ORGANIZATIONAL LEARNING, PROPRIETARY TECHNOLOGY, AND MANUFACTURING PERFORMANCE

by

NG GOOD CHING

Research report submitted in partial fulfillment of the requirement for the degree of Master of Business Administration

UNIVERSITI SAINS MALAYSIA

2003

ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratitude towards my supervisor, Professor Mohamed Sulaiman and co-supervisor, Encik T. Ramayah for the tireless effort in guiding and giving me valuable advice throughout this project.

I would also like to take this opportunity to thank all the participants who have taken their time to participate in this study. They have made the study possible and special mentioned is given to those who have helped me in the distribution and collection of the questionnaires.

Lastly, many thanks to my friends and course mate for their moral support and encouragement during the course of my study and making all things possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

ABSTRAK

Tujuan kajian ini adalah untuk menyelidik bagaimana syarikat-syarikat pengeluaran membina kebolehan dan sumber yang tidak dapat ditiru ataupun digantikan untuk mencapai tahap syarikat pengeluaran berprestasi tinggi. Kajian ini cuba menyiasat: pertama, sama ada pembelajaran organisasi akan mengakibatkan penciptaan teknologi yang unggul; kedua, sama ada penciptaan teknologi yang unggul mengakibatkan syarikat pengeluaran mencapai tahap prestasi tinggi dan akhir sekali, sama ada pembelajaran organisasi akan mengakibatkan syarikat pengeluaran mencapai tahap prestasi tinggi melalui penciptaan teknologi yang unggul. Sebanyak enam puluh lapan data telah dikumpul daripada pekerja yang berkhidmat di dalam syarikat pengeluaran di Utara Semenanjung Malaysia. Hasil daripada kajian tersebut mendapati sebahagian daripada hipotesis yang dikemukakan dapat diterima. Hasil kajian ini menunjukkan bahawa pembelajaran dalaman menggalakkan penciptaan teknologi yang unggul and susulan daripda itu mengakibatkan syarikat pengeluaran mencapai tahap prestasi tinggi. Selain daripada itu, kajian ini juga menunjukkan penciptaan teknologi yang unggul adalah pembolehubah penyerdahana di antara organisasi pembelajaran dan pencapaian pengeluaran tahap prestasi tinggi. Kajian ini juga menunjukkan pembelajaran dalaman dan penciptaan teknologi yang unggul adalah satu kelebihan bagi syarikat-syarikat pengeluaran berbanding dengan yang lain. Selain itu, kajian ini memberi implikasi kepada syarikat pengeluaran. Pengurusan syarikat hendaklah berhati-hati kerana pembelajaran dari sumber luar yang lebih mungkin akan menyebabkan kehilangan peluang untuk mencipta teknologi yang unggul. Oleh itu, pihak pengurusan mesti berhati-hati mengenalpasti sumber dan kebolehan yang boleh dimanfaatkan.

ABSTRACT

The objective of this research is to study how manufacturing firms develop capabilities and resources that are inimitable, and non-substitutable in pursuit of higher performance and competitive advantage. This research attempts to find out: firstly, whether organizational learning leads to proprietary technology development; secondly, whether proprietary technology development leads to manufacturing performance; lastly, whether organizational learning leads to manufacturing performance via proprietary technology development. Data were collected from a sample of sixty-eight lower to top-level managers in manufacturing firms in the Northern of Peninsular Malaysia. The findings have resulted in substantial acceptance of the hypotheses formulated. The results of this study indicates that the internal learning will lead to more proprietary technology development and in turn proprietary technology will lead to high level of manufacturing performance. Besides, this study also empirical demonstrates that proprietary technology mediates the relationship of organizational learning and manufacturing performance. The study shows that internal learning and proprietary technology are important means for a manufacturing firm to gain competitive advantage. Besides, this study has an important implication to manufacturing firms. Management needs to be aware that excessive use of external sources of learning might cause the companies to lose opportunities to develop the proprietary technology. Therefore, management should carefully identify the critical resources and capabilities that should developed internally.

Chapter 1

INTRODUCTION

1.1 Introduction

The importance of the resource-based view (RBV) of strategic management is manifested in its rapid diffusion throughout the strategy literature (e.g., Amit & Schoemaker, 1993; Barney, 1986, 1991; Dierickx & Cool, 1989; Mahoney & Pandian, 1992; Rumelt, 1984; Wernerfelt, 1984). The resource-based theory is grounded on certain concepts that need to be outlined. According to Barney, a company's resources include all the credits, organizational characteristics, processes, aptitudes, information and knowledge controlled by the company and enabling it to conceive and implement strategies to improve its effectiveness. The fundamental postulate of this approach is as follows: leveraging the companies' resources and core competencies to generate a sustained competitive advantage which, in turn, translates into better performance.

Drawing on previous research in RBV, this study placed research on the manufacturing strategy in the context of RBV with the aims of illustrating the interrelationships between RBV and manufacturing performance. The manufacturing strategy in this study is refer to a pattern of consistent decisions regarding manufacturing resources, practices and capabilities that are aimed at building a competitive advantage for the business (Schroeder & Flynn, 2001). Specifically, this research is attempt to study how manufacturing firms develop capabilities and resources in pursuit higher performance and competitive advantage.

This research extends pervious research in the manufacturing strategy literature by examining whether the capability to develop proprietary technology through internal learning and external learning within the manufacturing firm is associated to the competitive manufacturing performance (Schroeder, Bates & Junttila, 2002). These resources and capabilities play an important role in the adoption of specific manufacturing practices as well as the formulation of the firm manufacturing strategy.

1.2 Research Problem

In recent years, globalization of industries, with its huge economic and rapid technological changes has created the 21st century competitive landscape. So, Malaysian manufacturing companies cannot avoid this economic trend, especially with the introduction of AFTA by 2005. Therefore, firms must learn how to compete in the highly turbulent and chaotic environments. According to Argyris (1996) and Wernerfelt (1988), in a changing environment, manufacturing firms must continually acquire, develop and upgrade their resources and capabilities if they are to maintain competitiveness and growth. A key challenge facing by a manufacturing firm is to identify the origin of resources and capabilities that establish and enhance the firm's sustainable competitive advantage.

However, within both the theoretical and empirical work to date, there has been limited discussion of how idiosyncratic resources and capabilities are actually developed, deployed, and protected (Schulze, 1994; Teece, Pisano & Shuen, 1997; Zajac, 1992), particularly in manufacturing.

Previous research mainly focused on the market driven development of capabilities in manufacturing. Competitive advantage has been assumed to be gained by those who respond most effectively to the external environment (Johnson & Scholes, 1994), the 'competitive forces' perspective (Porter, 1990). Successful manufacturing plants are those that meet the requirements and can even anticipate the future before it becomes common knowledge.

Teece and Pisano (1994), Teece, Pisano and Shuen (1997) however offer alternative approach to strategy formulation. They counterbalance the dominant 'competitive forces' view with 'resource based' perspectives (Penrose, 1959; Rumelt, 1984; Teece, 1994; Wernerfelt, 1984). Their approach focuses on the firm specific resources rather than the economic profits from market positioning. Competitive advantage lies upstream of product markets and rests on the firm's idiosyncratic and difficult to imitate resources (Teece et al., 1997). Some researchers describe capabilities as luck (Barney, 1986), whereas other analysts trace them to experiential learning by organizations (Nelson & Winter, 1982; Singh & Chang, 1993).

In Malaysia, there is also limited literature on manufacturing strategy and manufacturing performance. The recent study on manufacturing performance was conducted on SME that focused on the relationship between business strategy and manufacturing performance (Hashim, 2000). Others studies were focused on the impact of manufacturing practices like Total Quality Management System, Just In Time and Total Preventive Maintenance on manufacturing performance (for example, Ng, 1999). As far as the author knowledge, there was no study conducted on the how manufacturing plants in Malaysia develop their capabilities and resources in pursuit of

better performance and competitive advantage. Therefore, this research is to explore how manufacturing firms develop capabilities and resources in pursuit higher performance and competitive advantage.

Learning leads to acquisition of knowledge and knowledge is a vital necessity for proprietary technology generation (Gold, Malhotra & Segars, 2001). In the Malaysian workplace environment, learning has not been studied as extensively or as comprehensively as in the developed countries like United State (U.S) and Japan. Despite this prevailing background, manufacturing firms in Malaysia continue to accommodate technology capabilities. Therefore, this study seeks to address specifically the role of learning in proprietary technology development and performance of Malaysian manufacturing firms. It is hoped that this study would provide some useful findings, which aid manufacturing firms in their strategy formulation.

1.3 Research Objective

The objective of this research is to study how manufacturing firms develop capabilities and resources that are inimitable, and non-substitutable in pursuit of higher performance and competitive advantage. This research attempts to find out:

(i) whether organizational learning leads to proprietary technology development

(ii) whether proprietary technology development leads to manufacturing performance

(iii) whether organizational learning leads to manufacturing performance via proprietary technology development

Specifically, this research sought to achieve the following objectives:

(i) to assess the effect of internal learning on the proprietary technology development

(ii) to assess the effect of external learning on the proprietary technology development

(iii) to assess the effect of organizational learning to manufacturing performance

(iv) to assess the effect of proprietary technology development to the manufacturing performance

(v) to assess the mediating effect of proprietary in between the relationship organizational learning and manufacturing performance

1.4 Research Questions

The research questions addressed in this study are:

(i) Is there a significant relationship between the internal learning and the proprietary technology?

(ii) Is there a significant relationship between the external learning and the proprietary technology?

(iii) Is there a significant relationship between proprietary technology and the manufacturing performance?

(iv) Is there a significant relationship between learning and the manufacturing performance?

(v) Is there a mediating effect of proprietary in the relationship organizational learning and manufacturing performance

1.5 Scope of Research

The scope of this research will only cover the manufacturing firms in the northern region of Peninsular Malaysia. There are many factors that contribute to the performance of manufacturing firms. Some distinct determinants are benchmarking, management of quality system, leadership commitment and many other dimensions. However, this research strictly focuses on manufacturing strategy from the perspective of organizational learning and proprietary technology development.

This study examines concepts and phenomena at the level of an individual manufacturing plant. This choice builds on several arguments. First, plant performance is more traceable than business or corporate performance, that is, financial and aggregate measures are affected by a horde of determinants and finding even statistically significant relationships is often difficult. Further, as statistical significance does not guarantee practical significance, prescriptions should be approached with caution. Second, practices, resources and capabilities that have the potential of leading to higher performance are often developed at the plant level (Amit & Schoemaker, 1993; Bates & Flynn, 1997). Third, discussion and examples of *routines* as the means of building capability and enhancing performance concentrate heavily on day-to-day operations (Nelson & Winter, 1982). Finally, the operational performance of a plant (low cost, high flexibility etc.) has both theoretically and empirically been linked to business performance (Cleveland, Schroeder & Anderson, 1989; Swamidass & Newell, 1987), which validates the relevance of plant- level measures.

1.6 Significance of Research

Malaysia is highly depending on manufacturing as its main source of revenue. In order to achieve the 2020 vision, the manufacturing sector must continuously adapt to changes and innovate in order to sustain the required growth rate to achieve the industrialized nation status. Understanding how manufacturing plants develop capabilities and resources in pursuit of better manufacturing performance is very important in Malaysia, particularly in the Northern Region. This region covers several large multinational corporations like Intel, Dell, Solectron, Agilent and other companies. Silterra, for example is successful in acquiring the state-of-art technology in the silicone wafer fabrication which encompasses very stringent technical specifications and a series of complex processes, which in turn leads to superior manufacturing performance.

This study on the manufacturing strategy from the RBV perspective is timely to provide Malaysia manufacturing firms an idea towards how to build idiosyncratic capabilities in manufacturing processes that cannot easily be duplicated and non-substitutable.

1.7 Definitions of Key terms

1.7.1 Manufacturing Resources

Teece et al. (1997) define resources as strategic assets. Resources can also be defined as those assets that are tied semi-permanently to the firm (Maijoor & Witteloostuijn, 1996; Wernerfelt, 1984). It includes financial, physical, human, commercial, technological, and organizational assets used by firms to develop, manufacture, and deliver products and services to its customers (Barney, 1991).

1.7.2 Manufacturing Capabilities

Manufacturing capabilities refer to a firm's capacity to deploy and coordinate different resources, usually in combination, using manufacturing processes, to affect a desired end (Amit & Shoemaker, 1993; Grant, 1996; Prahalad & Hamel, 1990). They are information-based, intrinsically intangible processes that are firm specific and are developed over time through complex interactions among the firm's resources (Amit & Shoemaker, 1993; Itami & Rohel, 1987; Kogut & Zander, 1996; Leodard-Barton, 1992; Winter, 1987). They can abstractly be thought of as 'intermediate goods' generated by the firm to provide enhanced productivity of its resources, as well as strategic flexibility and protection for its final product or service. Manufacturing capabilities for this study will be defined in accordance to Amit and Schoemaker (1993) as "the ability to integrate, build, and reconfigure internal and external competencies."

1.7.3 Manufacturing Strategy

There are many existing definitions of manufacturing strategy. In the literature on manufacturing strategy, the influence of production technology choices in terms of market competition is usually cast in term of how manufacturing function supports the firm's market objectives (Kim & Lee, 1993; Kotha & Orne, 1989). In this study, manufacturing strategy is defined as a pattern of consistent decisions regarding manufacturing resources, practices and capabilities that are aimed at building a competitive advantage for the business (Schroeder & Flynn, 2001).

1.7.4 Learning

Levitt and March (1988) illustrate learning as a process by which repetition and experimentation enable tasks to be performed better and quicker. It also enables new production opportunities to be identified. Lundvall (1998) stated that learning involves adapting intelligently to new circumstances by developing a repertoire of routines that are stored in an institutional memory and which can be drawn on as circumstances change. Learning is not a stock construct as it is and not an asset that is allocated to a specific task, rather, learning is the ability to make use of resources. Therefore, learning, which includes internal learning and external learning, in this study, is construct to be the manufacturing firms' capabilities.

1.7.5 Internal Learning

Internal learning refers to the learning processes within the organization. Such processes include the training of multifunctional employees (Gerwin & Kolodny, 1992) and incorporating employee suggestions (Hall, 1987) into process and product development, among others. In this research, the internal learning will be defined as learning that occurs within a plant (by engineers, managers and workers) the plant develops a capability that is difficult to imitate since learning is embedded in the everyday operations of the plant.

1.7.6 External Learning

External learning refers to inter-organizational learning that occurs along the supply chain, both upstream and downstream from the plant (Schroeder, Bates & Junttila,

2002). Plants that have close contact to their suppliers and customers will achieve an edge in development of new products and processes.

1.7.7 Organizational Learning

Organizational learning refers to an adaptive response on the part of an organization to changing circumstances which calls on something more than random exploration of new technological or market spaces. It results in the coherence of firms over extended periods of time, as they develop and accumulate their dynamic capabilities (Teece et al., 1997). Organizational learning implies the existence and acquisition of "organizational competences" as the outcome of learning. The "learning organization" is one that can translate the learning of individual members or individual business units into something that belongs to an organization as a whole – into its organizational capabilities. It refers to the creation of competences/capabilities that transcend those held by individuals. (Teece et al., 1997).

1.7.8 Proprietary Technology

Proprietary technology is defined as unique production processes and equipment, which can be a valuable resource to a manufacturing organization. The term technology here includes the body specific knowledge, the organization and procedures, the machinery, tools and equipment, the material, and the human skills that are combined to produce socially desired products (Rath, 1994). The definition of proprietary technology in this study includes processes and equipment protected by patents as well as un-patented processes and equipment that is held in secret, which are impossible to replicate, or "buy-in" (Schroeder, Bates & Junttila, 2002). It also includes state-of-the-art equipment and processes that have been developed

exclusively by the plant. Proprietary technology in this study is constructed to be a resource rather than a capability because equipment is a stock, it is deployed by allocating it to a specific task.

1.7.9 Manufacturing Performance

Lindsay and Petrick (1997) defined performance as the contribution from both the individuals and system to the accomplishment of the objective of the firms. Commonly accepted dimensions of manufacturing performance are, quality, cost, delivery and flexibility (Hayes & Wheelwright, 1984)

1.8 Organization of Chapters

This study is organized into three chapters. Chapter 1 introduces the subject matter, explains the research problem and states the objectives of the study as well as the definitions of key terms. Chapter 2 pursues on the related literature review. Chapter 3 presents the conceptual model, formulation of the research hypotheses of this study. This chapter also delineates on the methodology, which covers the discussion on the unit of analysis, sample and procedures, measures and the statistical analyses employed. In Chapter 4, the results of the various statistical analyses are presented. Chapter 5 concludes the study, discusses survey findings and some limitations. It also discusses some implications and provides some suggestions for future studies in this field.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a summary of the literature review done for the research. It discusses the concept of resource-based view and the development of the RBV. This chapter also discusses several empirical approaches on manufacturing strategy as defined by capabilities and resources, and their relationship to manufacturing performance. This is then followed by a review of the role of internal learning and external learning in developing resources that are imitable and difficult to duplicate. Finally the dependent variable of manufacturing performance is reviewed.

2.2 The Resource-based view

There have been a large and diverse collection of contributions in the areas of economics and strategic management that seek to either refine the concept of the RBV or uses it as a framework for tackling conceptual and empirical questions. Consequently, the basic propositions of the RBV have become increasingly well delineated. In short, the principal contribution of the resource-based view of the firm to date has been as a theory of competitive advantage. Its basic logic is a relatively simple one. It starts with the assumption that the desired outcome of managerial effort within the firm is a sustainable competitive advantage (SCA). Achieving a SCA allows the firm to earn economic rents or above-average returns. In turn, this focuses attention on how firms achieve and sustain advantages. The resource-based view contends that the answer to this question lies in the possession of certain key resources, that is, resources that have characteristics such as value, rare, barriers to

duplication and suitability. A SCA can be obtained if the firm effectively deploys these resources in its product-markets. Therefore, the RBV emphasizes strategic choice, charging the firm's management with the important tasks of identifying, developing and deploying key resources to maximize returns.

During the last 50 years, many management academics have contributed to the development of this topic. The earliest acknowledgement of the potential importance of firm-specific resources is to be found in the work of economists such as Chamberlin (1933) which was subsequently developed by Penrose (1959). Rather than emphasize on market structures, they highlighted firm heterogeneity and proposed that the unique assets and capabilities of firms were important factors giving rise to imperfect competition and the attainment of super-normal profits. For example, Chamberlin (1933) identified that some of the key capabilities of firms included technical know-how, reputation, brand awareness, ability of managers to work together and particularly, patents and trademarks. However, the founding idea of viewing a firm as a bundle of resources was pioneered by Penrose in 1959.

Penrose (1959) provided arguably the most detailed exposition of a resource-based view in the economics literature. She noted that,

> a firm is more than an administrative unit; it is also a collection of productive resources the disposal of which between different users and over time is determined by administrative decision. When we regard the function of the private business firm from this point of view, the size of the firm is best gauged by some

measure of the productive resources it employs (Penrose 1959, pp. 24).

The above quotation highlights the important dimensions of the resource-based view that have occupied the minds of theorists over the past decade, namely, the role of managers in the development and deployment of resources, (Amit & Schoemaker, 1993; Barney, 1986; Barney & Zajac, 1994; Schoemaker, 1992) and the relationship between resources and the scope of the firm (Markides & Williamson, 1996; Prahalad & Hamel, 1990). Penrose's work also provides other penetrating insights into the nature and role of resources in the firm. Penrose (1959) sees this distinction as the source of uniqueness of each individual firm and it is a distinction that has many parallels with the separation of resources and capabilities that characterizes much of the strategy literature. Similarly, Penrose argues that 'internal' resource configurations both facilitate and constrain the direction of expansion of the firm and contrasts this with the prevailing external inducements to expand such as growing demand and changes in technology, etc.

Wernerfelt (1984) broadly recognized that a firm's own resources and capabilities are what make its competitive advantage. This idea has spawned a considerable theoretical literature within strategic management during the last eighteen years, and its regarded by many as a new paradigm in the field of strategic management.

In 1991, Barney presented a more concrete and comprehensive framework to identify the needed characteristics of firm resources in order to generate sustainable competitive advantage. These characteristics include whether resources are: valuable

(in the sense that they exploit opportunities and/or neutralize threats in a firm's environment), rare among a firm's current and potential competitors, inimitable, and non-substitutable (Barney, 1991). In this respect, many authors (Amit & Schoemaker, 1993; Dierickx & Cool, 1989; Mahoney & Pandian, 1992; Rumelt, 1984) have adopted and even expanded Barney's view to include: resource durability, non-tradeability, and idiosyncratic nature of resources.

In summary, the resource-based view of the firm emphasizes firm idiosyncratic resources (e.g., Barney, 1991; Penrose, 1959; Wernerfelt, 1984), especially resources that reside within organizations. RBV regards the firm as a bundle of resources and suggests that their attributes significantly affect the firm's competitive advantage; and by implication performance (Barney, 1986, 1991; Penrose, 1959; Wernerfelt, 1984). Most conspicuous among these resources are those that are valuable, scarce, imperfectly tradeable, and hard to imitate (Barney, 1986; Dierickx & Cool, 1989; Reed & DeFllippi, 1990).

2.3 Manufacturing resources and capabilities

Amit and Shoemaker (1993) argued that there are two key features that distinguish a capability from a resource. They make a clear distinction as well by defining resources as "stocks of available factors that are owned or controlled by the firm," and capability as the "firm's capacity to deploy resources". First, a capability is firm specific since it is embedded in the organization and its processes, while an ordinary resource is not (Makadok, 2001). This firm-specific character of capabilities implies that if an organization is completely dissolved, then its capabilities would also disappear, while in contrast, its resources could survive in the hands of a new owner.

For example, if Intel Corporation is completely dissolved then its microprocessor patents (a resource) could continue to exist in the hands of a new owner, but its skill at designing new generations of microprocessors (a capability) would probably vanish. The second feature that distinguishes a capability from a resource is that the primary purpose of a capability is to enhance the effectiveness and productivity of resources that a firm possesses in order to accomplish its targets, acting as 'intermediate goods' (Amit & Schoemaker, 1993).

However, both resources and capabilities that are valuable, difficult to trade and imitate, scarce, and non-substitute are considered strategic assets, although capabilities are more likely to result in a sustained competitive advantage (Barney, 1986, 1991; St. John & Harrison, 1999).

Capabilities arising from manufacturing processes and infrastructure may become a valuable resource for the firm. Manufacturing processes are particularly amenable to the RBV approach for two reasons. First, manufacturing resources and capabilities such as custom-designed process equipment, worker experience, and incremental process improvement can create a store of manufacturing capability that is difficult to observe or imitate and subject to causal ambiguity (Hayes & Wheelwright, 1984; St. John & Harrison, 1999). Second, at any one point in time, superior capabilities in manufacturing processes have been demonstrated to confer performance advantages, and consistent improvement of manufacturing processes can lead to a series of competitive advantages (Stalk, Evan & Shulman, 1992). These capabilities evolve, reflecting shifts in technological trajectories, defined as the paths particular technologies follow over time (Dosi, 1982). These evolutionary paths depend on

existing scientific knowledge and are fueled by a quest for improving a given technology's performance (Zahra & Nielsen, 2001)

In this research, specifically looking at three types of manufacturing resources and capabilities that are built within the manufacturing function and are difficult to imitate and transfer (St. John & Harrison, 1999): (1) proprietary technology, (2) internal learning, and (3) external learning. These resources and capabilities play an important role in the adoption of specific manufacturing practices as well as the formulation of the firm manufacturing strategy.

2.4 Learning and competitive advantage

Empirical studies by researchers such as Morgan, Katsikeas and Appuh-Adu (1998) have demonstrated that a relationship exists between organizational learning and competitive advantage that can provide the basis for delivering superior customer satisfaction. Other research has provided evidence of links between learning and optimal operation of internal managerial processes.

Bell (1973) proposed that the information and knowledge acquired by employees is now more important than the traditional orientation of assuming the technology contained within the firm's capital assets can provide the basis for delivering product superiority over competition. Slater and Narver (1995) also concluded that one of the most effective routes to acquiring competitive advantage is to exploit the skills learned by employees as a route through which to offer superior services that lead to the building of closer relationships with customers.

A common conclusion within the management learning literature is the critically important role which learning style plays in providing a mechanism through which firms can acquire and retain competitive advantage (Senge 1990). In commenting on these materials, Hamel and Prahalad (1993) suggest that merely being a learning organization is not sufficient. The learning style must support the acquisition of new knowledge that can be used to upgrade those areas of competencies, which permit the organization to be more effective in the provision of products and/or services than their competitors.

Goldsmith (1989), for example, proposed that some firms take a different approach to problem solving, being superior in areas such as the ability to be creative and produce original ideas. Mabey and Salaman (1995) argued that the way an organization learns to be innovative is a key variable in determining profitability. Hurley and Hult (1998) and Li and Calantone (1998) both demonstrated an empirical relationship between organizational learning and the successful development of new products and/or services.

Organizations and the individuals often improve their performance over repetitions of the same task. Repetition-based improvements in manufacturing performance have been documented in some detail in studies of learning curve (Yelle, 1979). Such experiential based knowledge can be an important basis of competitive advantage for a manufacturing firm. The re-discovery of learning has been stimulated by current interest among researchers of strategic management in organizational capabilities and knowledge (Prahalad & Hamel, 1990). Successful organizations are described as having capabilities for learning – for responding to experience by modifying their

technologies, forms, and practices (Stalk, Evans & Shulman, 1992). In other words, in order to become competitive, manufacturing firms have to acquire knowledge to build up and accumulate technological resources that are imperfectly imitable and difficult to duplicate.

2.5 Organizational learning and firm's performance

The organizational structure is recursively organized rules and resources, which organizational members use in their everyday interaction (Sarason, 1995). This interaction constitutes a learning process, which transfers knowledge in replicating activities into organizational routines and behaviors. These routines and behaviors shape how organizations define and solve problems associated with the deployment of technology.

Inkpen and Crossan (1995) stated that firms that learn more effectively will in the long run perform better than their competitors. Slater and Narver (1995) and Morgan et al., (1998) concluded that organizational learning is clearly an attribute which is exhibited by organizations that exhibit excellence in the delivery of products and/or services to their customers. Thus, there should be a link between organizational learning and performance however; the time lags between the two make the empirical observation very difficult. They added that performance provided important feedback about the efficiency and effectiveness of a learning process and, ultimately, an organization's strategy will come to reflect the accumulated learning. Further, they stressed that the incremental learning should not always lead to incremental performance improvements. Specific performance enhancements may results because

of learning, or may also be attributable to efforts of imitation, regeneration, or technological development.

Schroeder, Bates and Junttila (2002) concluded learning is directly linked to development of proprietary process technology and indirectly to manufacturing performance. Their study also proven that the capability of the plant to incorporate internal and external learning into proprietary processes and equipment emerges as an important contributor to manufacturing performance.

2.6 Internal learning

Learning is dependent on the employees themselves who have the knowledge (resources) necessary to operate and improve the plant. Prusuk (1997) argued that learning may occur in an unpredictable and sometimes haphazard way and is difficult to codify, leading to the deployment of manufacturing resources. Further, he also stated that learning is the only source of sustainable competitive advantage. Internal learning leads to an adaptable work organization, which can provide a competitive edge for the manufacturing firm (Gerwin & Kolodny, 1992). Adler and Clark (1991) and Pisano (1994) further discuss the importance of internal learning in manufacturing and its relationship with manufacturing performance.

A few studies have been concerned with different practices for learning through day-to-day manufacturing operations and/or experimentation at plant level (Garvin, 1993; Leonard-Barton, 1990, 1992, 1995). Practices can be purposefully created (e.g. through 'implementation teams') which allow individuals to learn during day-to-day work on 'how' and 'why' a technology is designed and operates in a given fashion

(Leonard-Barton, 1990). Individuals might also be encouraged to engage in independent problem solving in daily operations (Leonard-Barton, 1992). Successful cases of experimentation on the basis of on-going improvement programs (e.g. diversification of new materials) are associated with continuous knowledge flow from outside the company (Garvin, 1993). This suggests that interaction between learning mechanisms does matter. This also implied that manufacturing companies should create a climate and mechanisms to encourage experimentation.

According to Garvin (1993), a variety of mechanisms may lead to the spread of knowledge throughout the organization (e.g. written, oral, and visual reports, rotation of personnel, education and training, standardization practices). Other practices, like shared experience, on-job training, 'brainstorming camps', and meetings may lead to knowledge-socialization (Nonaka & Takeuchi, 1995). 'Internal knowledge integration' encompasses collection of practices to facilitate the spread of knowledge across the company and the deepening of technological capabilities (Garvin, 1993; Leonard-Barton, 1992; Leonard-Barton et al., 1994; Leonard-Barton, 1995). In other studies a more specific treatment was given to knowledge integration such as problem-solving activities (Iansiti & Clark, 1994) or the integration of groups of individuals for product development (Clark & Fujimoto, 1991). Standardization of production practices and systematic documentation were specified as key practices for knowledge codification in Japanese companies (Nonaka & Takeuchi, 1995).

Bell and Pavitt (1993), gave great attention to the evolution of the intra-firm 'routine' and 'innovative' technological activities (e.g. process and production organization, product-centred, and equipment). The study also looked at the role of learning

mechanisms built in each company to acquire knowledge for capability accumulation (e.g. external training). Although not explicitly, knowledge-conversion mechanisms (e.g. internal training) were also explored. In addition, the study has raised the importance of cumulative interaction between learning mechanisms for proprietary technology generation. In doing so, this study stimulated an interest in deeper investigation into that issue.

Extending this study, Ariffin (1996) focused on a sample of 53 electronics firms in Malaysia to examine whether any internationalization of proprietary technology has occurred in these firms. Drawing on a systematic analysis of rates of proprietary technology, the study found that 85% of the firms conducted at least intermediate innovative activities and took an average 11 years to do so, while two companies conducted advanced and research-based product and process innovations. The contributing factors include (i) time and the agglomeration of learning which reduced learning rates of later entrants, and (ii) the cumulating interaction of diffusion of knowledge and people flows from transnational corporations (TNCs) primarily through subsidiary-parent and supplier-customer links, and independent learning.

2.7 External learning

Plants that have close contact to their suppliers and customers will achieve an edge in development of new products and processes. A close customer relationship provides a source of tacit knowledge which is not easy to duplicate or copy by the competitors (Madhok & Tallman, 1998; Ward, Duray, Leong & Sum, 1995). External learning also occurs when a plant works closely with its suppliers to develop better linkages

with them. Long-term relationships with suppliers can provide a unique capability for the plant (Gerwin, 1993), which establishes a source of competitive advantage.

Webster (1992) concluded that the survival of firms in the highly competitive market conditions depends on how they learn to build stronger relationships with customers. Similarly DeGeus (1988) suggested that, stimulate learning by employees could be the real source of competitive advantage where products and processes can be rapidly copied.

On the other hand, Cohen and Levinthal (1990) point out that incorporating outside knowledge into the firm is critical for innovative capabilities. Individuals can achieve this through different 'internal mechanisms'. Other studies have pointed out the relevance of practices for importing and absorbing technological knowledge from outside the company for capability building: through vendors, national laboratories, customers, consultants (e.g. Garvin, 1993; Leonard-Barton, 1990, 1995). Knowledge may also be acquired from suppliers, competitors or through forming a technological alliance with a firm that possesses the knowledge (Huber, 1996a, 1996b). 'Integrating external knowledge' has been viewed as one of the practices underlying the building of capabilities in the successful near-net-shape project in Chaparral Steel (Leonard-Barton, 1992).

Other external learning processes involve pulling in expertise from outside the company by inviting experts to give talks to personnel, hiring in experts, hiring back retired employees, nurturing 'technological gatekeepers' and individuals who can search, interpret and disseminate external knowledge across the company, or fighting

the 'not-invented-here' practices (Garvin, 1993; Huber, 1996a, 1996b; Leonard-Barton, 1992b, 1995; Leonard & Sensiper, 1998). Individuals may be hired to bring in expertise in 'problem-solving' and also in 'problem-finding' (Leonard & Sensiper, 1998). Employees may be critical providers of knowledge for the firm through feedback and/or their involvement in development projects or their lead in new development projects (Iansiti & Clark, 1994; Leonard-Barton, 1995).

2.8 Firm Size

The manufacturing sector continues to experience consolidation and has claimed that firm size is the key to reaping the benefits, in terms of economies of scale and scope in the manufacturing industry. The benefits from scale are especially apparent in the area of technology should provide a competitive advantage to large firm. Large firms are generally assumed to operate at lower unit costs than small firms. Scale effects are found in almost any cost element and it is evident that large firm need less manufacturing cost per unit than small firms. Large firm can afford to develop internal resources and core competences in technology and invest in sophisticated infrastructure, including financial control systems. However, size does not ensure benefits of scale. Size only provides an opportunity for scale economies and may not be achieved without adequate strategies and actions (Abell & Hammond, 1979).

While large firms are able to benefit from internal resources and leverage its resources into a competitive advantage, smaller firms may well be forced to rely on a partnering strategy, because their size may not allow them to rely on internal capabilities, as these are sub-scale compared to minimum efficient scale. The size as reinforcement argument is in line with Powell and Dent-Micallef (1997) who find that information