CHAPTER 3

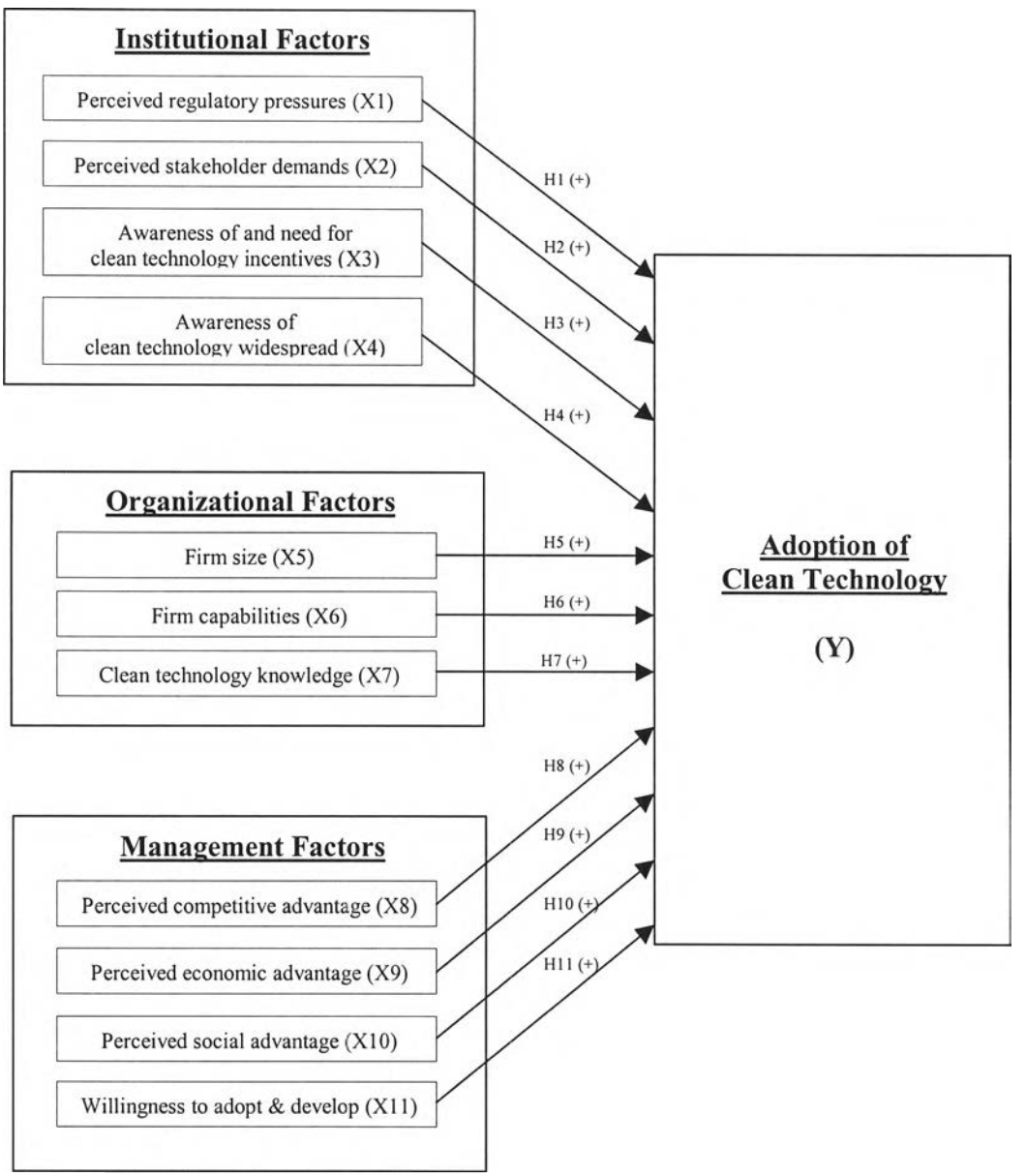
RESEARCH MODEL AND HYPOTHESES

3.1 RESEARCH MODEL

Figure 5.1 shows the conceptual framework of this study in the context of food processing industry and electrical / electronics industry in Thailand. The purpose of this model is to use the institutional factors, organizational factors, and management factors for predicting the adoption of clean technology. Manufacturing firms with different level of effects from these factors will decide differently to adopt or reject clean technology.

The framework of this study consists of four constructs. Adoption of clean technology is the dependent variable. The independent variables are institutional factors, organizational factors, and management factors. Institutional factors (e.g., perceived regulatory pressures, perceived stakeholder demands, awareness of and need for clean technology incentives, and awareness of clean technology widespread) are based on the institutional theory and the diffusion of innovation theory. Organizational factor (e.g., firm size, firm capabilities, and clean technology knowledge) are based on the resource-based theory. Management factors (e.g., management's perceived competitive advantage, economic advantage, and social advantage derived from clean technology adoption, and management's willingness to adopt and develop clean technology) are based on the diffusion of innovation theory.

Control variables in this framework include the industry type (e.g., food processing industry and electrical / electronics industry) and the major export markets (e.g., no export, export mainly to countries in Asia, export mainly to Japan, and export mainly to the U.S. and EU).



Context: Food Processing Industry and Electrical / Electronics Industry in Thailand

Figure 3.1 Research Model

3.2 HYPOTHESES

There are eleven hypotheses proposed in this study.

Institutional Factors

State and societal forces in the organization's environment are among the most critical agents of institutional change (DiMaggio & Powell, 1983). State pressures on organizations to conform to public demands and expectations (e.g., pollution abatement) typically displace previously institutionalized practices (the traditional use of certain production processes) that were once considered appropriate organizational activities in an earlier context (Oliver, 1992). According to Wood (1991), social legitimacy is the main driving force of corporate environmental responsibility. Government regulators have assembled a dizzying series of laws under which firms must report and ensure environmental compliance. International organizations have written treaties calling for better global business conduct. The Asia-Pacific Economic Cooperation (APEC), for example, officially adopted the Cleaner Production Strategy in 1997, in order to reduce the levels of pollution in various industry sectors by promoting the adoption of clean technology. In Thailand, pollution prevention projects have been promoted since 1990. The Department of Industrial Works and the Department of Industrial Promotion, from Ministry of Industry, and the Pollution Control Department, from Ministry of Science, Technology and Environment, play roles in both assisting industries in Pollution Prevention projects and in environmental control issues. Hence, industries that these government agencies exert their power and support to promote clean technology tend to encourage their members in those industries to put pollution prevention options as a high priority in their factories and find it is rational to invest in this innovation.

Hypothesis 1: The greater the perceived regulatory pressures, the higher the likelihood of clean technology adoption by manufacturing firms.

Freeman (1984) defined stakeholders as "any group or individual who can affect or is affected by the achievement of the organization's objectives". Stakeholders can express interest and influence the practices of an organization via direct pressures or by conveying information (Henriques and Sadorsky, 1999). Proactive strategies that build on basic management principles of reducing waste and cutting costs also respond to customer and shareholder demands (Berry & Rondinelli, 1998). Pressure from public and other external stakeholders motivates managers to develop a more proactive orientation to environmental issues (Lawrence & Morell, 1995). Henriques and Sadorsky (1999) found in their empirical study that firms with more proactive profiles do differ from less environmentally committed firms in their perceptions of the relative importance of different stakeholders. Companies such as 3M, Kodak, Xerox, Alcoa, and Procter and Gamble that adopted quality management programs during the 1980s to improve their competitive positions are also recognized by their shareholders and external stakeholders for exemplary environmental performance and social responsibility.

Hypothesis 2: The greater the perceived stakeholder demands, the higher the likelihood of clean technology adoption by manufacturing firms.

According to Post and Altman (1994), a great discovery of the 1980s was the power of market incentives to induce and encourage behaviors that are ecologically beneficial. Beginning with the opening of an office of pollution prevention within the Environmental Protection Agency, governmental programs in the United States sought to find alternatives to costly regulatory standard setting and experiments with "carrots" not "sticks" were launched. The efforts of several leading companies to achieve cost savings through pollution prevention were highlighted. To a business community eager to improve efficiency, productivity, and the bottom line, pollution prevention warranted a close book. From the institutional theory, an institutionalized activity may continue or

proceed because its perpetuation is still rewarding. In a study of institutional pressures on drug abuse treatment units, for example, D'Aunno, Sutton and Price (1991) showed the central role of rewards (such as funds, personnel and materials) controlled by parent institutions in limiting the discontinuity of traditional drug abuse treatment practices. In Thailand, clean technology policy implemented by Department of Industrial Works, Ministry of Industry, gives incentives to companies by using clean technology criteria for consideration when approving grants, loans, funding, and privileges, i.e., waiving of operation permit fees and exemption of income tax and / or import duty on clean technology equipment.

Hypothesis 3: The greater the awareness of and the need for clean technology incentives, the higher the likelihood of clean technology adoption by manufacturing firms.

Organizations are predicted to conform to institutionalized beliefs or practices when these beliefs or practices are so externally validated and accepted by organizations (DiMaggio, 1988). Knoke (1982) found that the best basis for predicting the adoption of municipal reforms was the percentage of other municipalities that had already adopted the reform. Tolbert and Zucker (1983) demonstrated that later adoption of civil service policies and programs was a function of how widespread or broadly diffused these policies and programs had become in the institutional environment. Hence, an increase in the number of organizations that adopt an innovation will increase institutional pressures (Oliver, 1991) and cause other organizations to adopt the cleaner innovation arising from the threat of lost legitimacy and lost stakeholder support (Abrahamson & Rosenkopf, 1993).

Hypothesis 4: The greater the awareness of the clean technology widespread, the higher the likelihood of clean technology adoption by manufacturing firms.

Organizational Factors

Size of companies is one of the organizational factors, which is described as a bottleneck in pollution prevention projects in Thailand (Hoftman and Koottatep, 2001). Small firms generally have been reported as more reactive and resistive to environmental issues (Harris, 1985), and size also correlates with pollution control, with large firms generally being cleaner (Spicer, 1978). Proposed explanations include the greater ability of large firms to purchase the equipment, greater scrutiny by regulators and the public, and economy of scale (Ullmann, 1985). Despite the result of clean technology projects seems to be very promising, they also create a heavy burden to some firms, especially small and medium enterprises (SMEs), to set up and implement them. Most of the pollution prevention programs involve rather high consulting fee, as the program itself requires many experts and time for implementation (Hoftman and Koottatep, 2001).

Hypothesis 5: The greater the size of total assets and the number of employees of manufacturing firms, the higher the likelihood of clean technology adoption by manufacturing firms.

In addition to providing manufacturing firms with a competitive advantage (Boyer et al., 1996), advanced manufacturing technologies and newer production equipment offer an excellent opportunity to upgrade related environmental systems (Cairncross, 1992; Lawrence & Morell, 1995). Investing in environmental technologies may be simpler and less costly when installed concurrently with other new process equipment, rather than as a later, retrofitted conversion. Moreover, older equipment results from low investment levels, which can favor smaller, incremental investment in environmental technologies (Bragdon & Marlin, 1972). The survey of 256 large and small firms in the United States found that more than 60 percent of the firms used improved process technology or new process technology, and about 58 percent reported using new

product technology to prevent pollution (Florida, 1996). The adoption of waste minimization strategies has stimulated computer design processes and new software, expert systems, and comprehensive databases that integrate waste minimization requirements into process design and plant restructuring. Firms are developing new retrosynthesis and computational chemistry-based techniques that will make pollution prevention far easier in the chemical industry (Samdani, 1995).

Hypothesis 6: The greater the intensity of manufacturing technologies and the newer production machines and equipment, the higher the likelihood of clean technology adoption by manufacturing firms.

From the diffusion of innovation theory, firms with highly diverse networks and a high frequency of interaction in industrial and professional networks are more likely to gain advantages in utilizing information necessary for making decision to adopt clean technology. The diversity of networks helps firms with idea generation, thus provoke the firm's creativity, interest, and knowledge (Rogers & Eveland, 1978). Professional networks, which include consulting firms and other innovation vendors (Lorsuwannarat, 1995), provide a major mean of disseminating information about innovative ideas (Miller & Friesen, 1982), recent technological developments, assessments of particular technologies, and specific experiences with an application (Perry & Kraemer, 1978; Rogers & Shoemaker, 1971). In summary, the clean technology knowledge and information from these entities encourage manufacturing firms to adopt clean technology:

Hypothesis 7: The greater the clean technology input provided by organizations that promote the diffusion of clean technology, the higher the likelihood of clean technology adoption by manufacturing firms.

Management Factors

Hoftman and Koottatep (2001) reported that the willingness of top management is a crucial issue in adopting pollution prevention program in Thailand. This finding is in line with the process model proposed by Oliver (1997) that the decision to accumulate or deploy resources and capabilities (e.g., technological capabilities) will begin with the individual-level discretionary strategic decisions that managers make in pursuit of individual and firm gains. Oliver (1997) refers to it as managerial choice and posits that this choice is grounded on the economic rationality motivated by efficiency and profitability, and on the normative rationality induced by historical precedent and social justification.

Hypothesis 8: The greater the management's willingness to adopt and develop clean technology, the higher the likelihood of clean technology adoption by manufacturing firms.

From the diffusion of innovations perspective, the individual-level discretionary strategic decision is made on the basis of the relative advantage to which an adopted innovation is perceived as being better than the idea it supersedes. According to Rogers (1983), the nature of the innovation largely determines what specific type of relative advantage (such as economic, social, and the like) is important to adopters. In addition, Sharma and Vredenburg (1998) suggest that firms may gain competitive advantage in ways other than waste / efficiency cost savings from environmental strategies. This competitive advantage includes a capability for continuous innovation in firms (Sharma & Vredenburg, 1998), brand loyalty created by superior quality (Gavin, 1984), customer responsiveness to create customer satisfaction (Hill & Jones, 1995), and social legitimization (Shrivastava, 1995). Based on this premise, relative advantage of clean technology is separated into three aspects, i.e., economic, competitive, and social. Economic aspect includes profitability, cost reduction, and energy savings. Competitive

aspect involves healthy market share, customer satisfaction, superior product quality, and continuous technology development. Social aspect refers to the social status or image gaining from the innovation adoption. Hence, these three aspects of relative advantage of clean technology are summarized in the following three hypotheses:

Hypothesis 9: The greater the competitive advantage of clean technology perceived by the management, the higher the likelihood of clean technology adoption by manufacturing firms.

Hypothesis 10: The greater the economic advantage of clean technology perceived by the management, the higher the likelihood of clean technology adoption by manufacturing firms.

Hypothesis 11: The greater the social advantage of clean technology perceived by the management, the higher the likelihood of clean technology adoption by manufacturing firms.

3.3 SUMMARY

This chapter describes a conceptual framework for analysis derived from the resource-based theory, the institutional theory, and the diffusion of innovation theory. This framework suggests that there are three constructs of factors (i.e., institutional factors, organizational factors, and management factors), and these factors can be used as the predictors of the adoption of clean technology by manufacturing firms in Thailand. Based on this framework, eleven hypotheses are proposed.