CHAPTER 2

LITERATURE REVIEW

In this chapter, the first section is the literature review of the resource-based perspective, which describes how this theory emerges, establishes, and extends by combining with the insights from the institutional theory to become the important tool in explaining the process of resource selection under the social influence and pressure. These theoretical complementarities offer a significant opportunity that the author exploits in this study to explain the clean technology adoption by manufacturing firms as the effect of the economically rational managerial factors in selecting and accumulating resources. The second section is the literature review of the institutional theory, which generates valuable insights into the role of social influence and pressures for organizational conformity to the environment. The third section is the literature review of the diffusion of innovation theory. Theorists in this field provides the explanation to the phenomenon that has long been recognized that the increases in the number of firms that adopt an innovation influence the number of remaining firms that will subsequently adopt this innovation. Diffusionists believe that firms choose to adopt an innovation based on either the rational-efficiency or on what other firms have adopted that innovation. The strength of diffusion of innovation theory is its focus on communication networks, which can have an effect on information sharing to reach mutual understanding and consequently it can lead to the innovation adoption or rejection by the agents of the firm based on their perceived values of that innovation. The last section of this chapter is the literature review of the clean technology. Firstly, the concept of pollution control and pollution prevention is explained. Secondly, the information about pollution prevention technology is elaborated. Finally, the detail of clean technology, which is another name of pollution prevention technology, is provided.

2.1 REVIEW OF THE RESOURCE-BASED PERSPECTIVE

The resource-based view of the firm proposes that resource selection and accumulation are a function of both within-firm decision-making and external strategic factors. Within firms managerial choices are guided by an economic rationality and by motives of efficiency, effectiveness and profitability (Corner, 1991). External influences are strategic industry factors that impact the firm, including buyer and supplier power, intensity of competition, and industry and product market structure. These factors influence what resources are selected, as well as how they are selected and deployed (Oliver, 1997). The important insights from this theory were used by the environmental management researchers in explaining the competitive benefits emerging from the firm's response to natural environmental requirement. These include lower costs of process / inputs / products, innovations in process / products / operating systems, improved corporate reputation, and relationships with a wide range of stakeholders (Sharma & Vredenburg, 1998). According to Russo and Fouts (1997), this theory provides two key benefits. First, the resource-based view has a strong focus on performance as the key outcome variable. And second, work adopting this theory explicitly recognizes the importance of intangible concepts, such as know-how (Teece, 1980), corporate culture (Barney, 1986), reputation (Hall, 1992), and organizational capabilities (Days, 1994).

Emergence of the Resource-Based View

There has been an active debate among management scholars concerning the relative importance of internal firm capabilities under the banner of the resource-based view of the firm (e.g., Galbraith & Kazanjian, 1986; Peters & Waterman, 1982; Barney, 1991; Wernerfelt, 1984; Prahalad & Hamel, 1990) versus the structure-conduct-performance paradigm of the IO (industrial organization) view of the firm (e.g., Bain, 1959; Hannan & Freeman, 1977, Pfeffer & Salancik, 1978; Porter, 1980, 1990) to sustain competitive advantage.

The early resource-based theorists found the IO view (that a firm's success was wholly determined by its external environment) to be unrealistically limited and turned to the seminal work of Penrose (1959) for motivating other succeeding resource-based scholars (e.g., Wernerfelt, 1984; Dierickx and Cool, 1989; Prahalad and Hamel, 1990) to counter IO view by building resource-based theory around the internal competencies of firms. It has only been during the past decade that the resource-based view of the firm has gained prominence as a competitive theory of the firm (Barney and Zarjac, 1994). To understand how the resource-based view emerges and becomes established, a graphical summary (see Figure 2.1) developed by Hart (1995) will be used for reviewing the relationships among firm resources, capabilities, and competitive advantage and some of the key authors associated with the core ideas.

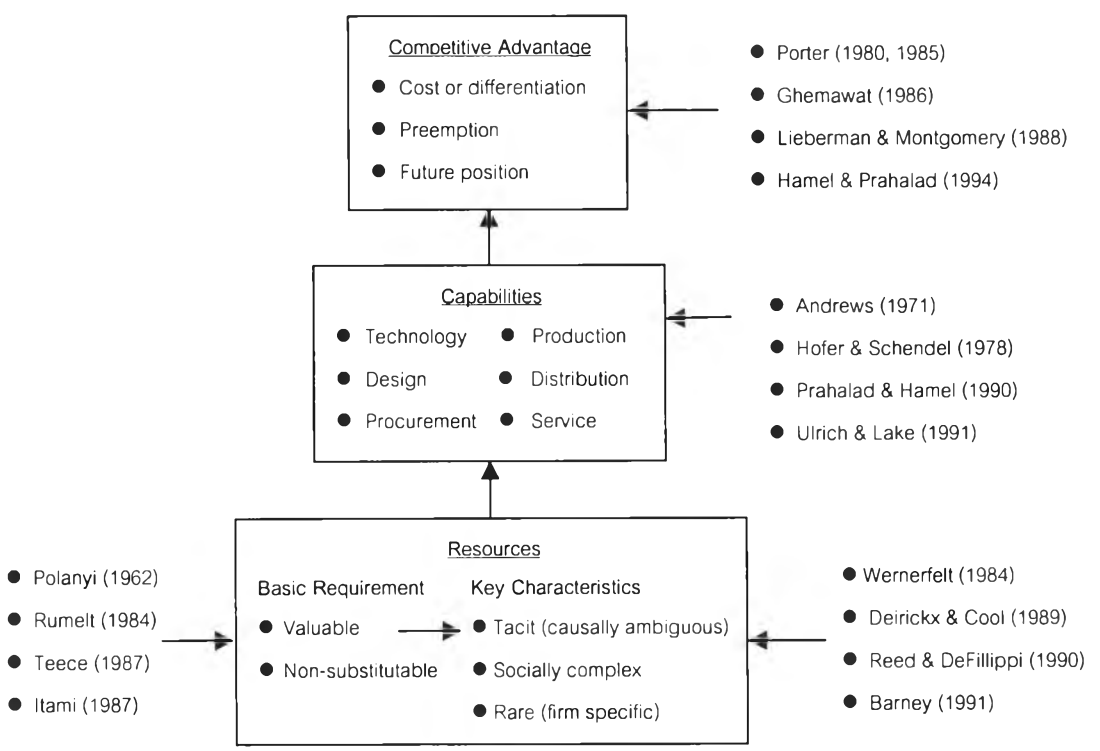

Figure 2.1 The Resource-Based View

Source: Hart (1995). "A Natural-Resource Based View of the Firm". Academy of Management Review, 20(4), p 986-1014.

Establishment of the Resource-Based View

The concept of competitive advantage has been treated extensively in the management literature. Porter (1980, 1985) thoroughly developed the concepts of cost leadership and differentiation relative to competitors as two important sources of competitive advantage: a *low-cost* position enables a firm to use aggressive pricing and high sales volume, whereas a *differentiated product* creates brand loyalty and positive reputation, facilitating premium pricing. Decisions concerning timing (e.g., moving early versus late) and commitment level (e.g., entering on a large scale versus more incrementally) also are crucial in securing competitive advantage (Ghemawat, 1986; Lieberman & Montgomery, 1988). If a firm makes an early move or a large-scale move, it is sometimes possible to preempt competitors by setting new standards or gaining preferred access to critical raw materials, locations, production capacity, or customers. Preemptive commitments thus enable firms to gain a strong focus and dominate a particular niche, either through lower costs, differentiated products, or both (Ghemawat, 1986; Porter, 1980). Finally, Hamel and Prahalad (1989, 1994) have emphasized the importance of "competing for the future" as a neglected dimension of competitive advantage. According to this view, the firm must be concerned not only with profitability in the present and growth in the medium term, but also with its *future position* and source of competitive advantage. This view requires explicit strategizing about how the firm will compete when its current strategy configuration is either copied or made obsolete.

The connection between firms' *capabilities* and competitive advantage also has been well established in literature. Andrews (1971) and, later, Hofer and Schendel (1978) and Snow and Hrebiniak (1980) noted the centrality of "distinctive competencies" to competitive success. According to the resource-based view, competitive advantage is rooted inside a firm, in assets that are valuable and inimitable. A firm's capabilities or competencies and management's abilities to command these assets to produce superior

performance determine competitive advantage (Grant, 1991). More recently, Prahalad and Hamel (1990) and Ulrich and Lake (1991) re-emphasized the strategic importance of identifying, managing, and leveraging "core competencies" rather than focusing only on products and markets in business planning. The resource-based view takes this thinking one step further: It posits that competitive advantage can be sustained only if the capabilities creating the advantage are supported by resources that are not easily duplicated by competitors. In other words, firms' resources must raise "barriers to imitation" (Rumelt, 1984). Thus, resources are the basic units of analysis and include physical and financial assets as well as employees' skills and organizational (social) processes. A firm's capabilities result from bundles of resources being brought to bear on particular value-added tasks (e.g., design for manufacturing, just-in-time production). Organizational capabilities, according to Day (1994), are the coordinating mechanisms that enable the most efficient and competitive use of the firm's assets – whether tangible or intangible. These capabilities are more likely to emerge during periods of greater turbulence and organizational change (Wernerfelt, 1984). The competitive advantages of these capabilities stem from their elusive nature based on social complexity and deep embeddedness in organizations (Hart, 1995; Teece, 1987; Winter, 1987).

Although the terminology has varied (Peteraf, 1993), there appears to be general agreement in the management literature about the resource characteristics that contribute to a firm's sustained competitive advantage. At the most basic level, such resources must be valuable (i.e., rent producing) and non-substitutable (Barney, 1991; Dierickx & Cool, 1989). In other words, for a resource to have enduring value, it must contribute to a firm capability that has competitive significance and is not easily accomplished through alternative means. Next, strategically important resources must be *rare* and / or *specific* to a given firm. These capabilities usually lack an identifiable owner in an organization and are not traded in factor markets (Barney, 1991; Reed &

DeFillippe, 1990). That is, they must not be widely distributed within an industry and / or must be closely identified with a given organization, making them difficult to transfer or trade (e.g., a brand image or an exclusive supply arrangement). Although physical and financial resources may produce a temporary advantage for a firm, competitors or new entrants often can readily acquire them on factor markets. Conversely, a unique path through history may enable a firm to obtain unusual and valuable resources that cannot be easily acquired by competitors (Barney, 1991). Finally, such resources must be difficult to replicate because they are either *tacit (causally ambiguous)* or *socially complex* (Teece, 1987; Winter, 1987). Tacit resources are skill based and people intensive. Such resources are "invisible" assets based upon learning-by-doing that are accumulated through experience and refined by practice (Itami, 1987; Polanyi, 1962). Socially complex resources depend upon large numbers of people or teams engaged in coordinated action such that few individuals, if any, have sufficient breadth of knowledge to grasp the overall phenomenon (Barney, 1991, Reed & DeFillippi, 1990). In other words, they are path dependent upon a combination of unique organizational actions and learning undertaken over a period of time (Barney, 1991; Diericks & Cool, 1989). They span several different functions and levels within an organization and are capable of multiple uses (Amit & Schoemaker, 1993; Barney, 1991).

The Resource-Based View and the External Environment

In pursuit of adding depth and breadth to this internal view, theorists have noted but left somewhat vague the role of a firm's links to its external environment. Barney (1986) addressed this issue by pinpointing the conditions under which a firm's resources become valuable by bringing the external environment into the resource-based picture. In developing the notion of external factor markets, he commented that IO model's recommendation of external resource analysis alone couldn't lead to valuable resources. However, by nurturing internal competencies and applying them to an

appropriate external environment, a firm can develop a viable strategy. He suggested that, for a firm's resource to become valuable, it must allow the firm to "exploit opportunities or neutralize threats" in the firm's environment (Barney, 1991).

Corner (1991) is another resource-based theorist whose contribution explicitly relates to the link in resource-based theory between the competitive environment and firm capabilities. She observed the comparison of the resource-based view and the IO and Chicago models that all three recognize the external constraints of demand conditions and public policy on strategy. In Corner's view, the task for resource-based theorists is to perceive the appropriate rent-generating inputs given both external (e.g., demand, public policy, and competitor action) and internal (e.g., past history, resource endowments, and corporate culture) constraints. Consequently, the resource-based view in its current state addresses the fit between what a firm has the ability to do and what it has the opportunity to do. Collis and Montgomery (1995) asserted that resources couldn't be evaluated in isolation, because their value is determined in the interplay with market forces. A resource that is valuable in a particular industry or at a particular time might fail to have the same value in a different industry or chronological context.

The Resource-Based View and the Natural Environment

Previous applications of resource-based theory to evaluation of environmental policies and strategy have concentrated on internal analysis of firms (Porter, 1991; Shrivastava, 1995). However, Hart (1995) expanded the resource-based view of the firm to include the constrains imposed and opportunities offered by the natural environment which he termed "a natural-resource-based view of the firm". He argued that corporate response to calls for environmental protection is an important emerging competitive domain for businesses and might be best understood in terms of the resource-based view of the firm. He provided a schema that links the imperative of capturing a competitive advantage with the goal of securing and enhancing social legitimacy. He viewed

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external stakeholders as playing a pivotal role in moving corporations toward sustainability. The logical extension of this argument is that viewing societal demands as part of the external environment facing a firm trying to develop unique resources leads to expectations about when such resources will be valuable and inimitable.

The Resource-Based Theory and The Institutional Theory

The resource-based view provides the important insights how firms make decisions about selecting and accumulating resources to enable them to generate above-normal rates of return and a sustainable competitive advantage within the context of imperfect and incomplete factor markets. However, this approach is criticized by the institutional theorists that it has not looked beyond the properties of resources and resource markets to explain enduring firm heterogeneity in terms of economic rents generating capability. Oliver (1997) points out that the process of acquiring resources and sustaining economic rents is not simply a function of imperfect or incomplete factor markets, but depends more fundamentally on the social context of resource decisions. To be specific, the resource-based view has not examined the social context within which resource selection decisions are embedded (e.g., firm's internal culture as well as broader influences from the state, society, and inter-firm relations that define socially acceptable economic behavior) and how this context might affect sustainable firm differences (Ginsberg, 1994).

To fill such gap, Oliver (1997) proposes to use insights from the institutional theory to complement the resource-based theory. Based on this approach, she uses the institutional theory to examining the role of social influence and pressures for social conformity in shaping organizations' actions. Therefore, it is appropriate to present the review of institutional theory in the next section.

2.2 REVIEW OF INSTITUTIONAL THEORY

From an institutional perspective, firms operate within a social framework of norms, values, and taken-for-granted assumptions about what constitutes appropriate or acceptable economic behavior. Economic choices are constrained not only by the technological, informational, and income limits that neoclassical models emphasize, but also by socially constructed limits that are distinctly human in origin, like norms, habits, and customs. The institutional view suggests that the motives of human behavior extend beyond economic optimization to social justification and social obligation (Zucker & DiMaggio, 1990). As partial captives of social convention, individuals and organizations are assumed to be approval seeking, susceptible to social influence, and relatively intractable creatures of habit and tradition (Scott, 1995; Zucker, 1987). According to institutional theorists, conformity to social expectations contributes to organizational success and survival (Baum & Oliver, 1991; Carroll & Hannan, 1989; DiMaggio & Powell, 1983; Oliver, 1991). As Scott (1987: 498) observes, "organizations .... conform because they are rewarded for doing so through increased legitimacy, resources, and survival capabilities." Unlike economic and strategic frameworks, which examine the extent to which firm behavior is rational and economically justified, institutional theorists emphasize the extent to which firm behavior is compliant, habitual, unreflective, and socially defined.

Institutional theorists are interested in the process by which items become institutionalized over time and the role of institutions in society (Scott, 1987). According to Scott (1987a: 498), institutions are defined as regulatory structures, government agencies, laws, courts, and professions. In accordance with most institutional theorists (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Meyer & Scott, 1983; Zucker, 1987a), institutional constituents that exert pressures and expectations include not only the state and professions, as institutions, but also interest

groups and public opinion (Scott, 1987b: 114). Because of its focus on how items become rule-like or become social facts, institutional theory is useful for understanding how concepts of environmentalism are generated and accepted both inside and out of organizations (Meyer & Rowan, 1977; Zucker, 1987).

Institutionalized activities are those actions that tend to be enduring, socially accepted, resistant to change, and not directly reliant on rewards or monitoring for their persistence (Oliver, 1992). Institutionalized activities for which there is no obvious economic or technical purpose are of particular theoretical interest because rational choice frameworks cannot explain their perpetuation. A firm, for example, that retains the same unreliable supplier over a period of years may be perpetuating this institutionalized activity simply out of habit, even though the firm believes such allegiance to be rational. When managers, for example, justify actions with the claim that "we've always done it this way," "everybody does it this way" or "that's just the way things are done around here," they are referring to institutionalized activities. Institutional theorists argue that many activities in firms (e.g., approaches to managing employees, routines for assigning resources) are so taken for granted or so strongly endorsed by the firm's prevailing culture or power structure that decision-makers no longer even question the appropriateness or rationality of these activities.

Institutional theorists have emphasized the survival value of conformity with the institutional environment and the advisability of adhering to external rules and norms (DiMaggio & Powell, 1983; Meyer & Rowan, 1977). Organizations are predicted to conform to institutionalized beliefs or practices when these beliefs or practices are so externally validated and accepted by organizations as to be invisible to the actors they influence (DiMaggio, 1988). Institutional theory illustrates how the exercise of strategic choice may be preempted when organizations are unconscious of, blind to, or

otherwise take for granted the institutional processes to which they adhere. Moreover, when external norms or practices obtain the status of a social fact, organizations may engage in activities that are not so much calculative and self-interested as obvious or proper (Oliver, 1991). Hence, proponents of institutional perspective assume that organizational choice is possible within the context of external constraints. It was noted by Oliver (1991) that the institutional theorists tend to focus on conformity, passivity, and preconscious acceptance of organizations in response to *institutional pressures.*

Institutional Pressures

Theory and research on institutionalization have generated valuable insights into the institutional pressures on organizational conformity to the environment. DiMaggio (1988) and DiMaggio and Powell (1983) suggest that organizations attempt to obtain stability and legitimacy. Motives of stability is hypothesized by the processes of reproduction or imitation of organizational structures, activities, and routines in response to state pressures, the expectations of professions, or collective norms of the institutional environment (DiMaggio & Powell, 1983; Zucker 1977; 728). According to Orru, Biggart, and Hamilton (1991), institutions create powerful pressures for organizations to seek legitimacy and strive for social conformity. Therefore, analysts have typically found institutional phenomena reflected in an increasing homogeneity of organizations, or isomorphism (Kraatz & Zajac, 1996).

The different strategic responses that organizations enact as a result of the institutional pressures toward conformity that are exerted on them were explicitly examined by Oliver (1991). In order to argue that institutional theory can accommodate interest-seeking and organizations' responses to institutional pressures and expectations are not assumed to be invariably passive and conforming across all institutional conditions, she applied the convergent insights of institutional and resource dependence theories to

demonstrate how organizational behavior may vary from passive conformity to active resistance in response to institutional pressures, depending on the nature and context of the pressures themselves. She also provides ten *conformity factors* to predict the degree of organizational conformity or resistance to institutional pressures. They are 1) the degree of social legitimacy, 2) the degree of economic, 3) the degree of constituent multiplicity, 4) the degree of external dependence on pressuring constituents, 5) the consistency of institutional norms or requirements with organizational goals, 6) the degree of discretionary constraints imposed on the organization by institutional pressures, 7) the degree of legal coercion behind institutional norms and requirements, 8) the degree of voluntary diffusion of institutional norms, values, or practices, 9) the degree of uncertainty in the organization's environment, and 10) the degree of interconnectedness in the institutional environment.

Combining Institutional and Resource-Based Views

Oliver (1997), with the spirit of extending the resource-based perspective to cover the social context, combines a resource-based view with insights from the new institutionalism in organization theory (DiMaggio and Powell, 1983, 1991; Scott, 1987, 1995). Drawing on an institutional perspective, she argues that resource selection and sustainable competitive advantage are profoundly influenced, at the individual, firm, and inter-firm level, by the institutional context (e.g., rules, norms, and beliefs surrounding economic activity that define or enforce socially acceptable economic behavior) of resource decisions. At the individual level, the institutional context includes decision-makers' norms and values; at the firm level, organizational culture and politics; and at the inter-firm level, public and regulatory pressures and industry-wide norms.

The Institutional Theory and The Diffusion of Innovation

The institutional theory contributes the important insights how the imitation behavior plays a major role in the innovation diffusion process (Abrahamson, 1991; Abrahamson & Rosenkopf, 1993). This theory is used to induce understanding why and how irrationality (e.g., myths, meaning, and values) and coercive process of isomorphism may be the forces behind the diffusion of innovation, no matter that innovation is efficient or not. Institutional theorists propose the innovation processes, which compose of early stage and later stage pattern of adoption, and argue that the early adoption could be predicted on the rational basis, while the diffusion of innovation occurred at later adoption stage could be explained by legitimacy (DiMaggio & Powell, 1983; Mayer & Rowan, 1977; Tolbert & Zucker, 1983; Zucker, 1987).

Despite the strengths of institutional theory, its one weak point is that institutional research on innovation tends to overlook the role of agency within organizations (Covaleski & Dirsmith, 1988; DiMaggio, 1988; Oliver, 1991; Perrow, 1986; Powell, 1985). Van de Ven and Rogers (1988) suggested that any macro theory of organizational innovation should be grounded in the purposive actions and ambitions of individuals. Fortunately, the diffusion of innovation theory, which considers the members of a social system and the communication channel as the fundamental elements in the process of diffusion (Roger, 1983), provides the complementary insights concerning with this issue. Therefore, the review of diffusion of innovation theory is presented in the next section.

2.3 REVIEW OF DIFFUSION OF INNOVATION THEORY

Diffusionists have long recognized that increases in the number of organizations that adopt an innovation influence the number of remaining organizations that will subsequently adopt this innovation (Mansfield, 1961). Two types of perspectives can explain this phenomenon at least: rational-efficiency perspective and fad perspective (Abrahamson, 1991). Proponents of rational-efficiency perspective believe that organizations rationally choose to adopt an innovation that is diffusing based on updated information about the innovation's technical efficiency or returns. Reviewers of the innovation literature unanimously agree that this perspective contains pro-innovation biases (Downs & Mohr, 1976; Kimberly, 1981; Rogers, 1962, 1983; Rogers & Schoemaker, 1971; Van de Ven, 1986; Zaltman, Duncan, & Holbeck, 1973). Kimberly (1981) defined pro-innovation biases as presumptions that innovations will benefit organizations. Rogers (1983) points out that pro-innovation biases are reinforced by the rational-efficiency perspective in the diffusion of innovation literature, which relies on a model of choice in which adopters make independent, rational choices guided by goals of technical efficiency. Such perspective reinforces pro-innovation biases because it suggests that a rational adopter never decides to adopt a technically inefficient technology that was diffusing or to reject a technically efficient technology that this organization had adopted. The rational-efficiency perspective is based on two major assumptions (March, 1978): (a) organizations within a group can freely and independently choose to adopt a technology and (b) organizations are relatively certain about their goals and their assessments of how efficient technologies will be in attaining these goals. As a result, organizational choices can be rational and can lead to the selection and retention of technically efficient technologies. Advocates of fad perspective, in contrast, believe that organizations choose to adopt an innovation based on what other organizations have adopted it, rather than its technical efficiency or returns. Macdonald (1992) criticizes that this rational-efficiency perspective is not

applicable to the case of innovation adoption imposed by social influence in the form of authority. For example, it cannot explain the diffusion of administrative innovations suggested by the World Bank or the International Monetary Fund (IMF) to developing countries, despite the inefficiency of those innovations in solving the developing countries' problems (Lorsuwannarat, 1995). To overcome this pro-innovation biases, Abrahamson (1991) generates two counter-assumptions: (a) organizations outside a group, such as regulatory bodies or consulting firms, influence the choices made by organizations within this group and (b) organizations have unclear goals and high uncertainty about the technical efficiency of technology, which make them unable to rationally choose technically efficient technology because they would not be able to assess technical efficiency (March & Olsen, 1976). Also, these organizations would not have clear goals to help them decide which type of technical efficiency mattered in attaining organizational goals. According to perspective that include this counter-assumption, under conditions of uncertainty, organizations imitate other organizations – they base their decisions of which technology to use on the decisions of other organizations (DiMaggio & Powell, 1983; Thompson, 1967).

Other key aspects to be reviewed here are the agents and the communication channels, which play important roles as the mechanisms of change in the diffusion of innovation theory. This theory has the implicit assumption of considerable free choice, in which a source of communication can interact with anyone in the system (Rogers & Schoemaker, 1971). The model pays great attention to the active role of agency. Adopters and non-adopters utilize the information and make decisions on adoption or rejection. In other words, agency has purposive action and has the capacity to create change. Opinion leaders and change agents also play significant roles in influencing innovation adoption (Lorsuwannarat, 1995). In addition, the core concept of the theory is based on the notion of information as a means to reduce the uncertainty surrounding innovation (Rogers, 1983; Rogers & Kincaid, 1981). Therefore, the strength of

diffusion theory is its focus on communication networks, which can have an effect on information sharing to reach mutual understanding and consequently it can lead to social or organizational change (Lorsuwannarat, 1995). When a unit of adoption has updated information about an innovation through communication channels, the unit will assess the innovation returns or benefits before adopting or rejecting it. According to Ebadi and Utterback (1984), their empirical study found that at the individual level, the frequency, centrality, and diversity of communication all have positive effects on the success of technological innovation. They also found that, on aggregate level, network cohesiveness, centrality, and diversity of communications all were positively related to technological innovation. However, there are some limitations relating to the agents and the communication channels. First, it pays little attention to the institutional conditions, which may constrain the autonomy of decision makers. Only norms and organizational structures have been added to the theory as constraints, while other conditions such as organizational capabilities have still not been discussed in detail. Second, this theory emphasizes communication channels only at the individual and group levels, but not the inter-organizational level. Thus, inter-organizational relations (IORs) concepts are still not extensively incorporated into diffusion theory (Lorsuwannarat, 1995). IORs ascribe central importance to environments, with the focus on the interconnection of organizations, in explaining organizational behavior. IORs can be defined as "the relatively enduring transactions, flows, and linkages that occur among or between an organization and one or more organizations in its environment" (Oliver, 1990: 241).

2.4 REVIEW OF THE CLEAN TECHNOLOGY

Stakeholders, e.g., customers, suppliers, and the public, are increasingly demanding that firms minimize any negative impact of their products and operations on the natural environment. Manufacturing operations, through product and process technologies, have been recognized as a critical driver of environmental performance (Cairncross, 1992; Hart, 1995; Schmidheiny, 1992). Ecological impacts vary with raw material specifications, production efficiencies, energy consumption, pollution emissions, product delivery systems, and recycling (Sarkis, 1995). Technologies that limit or reduce negative impacts of products or services on the natural environment have been termed *environmental technologies* (Shrivastava, 1995). Shrivastava called for their inclusion in frameworks of strategy, and he, along with others (Hart, 1995; Porter & van de Linde, 1995), has noted the potential of these technologies to offer competitive advantage. In response, management research and conceptual thinking on environmental issues has expanded from a narrow focus on the concept of pollution control (Bragdon & Marlin, 1972) to include a larger set of management decisions, programs, tools, and technologies that incorporates environmental issues into functional considerations (Hunt & Auster, 1990). Consequently, environmental policies were encouraged to go beyond compliance and control to proactively focus on prevention (Russo & Fouts, 1997). Thus, two dominant approaches to environmental management emerge from this theoretical base: proactive pollution prevention, which relies on strategic resources and thereby, can deliver sustainable competitive advantage, and reactive pollution control, which cannot impart competitive advantage.

Approaches to Pollution Abatement

Pollution abatement can be achieved through two primary approaches: pollution control and pollution prevention. Pollution control means cleaning up waste after it has been created while pollution prevention means minimizing or eliminating waste before it is

created (Hart, 1997). Pollution control approaches are considered as the traditional methods, also known as end-of-pipe solutions, that emissions and effluents are trapped, stored, treated, and disposed of using pollution-control equipment. Pollution prevention strategies imply the modern methods that emissions and effluents are reduced, changed, or prevented through better housekeeping, material substitution, recycling, or process innovation (Cairncross, 1991; Frosch & Gallopoulos, 1989; Willig, 1994; Schmidheiny, 1992). The former approach entails expensive nonproductive pollution-control equipment while the latter approach reduces pollution during the manufacturing process. Pollution prevention thus appears analogous, in many respects, to total quality management (TQM); it requires extensive employee involvement and continuous improvement of emissions reduction, rather than reliance on expensive "end-of-pipe" pollution-control technology (Imai, 1986; Ishikawa & Lu, 1985; Roome, 1992). Buchholz (1993) pointed out that normal regulations have usually required the use of traditional methods. Modern procedures are normally adopted on a firm's own initiative, as a result of a growing awareness of problems and perceptions of advantages.

Proactive environmental management policies have been seen as synonymous with the use of pollution prevention, whereas reactive or compliance policies have been equated to the use of "end-of-pipe" pollution controls (Russo & Fouts, 1997). However, Aragon-Correa (1998) reported evidence that firms with leading edge, proactive environmental management combined prevention and control, whereas some less proactive firms predominantly used control. This empirical evidence is consistent with the Organization for Economic Cooperation and Development's (1995) recommendation that companies adopt an integrated approach to pollution prevention and control.

Pollution Prevention Technologies

This category is defined as structural investments in operations that involve fundamental changes to a basic product or primary process. These technologies reduce or eliminate pollutants by using cleaner alternatives than those currently in place (Freeman et al., 1992; Organization for Economic Cooperation and Development, 1995). In other words, pollution prevention technologies are expected to significantly reduce the *total* quantity of harmful pollutants released into the environment and disposed of (Freeman et al., 1992; Royston, 1979; Schmidheiny, 1992). Pollutants are not merely transferred from one medium to another (for instance, from the air to solid waste); instead, their generation is avoided. Pollution prevention technologies can be further characterized as product or process adaptation, although the two are related. Product adaptation encompasses all investments that significantly modify an existing product's design to reduce any negative impact on the environment during any stage of the product's manufacture, use, disposal, or reuse. Process adaptation refers to fundamental changes to the manufacturing process that reduce any negative impact on the environment during material acquisition, production, or delivery.

Some management systems, such as improved housekeeping practices, might be considered to be pollution prevention (Freeman et al., 1992; Hart, 1995) or to be parts of implementing product or process adaptation. The emphasis here is the physical product and / or process change. This narrow definition reflects the structural / infrastructural distinction made in manufacturing strategy research, which has earned broad theoretical and managerial acceptance in operations management (Hayes & Wheelwright, 1984).

Pollution prevention technologies can provide net benefits because of their potential to improve environmental performance up-front rather than as an afterthought (Porter & van de Linde, 1995; Schmidheiny, 1992). The fundamental rethinking of a product or

manufacturing process also places fewer constraints on the means of achieving environmental improvement, thereby offering greater opportunity for innovation. Parallels can be drawn to current views on quality management, in which the failure costs associated with controlling and repairing poor quality far outweigh the costs of prevention and better design (Juran, Gryna, & Bingham, 1988; Klassen & McLaughlin, 1993). Much like total quality management, pollution prevention strategies depend on continuous improvement efforts to reduce waste and energy use. This transformation is driven by a compelling logic: pollution prevention pays. Emerging global standards for environmental management systems (ISO 14000, for example) also have created strong incentives for companies to develop such capabilities (Hart, 1997). Because the implementation of pollution prevention technologies depends on organizational and knowledge-based resources, greater competitive advantage is expected during periods of uncertainty due to high industry growth (Russo & Fouts, 1997), new environmental regulation (Dean & Brown, 1995), declining availability of natural resources, or increased external stakeholder pressure (Hart, 1995).

Clean Technology

There are many preventive terms – such as pollution prevention, eco-efficiency, waste minimization, resource reduction, and cleaner production – in use today. While the term "pollution prevention technology" is widely used in the United States, the term "clean technology" or "CT" is officially adopted in Thailand and is put into the Thailand National Pollution Prevention Master Plan prepared by the Ministry of Science, Technology and Environment. According to the Department of Industrial Works, Ministry of Industry of Thailand, clean technology (CT) is defined as a measure to improve or adjust production processes or products, so that consumption of raw materials, energy and natural resources is accomplished efficiently, with minimum waste or none at all. It is pollution reduction at source, including substitution of raw materials, recycling and reusing, which will help conserve the environment and

simultaneously reduce production costs (Department of Industrial Works, 2000). This definition emphasizes the reduction of environmental impacts at the source. It considers the inputs rather than outputs in the search to produce more goods with less waste and emission. Optimizing the use of all inputs in production, i.e., raw materials, energy, natural and human resources, is the cleaner technology approach.

It is increasingly recognized globally that cleaner production policy and practices must be an integral component of successful strategies for sustainable development. The preface in a booklet produced by the United Nations Environment Programme (UNEP) in 1994 noted cleaner production strategies are a cornerstone of successful sustainable development (UNEP, 1994). Clean technology projects have been carried out in various countries and with various designs. The Netherlands, for example, initiated pollution prevention as part of its environmental policy at the end of the eighties, and shifted the focus to preventive action at the onset of its first National Environmental Policy Plan of 1989. In Denmark, the clean technology support scheme has become a decisive element in the new environmental strategy that was formulated at the end of the 1980s. The New Zealand Ministry for the Environment pursued pollution prevention approach since 1992. A Waste Management Policy developed in 1992 declared that waste generators should meet the costs of the waste they produce and the Government's Coalition Agreement in 1996 outlined specific waste reduction policy initiatives. These included seeking to reduce solid waste generation to half the 1990 level by the year 2000. In the United States, Congress in 1990 passed the Pollution Prevention Act, which directs the Environmental Protection Agency (EPA) to separate office for the specific purpose of promoting pollution prevention. In 1989, the Industry and Environment Centre of the United Nations Environment Programme Industry (UNEP IE) launched the cleaner production programme in order to create awareness of the pollution prevention concept. In 1998, more than 140 cleaner production (CP) centres

and activities located in over 40 countries can be identified. Members of the network, including UNEP, CP centres, other UN organizations, universities, the World Bank, and other lending organizations, are active in promoting clean technology (CT).

CT in the Industrialized Developed Countries of Asia Pacific

In the more industrialized and developed countries such as Japan, Australia, New Zealand, Chinese Taipei, and Hong Kong, the clean technology (CT) concept has generally been well established through policy instruments and institutional mechanisms. Japan, for instance, enacted in November 1993 the Basic Environmental Law, which lays down the principles and policy direction. The Ministry of International Trade and Industry (MITI) initiated the plan of clean technology (CT). MITI has also launched "Eco Town Project" to promote construction of industrial parks based on the Zero Emission concept. The Clean Japan Centre was established under the support of MITI and other private and public organizations to promote recycling in society. Chinese Taipei, another example, adopted industrial waste minimization (IWM) in 1988. Necessary institutional mechanism was developed and goals and action plans were formulated. The first phase of the program was completed in 1995. The important program elements include public awareness promotion, information exchange systems, technical assistance, technology research sponsored toward IWM, and financial incentives. In summary, these governments were quick to assess the importance of the clean technology concept as it started gaining credibility in the Western countries and, hence, supported industry as well as other clean technology community efforts with necessary policy back up. As a result of a high level of environmental awareness amongst industry and the community at large, supplemented by the strict enforcement of environmental legislation, the clean technology (CT) concept and related activities have been institutionalized and are well sustained.

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Typical CT Promotion Pattern in Developing Countries of Asia Pacific

The CT advancement in the developing countries in Asia Pacific (e.g., India, Indonesia, Malaysia, Nepal, Pakistan, Sri Lanka, The Philippines, Viet Nam, and Thailand) is different from that in the more industrialized and economically advanced countries. Parasnis and Bunyagidj (1998) observe that most of these developing countries have been following the same path. Typically, the CT promotion pattern consists of:

1. Initial isolated CT activities originating from the non-government sector developing into donor supported comprehensive CT programmes have been the starting point for most of the developing countries in their CT promotion activities. These initial grass-root level activities have followed a similar model of launching CT programmes consisting of one or more components as outlined below:
   - Awareness, training, capacity building
   - Technical assistance / industrial CT audits
   - CT demonstration projects
   - Information dissemination
2. As a consequence, a network of concerned CT stakeholders was emerging in each country and led to the government policy support for institutionalizing CT at the national level. Because the environmental awareness and the enforcement of environmental legislation in the developing countries of Asia Pacific have not yet reached such a level that the industries (especially small and medium scale) are likely to take initiatives towards CT, it is the common believe that the government policies should be the major tool for overcoming this obstacle.
3. Finally, other means of making pollution prevention sustainable are set up. This includes using the market forces for promoting CT through green marketing or green purchasing, or by implementing the pollution pays principle (PPP). One important tool pursued by CT promoters is the ISO 14000 based Environmental

Management System (EMS). Many organizations are contemplating ISO 14000 as a vehicle to introduce the CT concept to the industry. This approach is getting more popular especially in countries where international trade and exports are the backbone of the economy.

CT in Thailand

A number of initiatives to prevent pollution and to promote clean technology concept have already been implemented in Thailand primarily under the support from international donor agencies. Several bilateral projects have also aimed at promoting the practice of clean technology in Thai industry. There also has been a growing interest in the government sector on the promotion of pollution prevention concept through the various government activities and the policy and legislative framework. Some of these activities are summarized and reported as follows:

1. U.S. Agency for International Development (USAID) set up and funded the Federation of Thai Industries (FTIs), "Industrial Environmental Management Programme" (FTI / EM) from 1990 to October 1995. The project promoted US clean technologies through the conducting of environmental audits in the textile dyeing, printing and finishing industries; pulp and paper industries; food processing and chemical industries; visits to US manufacturers, and the implementation of a number of pilot projects.

2. During the period of 1991–1994, Carl Duisberg Gesellschaft (CDG) in association with its South East Asian Programme Office assisted small and medium sized industries in the textile, electroplating and food industries. The project was implemented with the help of educational institutions such as Asian Institute of Technology, Chulalongkorn University and Chiang Mai University. A number of training, capacity building and industrial audit activities were undertaken.

3. Australia as well as Japan (JICA) have financed clean technology workshops for audiences composed of representatives from the public and private sectors involved in industry and environment. Canada also has supported similar efforts.

4. Danish Cooperation for Environment and Development (DANCED) set up the project "Promotion of Clean Technology in Thai Industry" in order to strengthen Thai environmental auditing and clean technology expertise at the implementing / advisory level. The project was implemented during 1996-1998 with Thailand Environment Institute (TEI) and the Industrial Environmental Management Office of the Federation of Thai Industries (IEM / FTI). The project activities include firstly, the capacity building and training of TEI and IEM / FTI staff to culminate in establishing of a clean technology advisory services at these organizations. The second project component consisted of carrying out environmental audits in the food, electroplating and textile industries. Some audits followed by demonstration projects for clean technology were co-financed by the DANCED. A third component of the project was the setting up of a "Cleaner Production Information Centre" at TEI to collect and disseminate national and international information on clean technology to Thai audiences.

5. The European Commission (EC) has been implementing a project jointly with TEI to encourage the "Public Participation in Environmental Management in Samut Prakarn". One important component in this project is to introduce clean technology concept and practices in target industry sectors by conducting clean technology audits and implementing demonstration projects.

6. The Asian Development Bank (ADB) and the DANCED supported the first Asia Pacific Roundtable on Cleaner Production in Bangkok in November 1997. This activity was implemented by the Pollution Control Department (PCD) in conjunction with the international exhibition and conference "Pollution Control 1997".

7. Among the multinational donors, in particular UNIDO and UNEP have been active in developing initiatives to promote the concept of clean technology in Thailand. UNIDO has attempted to introduce environmental audits in the tannery industry, and sponsored a clean technology seminar at the beginning of 1996, which proposed to set up a "Clean Technology Centre" in Thailand.

8. The GTZ provides long-term environmental advisory assistance for the Thai industry in cooperation with Department of Industrial Works (DIW) under the Ministry of Industry (MOI). The project was launched in August 1994 and an extension has been decided until 2001. The project aims to demonstrate systems to reduce the environmental impact from selected industrial sectors by development of environmental management guidelines, implementation of demonstration projects and development of environmental policy incentives.

9. DIW under MOI with the assistance from the DANCED launched a project by late 1998. The objectives for this project include: capacity building for the DIW staff on clean technology and development and pilot scale implementation of the industrial policies favoring clean technology within DIW.

10. In October 1995, the Pollution Control Department (PCD), MOSTE under the support from the Asian Development Bank (ADB), commissioned the Samut Prakarn Wastewater Management Project. Industrial Pollution Prevention and Clean Technology Transfer (IPP-CTT), an important activity under this project complements the massive investment in pollution prevention and control. It is important to note that Samut Prakarn Wastewater Management Project is the first in Thailand to purposely integrate clean technology and pollution control.

11. The Samut Prakarn Cleaner Production for Industrial Efficiency (CPIE) Program was initiated in January 2000. This initiative, sponsored by the Royal Thai Government through the Pollution Control Department (PCD), is working in

partnership with Samut Prakarn industry, government, and other partners to develop incentives and accelerate the adoption of clean technology and practices. The focal point of the project is the "20/20+ Program," a voluntary commitment program aimed at improving efficiency among industry in Samut Prakarn and achieving measurable reductions in water consumption, wastewater generation and energy consumption. The program also encourages facilities to achieve additional environmental improvements in areas such as toxic chemical releases, solid waste generation, and hazardous waste disposal. This four-year program will secure the involvement of additional Thai and international organizations, including local government and municipalities, universities, non-governmental organizations, and professional and business associations.

2.5 SUMMARY

From a resource-based perspective, sustainable competitive advantage is the outcome of discretionary rational managerial choices, selective resource accumulation and deployment, strategic industry factors, and factor market imperfections. One important insight provided by this theory is that the competitive advantage can be derived from the firm's response to natural environmental requirement. However, it is obviously unrealistic to conclude that firms decide to adopt clean technology just solely because of seeking competitive advantage in order to generate above-normal rates of return. In contrast, institutional theory argues that the social influence and pressures play significant roles in shaping organizations' actions, and successful firms are those that gain support and legitimacy by conforming to social requirement and maintaining the valuable idiosyncratic resources for sustainable competitive advantage. Hence, a key implication from these two perspectives is that clean technology adoption depends on the economic rationality and normative rationality context. Finally, the diffusion of innovation theory supplies the complementary insight that agents and communication channels are the mechanism of change in the process of diffusion of innovation.