studies on the supplier managed inventory (SMI) and the resource-based theory. This chapter reviews the findings from previous studies and reports that are deemed most relevant to the present study. It begins with a review of inventory management, then is followed by historical development of SMI, SMI overview, resource-based theory, SMI resources, environmental factors, SMI performance and a of summary of literature review will be drawn. Finally, the theoretical framework and hypotheses that seek to answer the research questions stated in section 1.4 are presented.

2.2 Inventory Management

Disney and Towill (2003b) noted that a supply chain is a system consisting of material suppliers, production facilities, distribution services, and customers who are all linked together through the downstream feed-forward flow of materials (deliveries) and the upstream feedback flow of information (orders). Each "player" in a traditional supply chain, is responsible for his own inventory control and production ordering activities. As a result of the need for a company to be in control of its own assets and uneconomical to pass vast amounts of information around, the structure of the traditional supply chain has been developed. Each echelon only has information about what their immediate customers want in the supply chain but do not know what the end customer wants (Disney & Towill, 2003b). Companies experience intensifying cost competition as well as rising customer sophistication are playing

important role in growing situations of the supply chain (Holmström, 1998a). This does not allow suppliers to obtain any insight into what their customers are ordering to cover their own inventory-based customer service level and cost requirements, and what the customers are ordering to satisfy immediate customer demand (Disney & Towill, 2003b). Blatherwick (1996) cited that inventory management is more than simply forecasting and replenishment; good inventory management is the management of inventory to optimize service and profit. In order to understand the precise effects of changes in stockholding policies, lead times or shipping quantities, the use of sophisticated business modeling techniques should be included. Inventory management is a great profit generator which must be taken seriously and given the time it deserves. The really successful companies have already begun to realize this (Blatherwick, 1996).

Lack of demand visibility can and does cause a number of problems in a supply chain if it is not properly designed and even then fluctuations cannot be completely eliminated. In reacting to this scenario, many companies have been compelled to improve their supply chain operations by sharing demand and inventory information with their suppliers and customers (Disney & Towill, 2002b; Disney & Towill, 2003b). Supplier-managed inventory (SMI) is one of the common types of these automatic replenishment programs (Daugherty, Myers & Autry, 1999).

Supplier Managed Inventory (SMI), also known as vendor-managed inventory (VMI) or consignment inventory (Dong & Xu, 2002) or vendor-managed replenishment (Tyan & Wee, 2003) on other occasions, has been widely used in various industries. For instance, SMI achieved higher penetration than just-in-time and stockless methods in one survey in hospital materials management, and another survey of the mass retail industry indicated that SMI programs would multiply in the

next few years (Dong & Xu, 2002). SMI has become more popular in the grocery sector in the last 15 years due to the success of retailers such as Wal-Mart (Dong & Xu, 2002; Disney & Towill, 2003b). As cited by Dong and Xu (2002), other major retailers such as Kmart, Dillard Department Stores, and JCPenney are among the early adopters of SMI and telecommunications giants such as Lucent Technologies are in the process of converting much of their materials management systems to SMI. Throughout the supply chain, SMI strategy takes a holistic view of inventory levels by delegating the control of all inventories, including shipments between echelons to a single point (Waller *et al.*, 1999; Disney, Potter & Gardner, 2003a).

2.3 Historical Development

This literature review begins with the historical development of Supplier-Managed Inventory (SMI). Tyan and Wee (2003) noted that SMI is a "pull" replenishment practice which is designed to enable a Quick Response (QR) from the supplier to actual demand. SMI represents the highest level of partnership. In SMI, the supplier is the primary decision-maker on the appropriate inventory levels of each of the products (within previously agreed upon bounds), and the appropriate inventory policies to maintain these levels (Tyan & Wee, 2003).

The early development of QR for general merchandize retailers and their suppliers is the historical perspective of SMI. In order to reduce the lead-time and inventory cost, a QR strategy was developed. In QR, the retailers and the suppliers work together to serve consumer needs quickly by information sharing. The suppliers use the point of sales data from retailers to synchronize their production and inventory control with actual sales and make decisions to improve demand forecasting and production scheduling. Milliken and Company, is a textile and chemicals company

which was among the first companies to adopt QR resulting in lead-time reduction from 18 weeks to 3 weeks (Tyan & Wee, 2003).

Similar to the textile industry, a joint industry task force called the efficient consumer response (ECR) working group was created by a group of grocery industry leaders in 1992 to improve overall performance of the supply chain. ECR enables distributors and suppliers to forecast demand far more accurately by expediting the quick and accurate flow of information in the supply chain (Tyan & Wee, 2003).

From ECR, the concept of continuous replenishment policy (CRP) was developed. CRP is a move from pushing products from inventory holding areas to pulling goods onto grocery shelves based on consumer demand, which is similar to the change from MRP push system to JIT pull system in production systems. In CRP, the suppliers receive point of sales data and use this information to prepare shipments at previously agreed intervals to maintain specific inventory levels, and further decrease inventory levels at the retail store or distribution centre as long as the service levels are met (Tyan & Wee, 2003).

The retailer and supplier, as well as the consumer gained the benefits from the implementation of retailer-supplier partnership (RSP). As cited in Tyan and Wee (2003), Simchi-Livi *et al.* (2000) proposed the view that RSP is a continuum. The degree of RSP ranges from information sharing to consignment schemes, which is from the retailer helps the supplier to plan demand more efficiently, to the supplier completely manages and owns the inventory until the retailer sells it (Tyan & Wee, 2003).

SMI is the latter type of partnership. In SMI, the supplier makes the decision on the point of order and holds the ultimate inventory ownership. The supplier must

have the capability to perform demand forecasting, inventory management, and retail management in order to operate under the SMI scheme (Tyan & Wee, 2003).

An early conceptual framework for SMI was described by Magee (1958) as cited in Disney *et al.* (2003a), that was when discussing who should have authority over the control of inventory. However, during the 1990s, the interest in this concept has only really developed. With SMI often advocated, companies have looked to improve their supply chains as a way of generating a competitive advantage. This SMI strategy has been particularly popular in the grocery industry but has also been implemented in other sectors as diverse as steel, books, and petrochemicals (Disney *et al.*, 2003a).

As noted by Tyan and Wee (2003), SMI system has been widely adopted by many industries for many years now and the classical success story for SMI system is found in the partnership between Wal-Mart and Procter & Gamble (P&G). In 1985, the partnership has dramatically improved P&G's on-time deliveries and Wal-Mart's sales. Both of their inventory-turns have also increased (Tyan & Wee, 2003). K-Mart also followed suit (Blatherwick, 1998; Tyan & Wee, 2003). K-Mart has developed over 200 SMI partners by 1992. Besides the retail industries, SMI is also adopted by leading companies such as Shell Chemical, Campbell Soup, and Johnson & Johnson to increase supply chain efficiency and to enhance customer and supplier relationships (Tyan & Wee, 2003; Kuk, 2003). High-tech industries such as Dell, HP and ST Microelectronics also operate supply chains efficiently through SMI to reduce inventory levels and costs (Tyan & Wee, 2003). SMI was rapidly hyped as a panacea for modern supply chain management problems and manufacturers saw SMI as a way of regaining control of their supply chain and reducing the power base of the large retailer (Blatherwick, 1998).

2.4 Supplier Managed Inventory (SMI)

Supplier Managed Inventory, SMI is a production/distribution and inventory control system. In SMI, stock positions and demand rates are known across more than one echelon of the supply chain. SMI comes in many different forms and has been described by terms such as Vendor Managed Inventory (VMI) (Holmström, 1998a; Holmström, 1998b; Daugherty *et al.*, 1999; Waller *et al.*, 1999; Sabath, Autry & Daugherty, 2001; Disney & Towill, 2002a; Disney & Towill, 2002b; Kuk, 2003), Synchronized Consumer Response, Rapid Replenishment, Collaborative Planning, Forecasting and Replenishment (CPFR), Centralized Inventory Management (Disney & Towill, 2002b), Efficient Consumer Response (ECR) (Daugherty *et al.*, 1999; Disney & Towill, 2002b), Continuous Replenishment Programs (CRP) (Daugherty *et al.*, 1999; Waller *et al.*, 1999; Sabath *et al.*, 2001; Disney & Towill, 2002b), Quick Response (QR) and Automatic Replenishment Program (ARP) (Daugherty *et al.*, 1999; Sabath *et al.*, 2001), depending on the sector application, ownership issues and scope of implementation.

SMI is a recent alternative for the order-delivery process and the fundamental change is that the ordering phase of the process is abolished. In SMI, the supplier is given both authority and responsibility to take care of the entire replenishment process (Kaipia *et al.*, 2002).

Under SMI process, the supplier is given access to its customer's inventory and demand information and the supplier monitors the inventory levels at its customer's warehouses. The supplier has the responsibility to replenish the customer's stock according to jointly agreed inventory control principles and objectives, through the use of highly automated electronic messaging systems (Dong & Xu, 2002; Kaipia *et al.*, 2002; Disney *et al.*, 2003a; Småros *et al.*, 2003). The

supplier makes the decision on inventory replenishment, rather than waiting for the customer to reorder the product (Dong & Xu, 2002). Replenishment is made when the stock level at the customer reaches a pre-specified level, also called safety stock level. The safety stock level is calculated based on both the average demand during the transportation lead-time and a safety stock to cover for demand variations (Kaipia *et al.*, 2002).

For SMI to be successful it is necessary for a large amount of information sharing between both parties, especially data regarding end user sales and inventory levels at the customer (Disney *et al.*, 2003a). SMI offers sell-through information, this means that the supplier access to its customer's sales information rather than its orders. That is, when one level of order batching is removed, allowing for more accurate, more rapidly available, and more level demand information (Småros *et al.*, 2003). It is only relatively recently that this strategy has become economically viable with the advent of electronic commerce. In the simplest form, SMI has been operationalized using just spreadsheets and e-mails (Holmström, 1998a; Disney *et al.*, 2003a).

With greater concentration and knowledge of a smaller number of products, the suppliers should be able to forecast and manage the flow of those products through to the end consumer. Suppliers could gain control of their supply chain and effectively control the flow of goods from raw materials to end consumer (Blatherwick, 1998). However, without proper allocation of resources, it is difficult to achieve success of SMI programs. Cooper and Kleinschmidt (1996) stressed "Even the best game plan in the world comes to nothing if there aren't player on the field!" This leads to an important arena – resource context – in determining the success of SMI.

2.5 Resource-based Theory

Empirical evidence repeatedly suggests that industry structure is not the only factor of competitive strategy and performance. A group of people called "resource-based theorists" is identified to the search for other factors, concluded that differential endowment of strategic resources among firms is the ultimate determinant of strategy and performance (Zou & Cavusgil, 1996). The work of economists such as Chamberlin and Robinson in the 1930s (Chamberlin, 1933; Robinson, 1933) are the earliest acknowledgment of the potential importance of firm-specific resources, and it was subsequently developed by Penrose in 1959 (Fahy, 2000). Penrose (1959) argued that her theoretical purpose was different from neoclassical theory where the latter views resources as homogeneous and perfectly mobile across the firms. Firms are standardized production functions that combine these resources (i.e. land, labor, and capital). Due to the restrict the mobility of production factors, sustainable and superior performance can only be achieved from industry factors, for example, collusion, market power (economies of scale and market imperfections), and barriers to entry,.

Penrose (1959) also conceptualized the firm is 'an administrative organization and a collection of productive resources'. She distinguished between 'human resources' and 'physical resources', and latter including the knowledge and experience of the management team. Penrose then proceeded on the basis that all strategic management scholars and practitioners take for granted: firms are 'heterogeneous' and there is money to be made from exploiting the differences. The resource-based perspective works from the premise that competition does not eliminate all 'differences among firms in the same line of business', rather than

subscribing to the neoclassical position of firm homogeneity within industries (Nelson, 1991; Boxall, 1996).

Fahy (2000) contend that firm differences were at the heart of much of the early work in the business policy, which later matured into the field of strategic management. A rational process of setting objectives is proposed as early models of strategic decision making propose, then followed by an internal appraisal of capabilities, an external appraisal of outside opportunities leading to decisions to expand or diversify based on the level of fit between existing products / capabilities and investment prospects (Fahy, 2000).

The resource-based view of the firm emerged in 1984 and a hint of the richness that lay in the approach is evident in Wernerfelt's description of his article as a "first cut at a huge can of worms" (Wernerfelt, 1984). However, the concept remained dormant for much of the 1980s. Then towards the latter part of the decade, increased interest in firm-specific variables became apparent and the number of contributions claiming to adopt a "resource-based perspective" mushroomed (Fahy, 2000). A burgeoning management literature highlighted examples and cases of where companies with particular skills and capabilities were able to out-perform their rivals (Grant, 1991; Williams, 1992; Fahy, 2000). A number of industrial economists contributed rigorous examinations of why performance differences persisted in situations of open competition, which has become one of the core insights of the resource-based view (Dierickx & Cool, 1989; Reed & DeFillippi, 1990; Barney, 1991; Amit & Schoemaker, 1993; Peteraf, 1993; Fahy, 2000). By the mid-1990s, the resource-based view, with its cogent mix of economic rigour and management reality, had assumed center stage in the strategic management literature (Fahy, 2000).

There is a mixture of theories for the resource-based view of the firm. Wernerfelt (1984) concluded that his introduction of this 'new' view by arguing that his paper has attempted to look at firms in terms of their resources rather than in term of their products (Maijoor & Witteloostuijn, 1996). Wernerfelt (1984) was the first researcher to develop Penrose's ideas in strategy and has been given the name of resource-based theory in a prize-winning article. The resource-based view of the firm looks inwardly to the resources available to the firm. According to Wernerfelt (1984), a firm's resources can include "anything that might be thought of as a strength or weakness of a given firm", and as such "could be defined as those tangible and intangible assets which are tied semi-permanently to the firm". The term "resource" is used in a very broad sense by the theorists; Barney (1991) defined internal organizational resources as all firm-specific assets, capabilities, organizational processes, business attributes, information, knowledge, and so forth, controlled by a firm and enabling it to conceive of and implement strategies which improve its efficiency and effectiveness (Collis, 1991; Bates & Flynn, 1995; Smith, Vasudevan & Tanniru, 1996; Zou & Cavusgil, 1996; Krause, Scannell & Calantone, 2000; Costa, 2001; López, 2001; Makhija, 2003). Resources are said to confer enduring competitive advantages to a firm to the extent that they are rare or hard to imitate, have no direct substitutes, and enable companies to pursue opportunities or avoid threats in more specifically way (Barney, 1991; Miller & Shamsie, 1995).

Barney (1991) cited that the resource-based view examines the link between a firm's internal characteristics and performance. There are two alternate assumptions discussed in resource-based view of the firm in analyzing sources of competitive advantage. First, the firms within an industry may be heterogeneous with respect to the strategic resources they control and second, these resources may not be perfectly

mobile across firms, and thus heterogeneity can be long lasting. The implications of these two assumptions for the analysis of sources of sustained competitive advantage are examined by the resource-based model of the firm (Barney, 1991).

The resource-based view of the firm is the most recent of the three theories reviewed to break upon the strategic management scene (Barney, 1991; Mahoney and Pandian, 1992; Wernerfelt, 1984). As cited by Penrose (1959), the resource-based view seeks to explain the pattern of performance differences between firms over time and central to the resource-based view is a conception of the firm as a collection of heterogeneous resources, or factors of production. Resources include physical resources such as plant and equipment, human resources such as managerial and technical staff (Penrose, 1959). The resource-based view argues that heterogeneous resource endowments are the source of competitive advantage (or disadvantage). The magnitude of competitive advantage generated by a resource depends upon the extent to which it either helps differentiate the firm's product offering or reduces the cost structure of the firm. It also depends upon uniqueness of the resource in relation to those possessed by competitors (Godfrey & Hill, 1995).

Barney (1991) noted that the resource-based theory rests on two key points. First, that resources are the determinants of firm performance, second, that resources must be rare, valuable, difficult to imitate and non-substitutable by other resources. , A competitive advantage has been created when the latter occurs (Barney, 1991). Such resources contribute to an industry's resource heterogeneity at any one point in time, and disequilibrium due to creative destruction of resource-based competitive advantages over time (Barney, 1991; Bates & Flynn, 1995).

Resources of firms are strengths that can use to devise and implement their strategies. The resources include: financial, physical, human and organizational

(Barney, 1995; Costa, 2001). Barney (1991) classifies the numerous possible internal organizational resources into three categories: physical capital, human capital, and organizational capital. Whereas, Grant (1991) suggested 6 major categories of resource: financial resources, physical resources, human resources, technological resources, reputation, and organizational resources. However, not all of these are strategically relevant. As Barney (1986) points out, some may lead to strategies that reduce its performance, others may prevent a business from conceiving of and implementing valuable strategies, and yet others may have no effect on a firm's strategic choice (Porter, 1991; Zou & Cavusgil, 1996). According to Porter (1991), such resources can arise either from acquiring them outside the firm for less than their intrinsic value because of factor market imperfection or from performing activities over time which create internal skills and routines, or a combination of the two. The most appropriate types of resources to examine in strategy research are. Porter (1991) also argues that underlying the firm's ability to link activities or share them across units are organizational skills and routines (Zou & Cavusgil, 1996).

In order to build competitive advantage, firms utilize their unique bundle of resources and may, if the resources are used in such a manner that is difficult to imitate, experience superior performance. An internalization or externalization framework proposed by Buckley and Casson (1976) complements resource-based theory. They predicated on the assumption that firms internalize activities that are critical to success, and externalize activities unrelated to their core capabilities (Krause, Scannell and Calantone, 2000). For the purpose of this research, three types of resources are studied: physical resources, human resources and financial resources. The various resources context is discussed in the following section.

2.6 Resources

For SMI to work, the resources context has to be conducive. This section discusses the various resources that have been identified in the literature.

There are some parties involved in a supplier-managed inventory (SMI) relationship, especially the suppliers, are less certain about these potential benefits and tend to accept SMI as a necessity due to intense global competition (Dong & Xu, 2002). However, there are several problems hidden below the surface of SMI from the suppliers' perspective.

There are a number of factors that make the efficient operation of SMI difficult, top management support is one of the key factors. Senior Management must commit to the SMI process. Their support is vital. They must commit to the manpower needed for setup or maintenance, costs involved, and also the concept of having someone else manage their inventory (Gnanasekaran, 2000; Tyan & Wee, 2003).

High employee involvement also ensures success of SMI programs. Organizations are cultivating high-level involvement to provide opportunities for employees to make a significant contribution by co-opting internal employees in the process of information sharing and task execution. Self participation in SMI implementation allows individual employees to see the value of the linked operations from supply to delivery. Employees are likely to understand their roles as the supply chain becomes transparent and, in turn, develop a high sense of task identification (Kuk, 2003).

To adopt this new concept, the employees should reorient. The SMI programs cannot take off without their acceptance. They must understand that SMI will not

push them out of a job but it will free up some of their time to allow them to be more productive in other areas (Gnanasekaran, 2000).

There is a risk of loss of control or flexibility particularly when procedures are new and the understanding and ability to control procedures is low (Gnanasekaran, 2000). An ideal way to install a SMI program is providing necessary assessment and training by an experienced consultant (Tyan & Wee, 2003).

To deploy SMI, large organizations have more slack resources at their disposal. This is due to large organizations can afford to experiment with new technologies, absorb any failures, bear the cost of implementing innovative technologies, and develop core competencies and internal resources when compared with smaller companies. Besides, slack resources have provided large organizations the competitive edge over the small companies through the deployment of state-of-the-art SMI technologies (Kuk, 2003).

An effective information system is another important determinant for success in SMI system. It can be broken down into two sub-categories such as information technology and integrated production system. Bar coding and scanning are essential in data processing efficiency and data maintenance accuracy and (Daugherty *et al.*, 1999; Waller *et al.*, 1999; Tyan & Wee, 2003). Electronic data interchange or Internet is required for delivering point of sales data and other relevant information in order to create a direct link between the customer and the supplier (Holmström, 1998a; Daugherty *et al.*, 1999; Tyan & Wee, 2003). Direct communication links also avoid entry error and further cut down the data transfer time. SMI requires an integrated system to incorporate planning, inventory, production, and distribution to take full advantage once the real time data is available. A tactical decision support system can be developed to assist in coordinating inventory management and transportation

policies as well as to ensure data transparency (Tyan & Wee, 2003). The integration of a SMI system with an existing enterprise resource planning system is an effective solution to meet the information system requirements of a SMI system (Holmström, 1998a; Tyan & Wee, 2003). Besides, investment in IT is a fundamental requirement of a SMI program and it may constitute a major capital spending. A detail cost-benefit analysis should be conducted before applying the program if a supplier does not have the necessary IT infrastructure, (Tyan & Wee, 2003).

SMI implementation in a successful way often depends on communications technology, computer platforms, as well as product identification and tracking systems. However, these systems are already in place at both the customer and supplier ends in many cases. Software systems are the most likely areas of deficiency and are important because they facilitate such discussions as replenishment quantity and timing; safety stock levels, transportation routing and inter facility transshipments (Waller *et al.*, 1999)

Leverage the value of IT through restructuring and changing work practices is an increasingly important way to organize SMI. Technologies such as advanced online messaging, data retrieval systems, product identification technology, and decision support systems become essential (Daugherty *et al.*, 1999; Kuk, 2003).

The most critical part of the SMI process is electronic transfer of information. The distributor usually sends discrepancy reports, point of sale and history data and electronic payments to the manufacturer, where the manufacturer sends cost discrepancies, purchase orders, advanced ship notices and suggestions for reducing excess material to the distributor. The distributor's understanding on how the new stock plan is generated is one of the first steps in SMI implementation. The

manufacturer must fully explain how it arrives at the new stock level (Gnanasekaran, 2000).

2.7 Environmental Factors of SMI programs

The success of SMI implementation is also affected by the environmental factors such as supplier lead-time and demand distortions.

Long lead times in sourcing from international producers and high variability of incoming order volume from wholesalers and big retailers are two of the main operational problems from the suppliers' perspective are (Holmström, 1998a; Holmström, 1998b). The key issues for the wholesaler are high stocks and periodically poor service levels for the supplier's products. Demand distortions on the retail chain level partly contribute to long lead-time and poor accuracy of supply issues. As cited in Holmström (1998a), demand distortion was first described by Forrester (1961) in his classic supply chain model. Recently, the issue of demand distortion has received renewed attention as more businesses have recognized the full extent of the problem in their supply chains (Holmström, 1998a).

The supply chain is not coordinated to consumer demand. When goods can be obtained at discount rates, the customer stocks up before marketing activities. Additionally, both the marketer and supplier feel the need to buffer against supply disruptions to secure high service levels. This in turn distorts the demand that is communicated to the supplying factories (Holmström, 1998a).

2.8 SMI Success

This literature review focuses on the supplier performance. There are evidences that SMI is beneficial to both customer and supplier. Nevertheless, the supplier may take a longer period of adjustment and reconfiguration before the benefits of SMI can be realized.

As contend by Nolan (1998), SMI could induce inventory turns. For example, Northwestern Steel and Wire as a supplier, was able to generate more volume after SMI implementation (Nolan, 1998). Another evidence can be seen where Northwestern's customers placed more orders with Northwestern after seeing real benefits and efficiency gains with the SMI programs (Dong & Xu, 2002).

After the full-scale implementation of SMI, the supplier's delivery and administration costs for all the supplier's products decreased. The benefits of the reduced delivery and administration costs have been transferred to consumer prices. Hence, both the supplier and customer have secured a competitive advantage through the introduction of SMI (Holmström, 1998a). In addition, transportation costs are reduced with SMI. Managed properly, the approach helps increase the percentage of low-cost full truckload shipments and eliminates the higher-cost less than truckload (LTL) shipments. This is achieved by allowing the supplier to coordinate the re-supply process instead of responding automatically to orders as they are received. Another attractive option is more efficient route planning. For example, one dedicated truck can make multiple stops to replenish inventories for several nearby customers (Waller *et al.*, 1999).

Both the customer and supplier work together to maximize the competitiveness of the supply chain is driving force behind a SMI system. As the supplier now receives a direct view of end consumer demand patterns and can use this