CHAPTER 4

RESEARCH METHODOLOGY

The purpose of this chapter is to present the methodology for testing all hypotheses proposed in the previous chapter. Consequently, this chapter includes the construct operationalization, research design (population, sample, sample size, and data collection), and response rate.

4.1 CONSTRUCT OPERATIONALIZATION

From the research model in figure 3.1, there are one dependent variable and eleven independent variables, i.e., adoption of clean technology, perceived regulatory pressures, perceived stakeholder demands, awareness of and need for clean technology incentives, awareness of clean technology widespread, firm size, firm capabilities, clean technology knowledge, perceived economic advantage, perceived competitive advantage, perceived social advantage, and willingness to adopt and develop clean technology. Table 4.1 summarizes the construct operationalization of these variables.

Table 4.1 Construct Operationalization

Variables	Operationalization	Question No.
Dependent Variable ● Adoption of CT (labeled as CT.INVES)	**Objective:** - A five-point scales addressing the clean technology investment in the respondents' manufacturing plants. Respondents that answered question 9 that their firms had adopted CT were asked to answer question 11. Then, they were coded with 1, 2, 3, and 4 if their answers indicated that their firms had CT investment lesser than 100,000 baht, 100,000 to not more than 1 million baht, 1 million baht to not more than 5 million baht, and more than 5 million bath, respectively. Respondents that answered question 9 that their firms had not adopted CT were code with 0 and were asked to skip question 11.	9 & 11
Independent Variables ● Perceived regulatory pressures (labeled as REG.PRES)	**Objective:** - Amount of environmental audits by government agencies. - Amount of warnings the respondent firm received from the government agencies. - The penalty for violating the environmental laws and regulations experienced by the respondent firm.	17 18 19

Variables	Operationalization	Question No.
	Subjective: - A four-point scales addressing the management's perception of respondent firm on the degree of threat from Thai and international environmental laws, the degree of threat from WEEE / HACCP regulations, and the degree of threat from Thai and foreign government agencies and NGOs.	14
• Perceived stakeholder demands (labeled as STAK.DEM)	**Subjective:** - A four-point scales addressing the management's perception on the degree of demand from employees, customers, shareholders, suppliers, mother company, joint company, competitors, federation of Thai industries, and community for CT adoption.	15
• Awareness of and need for CT incentives (labeled as INCENTIV)	**Subjective:** - A four-point scale addressing the management's awareness of the availability of the incentives provided for the CT adopters. - A four-point scale addressing the management's degree of requirement to receive each type of the incentives. - The respondent firm's experience of receiving grant for adopting CT.	20 21 22
• Awareness of CT widespread (labeled as CT.WIDE)	**Subjective:** - A five-point scale addressing the management's awareness of the CT widespread among their competitors, industries, and neighboring firms.	23

Variables	Operationalization	Question No.
● Firm size (labeled as CO.SIZE)	**Objective:**	
	- Total assets	24
	- Number of employees	25
● Firm capabilities (labeled as CO.CAPA)	**Subjective**	
	- A four-point scale addressing the management's perception on the level of technology intensive capability of their firms.	26
	- A four-point scale addressing the management's perception on the level of technology development capability of their firms.	27
	- A four-point scale addressing the management's perception on the modernized machine capability of their firms.	28
● Clean technology knowledge (labeled as CT.INPUT)	**Subjective:**	
	- A four-point scale addressing the management's perception on the level of CT knowledge that their firms received from the organizations that promote the diffusion of CT, i.e., government agencies, consulting firms, NGOs, academic institutes, customers, suppliers, federation of Thai industries, printing media, and Internet.	29
● Willingness to adopt and develop CT (labeled as WILLING)	**Subjective:**	
	- A four-point scale addressing the management's willingness to adopt clean technology.	30
	- A four-point scale addressing the management's willingness to develop clean technology.	32

Variables	Operationalization	Question No.
● Perceived competitive advantage (labeled as ADV.COM)	**Subjective** - A four-point scale addressing the management's perception on the competitive advantage enhanced by clean technology, i.e., healthy market share, customer satisfaction, superior product quality, and continuous technology development.	31
● Perceived economic advantage (labeled as ADV.ECO)	**Subjective** - A four-point scale addressing the management's perception on the economic advantage enhanced by clean technology, i.e., profitability, cost reduction, and energy savings.	31
● Perceived social advantage (labeled as ADV.SOC)	- A four-point scale addressing the management's perception on the social advantage enhanced by clean technology, i.e., better company image, better surrounding environment, and social recognition.	31

4.2 RESEARCH DESIGN

The research design includes population, sampling method, and data collection. Figure 4.1 below is the research design diagram of this study, which shows all steps to be followed.

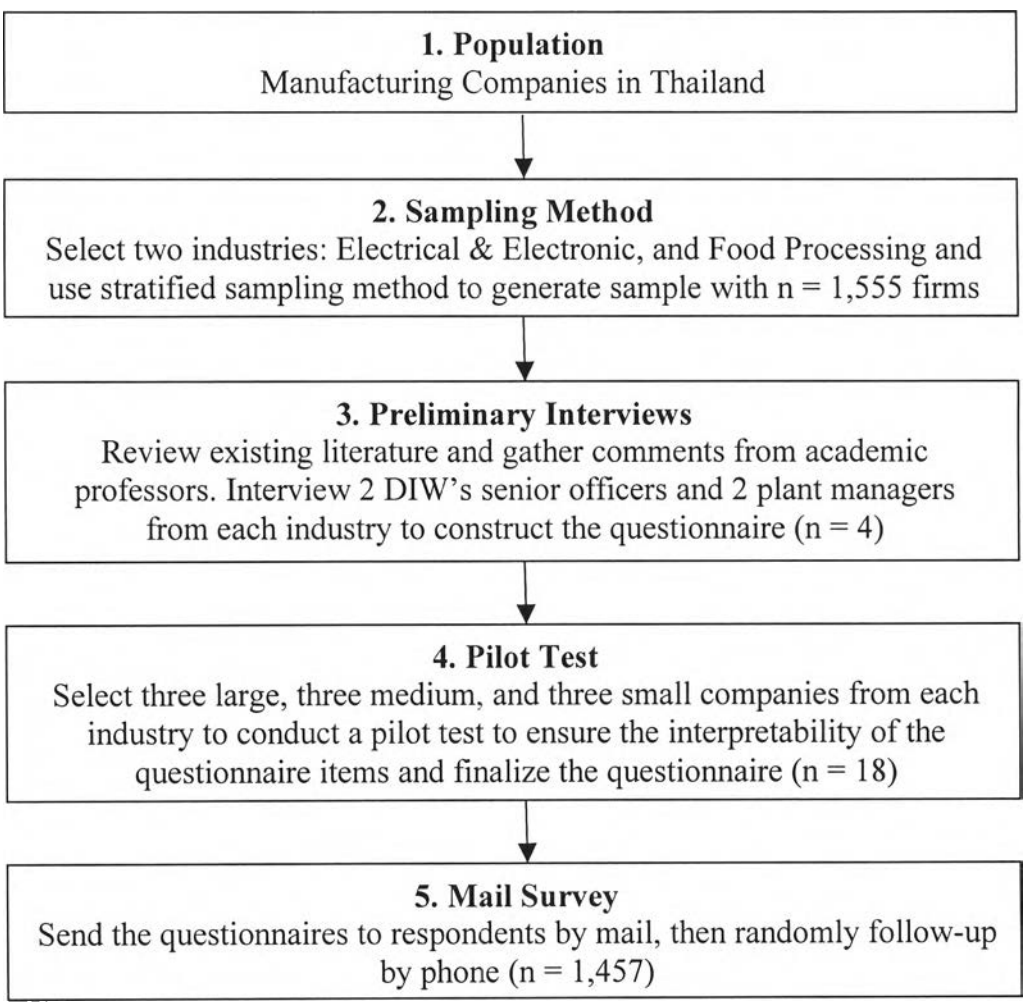

Figure 4.1 Research Design Diagram

Population

Manufacturing firms in the electrical & electronic industries and the food processing industry in Thailand are used as the population. These two industries are chosen in order to compare the effects of the institutional factors to the adoption process of clean technology. The sampling frame for this study is generated from the Department of Industrial Work's directories, yielding a target sample of 7,614 plants in Thailand. Those directories (last updated on August 28, 2000) are down loaded from the web site "www.diw.go.th".

The Sample

The unit of analysis for the survey will be an individual plant because the investments in environmental technologies are carried out at the plant level (Klassen & Whybark, 1999a). A single informant, the plant manager, will be used here because of his or her plant-level experience, extensive knowledge, and access to data.

This study uses the stratified simple random sampling method. Each selected industry will be stratified into three groups, i.e., large, medium, and small manufacturing companies

Sample Size

In case of using multiple regression, required sample size depends on a number of issues, including the desired power, alpha level, number of predictors, and expected effect sizes. As suggested by Tabachnick and Fidell (1996), the simplest rules of thumb are $N \geq 50 + 8$ m (m is the number of independent variables) for testing the multiple correlation and $N \geq 104 + m$ for testing individual predictors. These rules of thumb assume a medium-size relationship between the independent variables and dependent variable, $\alpha = 0.05$ and $\beta = 0.20$. There are 11 independent variables for running multiple regression model in this study, therefore the

minimum required data should be at least = 50 + (8 X 11) = 138 cases from two industries.

The population will be from the Department of Industrial Work's list of factories by industry. Table 4.2 below shows the number of population, the minimum sample size, and the required response rate from the manufacturing firms in each industry.

Table 4.2 Detail of Sample

Number of Population	Sample Size	Minimum Response	Expected Response Rate
7,614	1,533	138	9.00%

Data Collection

Data were collected from two sources: primary and secondary data sources. The primary data will be collected by the response from questionnaire survey. The secondary data will be collected from publicity, government agencies and other institutions.

4.3 SUMMARY

This chapter is dedicated for the explanation of the quantitative methodology used in this research. Operationalization of all variables is provided in Table 4.1. Detail of research design is summarized in Figure 4.1. Data relating to the population, the sample, size of sample, and data collection are presented.