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**A comparison of Environmental Management System
(EMS) applied by large manufacturing companies in
Amata Nakorn Industrial Town and other areas of
Chonburi Province, Thailand**

*A thesis presented in partial fulfilment of the
Requirements for the degree of
Doctor of Philosophy in Management
At Massey University
New Zealand*

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ABSTRACT

Industrial pollution is one the most critical environmental problems facing Thailand at the present time. Therefore, control of industrial pollution is of the highest priority to the Thai government. Problems associated with industrial pollution place significant limitations on the potential growth of manufacturing industries in Thailand, because international trade today requires not only manufactured products of a high quality but also a commitment to high environmental standards by manufacturing companies (European Commission Environment Directorate-General, 2001; Ken, 2004).

This thesis investigated the major dimensions of the quality of the Environmental Management System (EMS) in large size manufacturers, that are located both inside and outside of industrial towns in Chonburi Province, Thailand. In particular, the research examined whether different stakeholders had the same or different perceptions about these dimensions.

The study used both qualitative and quantitative methods to collect information from four groups of stakeholders: Thailand's government officers in the government agencies concerned about environmental policy; top management within manufacturers; the manufacturers' staff at management level; and the local communities. A survey was carried out involving the government officers and top management staff within manufacturers. The qualitative data were collected from documentaries, interviews and observations.

The triangulation of methods and data permitted the comparison of the perceptions of the manufacturers' staff, from both inside and outside of industrial towns. The data were structured into the four major parts of an EMS: the performance agreement for the environmental programme; the plan for transformation implementation; the standards and processes; and the continuous improvement process.

The survey results show that manufacturers in the Town use ISO 14001. Two of the three manufacturers, outside the Town use TQM / TQEM as their EMS and the other

manufacturer, also from outside the Town, does not have any EMS within their company. The results also show that the factories in the Town, that used ISO 14001 and the factories outside of the Town that used TQM /TQEM, are similar in the four major parts of the EMS. However, they still have some processes which are notably different, such as the manufacturers that use ISO 14001 have better documentary systems, additional budgets for training staff and larger budgets to publicise, to the local communities, the companies' activities relating to their environmental management. However, the TQM / TQEM and Thailand's environmental legislation are more flexible and they allow companies to create environmental management activities.

Finally, the results suggest that there are three main factors that may effect the achievement of environmental management within manufacturers in Thailand. They are: the human factor (knowledge and awareness about the environment); the processes factor (green production and EMS processes); and the legislation factor (environmental standards, monitoring and enforcement systems).

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ABBREVIATIONS

ADB	Asian Development Bank
ANSI	American-National Standards Institute
ASEAN	Association of Southeast Asian Nations
BMA	Bangkok Metropolitan Administration
BOD	Biochemical Oxygen Demand
CEC	Commission for Environmental Cooperation
CEO	Chief Executive Officer
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSD	Commission on Sustainable Development
DEDE	Department of Energy Development and Enhancement
DEQP	Department of Environmental Quality Promotion
DIW	Department of Industrial Work
DO	Dissolved Oxygen
EA	Environmental Auditing
EAPS	Environmental Aspects in Product Standards
EGAT	Electricity Generating Authority of Thailand
EIA	Environmental Impact Assessment
EM	Environmental Management
EMS	Environmental Management System
EMAS	Eco-Management Audit Scheme
EMR	Environmental Management Representative
EMS	Environmental Management System
EPA	The United States Environmental Protection Agency
EPE	Environmental Performance Evaluation
EQPD	Environmental Quality Promotion Department
EU	European Union
FDA	Food and Drug Administration
GEMI	Global Environmental Management Initiative
GENCO	General Environmental Conservation Public Company Limited

ICC	International Chamber of Commerce
IEAT	Industrial Estate Authority of Thailand
INECE	International Network for Environmental Compliance and Enforcement
IPCS	International Programme on Chemical Safety
ISO	From the Greek “ISOS” meaning “equal”
ISIC	International Standard Industrial Classification
ITA	International Trade Administration
IUCN	International Union for Conservation of Nature and Natural Resources
LAC	Latin America and the Caribbean
LCA	Life Cycle Assessment
MOI	Ministry of Industry
MONRE	Ministry of Natural Resources and Environment
MOPH	Ministry of Public Health
MOST	Ministry of Science and Technology
MOSTE	Ministry of Science, Technology and Environment
n.d.	No Date
NEB	National Environmental Board
NGOs	Non-Government Organisations
NEI	National Emissions Inventory
NESDB	National Economic and Social Development Board
NESDP	National Economic and Social Development Plan
NO ₂	Nitrogen Dioxide
O ₃	Ozone
OECD	Organisation for Economic Co-operation and Development
OEPP	Office of Environmental Policy and Planning
ONEB	Office of National Environmental Board
ONEP	Office of the Natural Resources and Environmental Policy and Planning
Pb	Lead
PCD	Pollution Control Department
P-D-C-A	Plan-Do-Check-Action
PM-2.5	Particulate Matter with an aerodynamic diameter ≤ 2.5 microns

PM-10	Particulate Matter with an aerodynamic diameter ≤ 10 microns
R&D	Research and Development
SO ₂	Sulfur Dioxide
SPAЕ	Strategic Plan of Action on Environment
Sq.km.	Square Kilometre
TCB	Total Coliform Bacteria
TDRI	Thailand Development Research Institute
TEI	Thailand Environment Institute
TQEM	Total Quality Environmental Management
TISI	Thailand Industrial Standards Institute
TQM	Total Quality Management
TSS	Total Suspended Solids
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
U.S.A.	United State of America
WCED	World Commission on Environment and Development
WMA	Wastewater Management Authority
WSSD	World Summit on Sustainable Development
WWF	World Wide Fund for Nature

TABLE OF CONTENTS

Abstract	i
Acknowledgements	iii
Acronyms	iv
Table of Contents	vii
List of Tables	xii
List of Figures	xiv
List of Pictures	xvi
Chapter 1 Introduction	
1.1 GLOBAL STRATEGIES AFFECTING INDUSTRIES	2
1.2 IMPLEMENTATION FOR INDUSTRIES IN THE ASSOCIATION OF SOUTHEAST ASIAN NATIONS (ASEAN)	6
1.3 BACKGROUND OF THE DEMAND FOR QUALITY FROM THE EMS THAT ARE USED IN LARGE MANUFACTURING IN THAILAND	8
1.4 THE PURPOSE OF THE STUDY	14
1.5 STRUCTURE OF THE THESIS	17
Chapter 2 Environmental Management Systems	
2.1 INTRODUCTION	19
2.2 THE BACKGROUND TO THE STANDARDS	20
2.3 WHAT IS ENVIRONMENTAL MANAGEMENT?	24
2.4 WHAT ARE THE ENVIRONMENTAL MANAGEMENT SYSTEMS USED?	30
2.4.1 ISO 14001	43
2.4.2 EMAS – the EU Eco-Management and Audit Scheme	46
2.4.3 International Chamber of Commerce (ICC) Principles	50
2.4.4 Total Quality Management (TQM) and Total Quality Environmental Management (TQEM)	56
2.5 CONCLUSION	63

Chapter 3	Background of Thailand's General Environmental Approaches and Legislation	
3.1	INTRODUCTION	66
3.2	OVERVIEW OF THAILAND'S ENVIRONMENTAL MANAGEMENT SYSTEMS	66
3.3	THE ENVIRONMENTAL ADMINISTRATIVE SYSTEM IN THAILAND	73
3.3.1	The Ninth National Economic and Social Development Plan of Thailand	74
3.3.2	The Enhancement and Conservation of National Environment Quality Act, 1992	78
3.3.3	The Principle Laws and Regulations Relating to Industrial Pollution	82
3.4	THAILAND'S GENERAL ENVIRONMENTAL APPROACHES	90
3.4.1	Air Pollution Approaches	91
3.4.2	Wastewater Pollution Approaches	94
3.4.3	Hazardous Waste Disposal Approaches	96
3.4.4	Other Environmental Pollution Approaches	98
3.5	CRITIQUE OF THAILAND'S ENVIRONMENTAL ADMINISTRATIVE SYSTEM	99
3.6	THAILAND'S INTERNATIONAL COOPERATION ON ENVIRONMENT	105
3.7	CONCLUSION	106
Chapter 4	Methodology	
4.1	INTRODUCTION	108
4.2	THEORETICAL CONSIDERATIONS FOR METHODOLOGY	108
4.2.1	Triangulation	111
4.2.2	Validity and Reliability	114
4.2.3	Published Documentation Review	119
4.2.4	Individual Interviews	120
4.2.5	Observations	121
4.2.6	Questionnaire	122
4.2.7	Ethical Issues	123

4.3 THE RESEARCH STUDY IN THAILAND	124
4.3.1 Published Documentation Review for the Study	128
4.3.2 Individual Interviews for the study	131
4.3.3 Observations for the study	133
4.3.4 Questionnaire for the study	134
4.4 CONCLUSION	139
Chapter 5 Analysis of the Questionnaire Data	
5.1 INTRODUCTION	140
5.2 SAMPLE DESCRIPTION	141
5.2.1 Manufacturers' Staff	141
5.2.2 Members of Communities	145
5.3 DESCRIPTIVE STATISTICS RESULTS	146
5.3.1 Group One: The Sample Manufacturers' Staff in the Town and Outside of the Town	146
5.3.2 Group Two: The Community in the Town Area and the Other Three Communities in the vicinity of the Sample Manufacturers Outside of the Town Area	162
5.4 CONCLUSION	164
Chapter 6 Analysis of the Individual Interviews, Observations, and Document Reviews Data	
6.1 INTRODUCTION	168
6.2 RESULTS	169
6.2.1 Individual Interviews	169
6.2.2 Comparison of Research Observations of Industry Accounts	191
6.2.3 Document Reviews	206
6.3 CONCLUSION	212
Chapter 7 An EMS Assessment Framework for Business	
7.1 INTRODUCTION	215
7.2 COMPARE AND CONTRAST THE FINDING OF TRIANGULATION METHODS	215
7.2.1 Part A: Performance Agreement for the Environmental Programme	216
7.2.2 Part B: Plan for Transformation Implementation	217

7.2.3 Part C: Standards and Processes	217
7.2.4 Part D: Continuous Improvement Process	219
7.3 DIFFERENCES IN EMS CHOICES BETWEEN INDUSTRY IN INDUSTRIAL TOWNS AND INDUSTRIES LOCATED GENERALLY IN OTHER AREAS OF CHONBURI PROVINCE	219
7.3.1 Environmental and Social Effectiveness	220
7.3.2 Implications for Business	226
7.3.3 Environmental Management System Issues	228
7.3.4 Environmental Sustainability and Management Issues	229
7.4 AN EMS ASSESSMENT FRAMEWORK FOR BUSINESS	231
7.4.1 Human Factor Elements	234
7.4.2 Manufacturing Processes Factor Elements	238
7.4.3 Environmental Legislation Factor Elements	242
7.5 THE RESPONSE OF THE MANUFACTURERS' STAFF AND THE LOCAL COMMUNITY TO THE INDUSTRIAL ENVIRONMENTAL MANAGEMENT	245
7.5.1 The Government Responsibilities	246
7.5.2 Manufacturers Responsibilities	247
7.5.3 Community Responsibilities	249
7.6 FURTHER RESEARCH	250
7.7 CONCLUSION	251
References	255
Appendices	
Appendix 1: MAP OF AMATA NAKORN INDUSTRIAL TOWN AND THE THREE SAMPLING MANUFACTURERS OUTSIDE OF THE TOWN	274
Appendix 2: ETHICS APPROVAL LETTER	275
Appendix 3: QUESTIONNAIRE AND INTERVIEW STRUCTURE	277
Appendix 4: INFORMATION SHEET FOR RESEARCH PARTICIPANTS – INTERVIEWS AND OBSERVATIONS	289

Appendix 5: LETTER TO PARTICIPANTS FOR QUESTIONNAIRE PRETEST, QUESTIONNAIRE COVERING LETTERS AND FOLLOW-UP REMINDER LETTERS TO QUESTIONNAIRE PARTICIPANTS	294
Appendix 6: ENHANCEMENT AND CONSERVATION OF NATIONAL ENVIRONMENTAL QUALITY ACT, B.E. 2535 (1992)	299
Appendix 7: LIST OF THAILAND'S MAJOR INTERNATIONAL AGREEMENTS CONCERNED WITH ENVIRONMENTAL ISSUES	327
Appendix 8: LIST OF ITEMS FROM THE QUESTIONNAIRE	328
Appendix 9: SURVEY RESULTS BETWEEN STAFF IN THE TOWN AND OUTSIDE OF THE TOWN	331
Appendix 10: THE EFFECTIVENESS OF SEVEN DIFFERENT GROUPS IN COMMUNICATION	340
Appendix 11: LIST OF ITEMS FROM SECTION TWO OF THE QUESTIONNAIRE	341
Appendix 12: RESPONSES FROM THE LOCAL COMMUNITIES	344

LIST OF TABLES

Table 1.1	Structure of the Thesis	18
Table 2.1	Decision Criteria and Factors to Select an EMS from Pun and Hui (2001)	36
Table 2.2	Decision Criteria and Factors to Select an EMS from Hufhey, Tait, and Connell (2001)	37
Table 2.3	Success Factors for an EMS Implementation	41
Table 3.1	Core Environment Indicators of Thailand	68
Table 3.2	Government Ministries Concerned with Industrial Environmental Control	74
Table 3.3	Electricity Consumption in Thailand by Sectors (UNIT: GWH)	90
Table 4.1	Basic Types of Validity in Measurement	116
Table 4.2	The Number of Manufacturers in Muang District, Chonburi Province	133
Table 4.3	The Population of Muang District by Age and Employment in the Year 2000	137
Table 4.4	The Population of Muang District by Municipal and Non-municipal Area	137
Table 5.1	Top Management and Management Level Staff Respondents by Gender	141
Table 5.2	Staff Respondents by Age	142
Table 5.3	Respondents Domicile	142
Table 5.4	Staff Experience at Top Management Level and Management Level	143
Table 5.5	The Environmental Management System Categories	144
Table 5.6	Communities Member Respondents by Gender	145
Table 5.7	Communities Member Respondents by Age	145
Table 5.8	Significant Differences between the Sample Manufacturers' Staff in the Town and Outside of the Town	147

Table 5.9	List of Items, Part A: Performance Agreement for the Environmental Programme	148
Table 5.10	Results of Part A: Performance Agreement for the Environmental Programme (Group One)	149
Table 5.11	List of Items, Part B: Plan for Transformation Implementation	151
Table 5.12	Results of Part B: Plan for Transformation Implementation (Group One)	152
Table 5.13	List of Items, Part C: Standards and Processes	153
Table 5.14	Results of Part C: Standards and Processes (Group One)	155
Table 5.15	List of Items, Part D: Continuous Improvement Process	156
Table 5.16	Results of Part D: Continuous Improvement Process (Group One)	158
Table 5.17	Significant Differences between the Community in the Town area and the Other Three Communities in the Sample Manufacturers Outside of the Town Area	163
Table 6.1	Research Interview Participants	170
Table 7.1	Summary of the Interview Results about Environmental and Social Effectiveness	220
Table 7.2	Human Factor Elements	238
Table 7.3	Manufacturing Processes Factor Elements	241
Table 7.4	Legislation Factor Elements	245

LIST OF FIGURES

Figure 1.1	Actions of the Major Global Environmental Programmes	5
Figure 1.2	Environmental Management Programmes by Linking the Global Environmental Programmes, the Region Co-operation Programmes (ASEAN), the Thai Government, and the Industry and Community in Thailand	6
Figure 1.3	ASEAN's Strategic Plan of Action on the Environment	7
Figure 2.1	Management of Environmental Performance	27
Figure 2.2	The Basic Elements of TQEM	44
Figure 2.2	The Basic Elements of ISO 14001	47
Figure 2.3	The ISO 14000 Series of Environmental Management Standards	49
Figure 2.4	The EMAS Elements of Environmental Management System	54
Figure 2.5	The ICC Principles for Environmental Management	56
Figure 2.6	The ICC Elements of Environmental Management System	58
Figure 2.7	Summary the TQM/TQEM; ISO; EMAS; ICC Elements of EMS	60
Figure 3.1	Overview of Thailand's Environmental Administrative System, as at 2005, Relevant to Environmental Legislation	72
Figure 3.2	The Government Agencies Concerned with the Environment under the Seventh National Economic and Social Plan (1991 – 1996)	75
Figure 3.3	Main Functions of ONEB that were Split into Three Departments under the MONRE (after Government reform in 2002)	77
Figure 3.4	The Relationship between the Environmental Legislation Relevant to Large Manufacturers in Thailand	84
Figure 4.1	Methods of Triangulation	112
Figure 4.2	The Research Study Process	130

Figure 5.1	The Effectiveness of Seven Different Groups in Communication	126
Figure 7.1	An Optimal EMS Assessment Framework for Business	233

LIST OF PICTURES

Picture 6.1	Dust Collector and Noise Retaining Wall with Concave Noise Diffusion Surface at the Company from Outside of the Town (Respondent C)	179
Picture 6.2	Noise Retaining Wall with Concave Noise Diffusion Surface (under construction) at the Company from Outside of the Town (Respondent C)	180
Picture 6.3	Denso (Thailand) Co., LTD.	192
Picture 6.4	Thai Iwaki Glass Co., LTD.	193
Picture 6.5	Amata Nakorn Industrial Town	195
Picture 6.6	Amata Nakorn Industrial Town's Waste Water Treatment System	196
Picture 6.7	Amata Nakorn Industrial Town's Solid and Hazardous Waste Management System	196
Picture 6.8	UMC Metal Co., LTD.	198
Picture 6.9	Management Team Meeting, Denso (Thailand) Co., LTD.	199
Picture 6.10	Company's Activities for Employees and Communities, Denso (Thailand) Co., LTD.	200
Picture 6.11	Waste Water Treatment Plant, UMC Metal Co., LTD.	202
Picture 6.12	Water after Treatment Process was used to Maintain Gardens	204
Picture 6.13	Public Canal in Amata Nakorn Industrial Town	205

CHAPTER 1: INTRODUCTION

There is now mounting evidence that industrial pollution problems are already happening and that their impacts are growing. Industrial production processes account for a considerable share of the overall pollution (for pollutants such as greenhouse gases (global warming), wastewater emissions and solid and hazardous wastes). For example, Carbon Dioxide and other air pollution that are discharged from production process, is collecting in the atmosphere like a thickening blanket, trapping the sun's heat and causing the planet to warm up (global warming problem). Some manufacturing facilities use huge quantities of freshwater to carry away wastes of many kinds. The waste-bearing water, or effluent, is discharged into streams, lakes, or oceans, which in turn disperse the polluting substances (Beazley, 1993; ISSC, 2005; Waddell and Pruitt, 2005).

The Intergovernmental Panel on Climate Change (IPCC) reports that the global mean temperature went up around 0.6°C between 1861 and 2000 (Kahn and Franceschi, 2005). This has caused glaciers to retreat lifting sea levels 10 to 20 cm., over the last 100 years. The volume of the ice cap covering the Arctic Ocean has shrunk by more than 40 percent over the last 35 years. To deny that Earth is getting warmer in the face of such compelling evidence is to risk a loss of credibility, something that corporations cannot readily afford. The years 1998, 2002, and 2003 were the three warmest years recorded in the instrumental record (which dates back to the mid 1800s) and in fact, all of the top 10 warmest years have occurred since 1990 (ISSC, 2005). The IPCC has also predicted the average global temperature to increase 1.4°C to 5.8°C between 1990 and 2100 (Vermeersch, Krause, Sachs, Zwart, Keulartz and Petrella, 2005). The scientists cautioned that an average temperature rise above 3°C would likely have 'serious risk of large scale, irreversible system disruption', including an increased risk of flooding for tens of millions of coastal dwellers worldwide; increased incidence of extreme weather events; reduced yields of world's food crops; and decreased water availability in many water-scarce regions (Waddell and Pruitt, 2005). According to the study of the former United States Vice President Al Gore on the global warming problem, he mentions that "if the vast majority of the

world's scientists are right, we have just ten years to avert a major catastrophe that could send our entire planet's climate system into a tailspin of epic destruction involving extreme weather, floods, droughts, epidemics, and killer heat waves beyond anything we have ever experienced – a catastrophe of our own making” (Manawatu Standard, September 28, 2006, p.7).

1.1 GLOBAL STRATEGIES AFFECTING INDUSTRIES

Recently, the development and environmental impacts of industry have been distributed throughout the world. Therefore, industry has an obligation to improve environmental performance in partnership with governments around the world. The United Nations (UN), The World Conservation Union (IUCN), World Wide Fund for Nature (WWF), and other international environmental organisations have developed many global environmental programmes (e.g. Caring for the Earth, the Earth Summit - Agenda 21, and the Kyoto Protocols Programme) to reduce pollution emission (Cosbey, Bell and Moule, 2003; Huq, 2005).

In 1972, the world's leaders have met for the first time to discuss global environmental issues, at the UN Conference on the Human Environment. In October 1991, the the World Conservation Union is launching a world-wide campaign on the theme of 'Caring for the Earth'. Caring for the Earth is a plan of action for the survival of our planet and its inhabitants. It sets out a broad and explicit world strategies for the changes needed to build a sustainable society (Beazley, 1993). The first main international response to pollution problems is launched with the signing of the UN Framework at the “Earth Summit” in Rio de Janeiro in 1992, better known as “Agenda 21”. The convention represented an important step in the international diplomacy aiming at fighting environmental problems and established a long-term objective of stabilising concentrations of environmental pollution (Huq, 2005).

In 1997, the Kyoto Protocol was developed in the third session of the Conference of the Parties (COP) for the United Nations Framework Convention on Climate Change (UNFCCC) in Kyoto, where the international community agreed on binding greenhouse gas reductions (Cosbey, Bell and Drexhage, 2005). Based on the

principles agreed in 1992 (Earth Summit), the main aim of the Protocol is to contain emissions of the main greenhouse gases in ways that represent national differences in emissions, wealth, and capacity, and of 'common but differentiated' responsibilities, including leadership by the richer and higher-emitting industrialised countries (European Union, 2005).

The Protocol sets quantitative commitments by developed countries to reduce their greenhouse gas emissions (e.g. to reduce such emissions by 5.2% by 2012). These commitments take the form of absolute emissions targets, applicable to a basket of six greenhouse gases (carbon dioxide, nitrous oxide, methane, hydro fluorocarbons, per fluorocarbons, and sulphur hexafluoride) for a five-year commitment period (Babiker, 2002). The Protocol entered into force on February 16, 2005, which made the Protocol's emissions targets legal commitments for all the industrialised countries that signed it. Governments are separated into two general categories: developed countries, referred to as Annex 1 countries (who have accepted Global Greenhouse Gas (GHG) emission reduction obligations); and developing countries, referred to as Non-Annex 1 countries (who have no GHG emission reduction obligations). As of July 2006, 164 countries (including Thailand) ratified the Kyoto Protocol representing 61.6% of emissions from developed countries.

Notable exceptions include Australia and the United States. Many developing countries (e.g. Thailand, China, and India) ratified the Protocol but are not required to reduce carbon emissions under the Kyoto agreement. However, there are some successes of this Protocol, such as the creation of a new working group to formulate future commitments for countries after 2012 (UNFCCC, 2005). Other initiatives are also included, such as the "joint implementation" programme where industrialised countries can invest in developing countries to help reduce greenhouse emission, earning them emission credits. The industrialised countries committed US\$13 million to fund this programme. Another major breakthrough is the development of a body with the task to monitor whether countries adhere to the Protocol and administer penalties when needed.

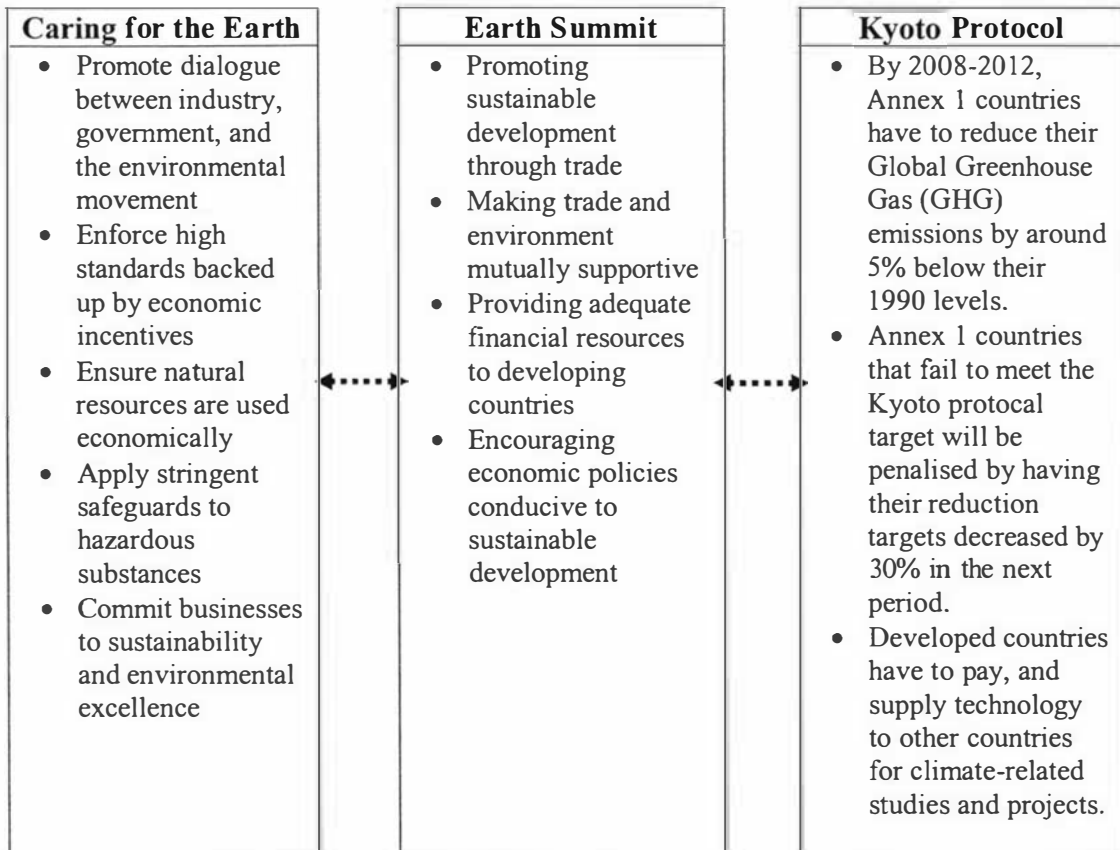
All the global environmental programmes (e.g. Agenda 21, Kyoto Protocol) have an effect on a few major industries that may strongly discharge pollutants such as energy,

steel, cement, and glass. For example the EU created an emissions trading system in an effort to meet the Kyoto protocol targets in 2002. The emission trading system's quota has been introduced in only six key industries which are: energy, steel, cement, glass, brick making, and paper /cardboard). The United States refused to ratify the Kyoto Protocol to protect some industries (e.g. energy, steel, mine, automobile) (UNFCCC, 2005). Further pressure is excerpted on some developing and many industrialised countries which refused to accept these rules, to protect their economic interests and their poor populations. Most of the small businesses in developing countries have no pollution prevention or EMS technologies. These businesses are affected by the Kyoto commitment. The US also still has refused to ratify the agreement, indicating it believes the agreement would harm the economy (so as to protect some industries, such as the petrol and mine industries) and it was 'unfair' not to include developing countries (Shah, 2005).

These commitments reflect a widespread feeling that past efforts undertaken by countries to deal with environmental issues have been mostly inadequate. This feeling is shared by people in both developed and developing counties, who are experiencing threats to and deterioration of the quality of their living environment. The global strategies are also a sign of a growing recognition, spurred on by scientific observation and analysis, that the global environment is under serious threat from multiple human activities, resulting in such phenomena as global warming, air pollution, water pollution, and waste deposal problems (Kahn and Franceshi, 2005).

The idea that time is running out, and that drastic action must be taken urgently, is no longer confined to a handful of doomsayers, but has even caught on among politicians at all levels of government. At the Earth Summit, would leaders acknowledged that dramatic changes are needed to avoid global environmental and social disaster (Grubb, 2003). Figure 1.1 presents the actions of some major global environmental programmes (e.g. Earth Summit, Kyoto Protocol, Caring for the Earth).

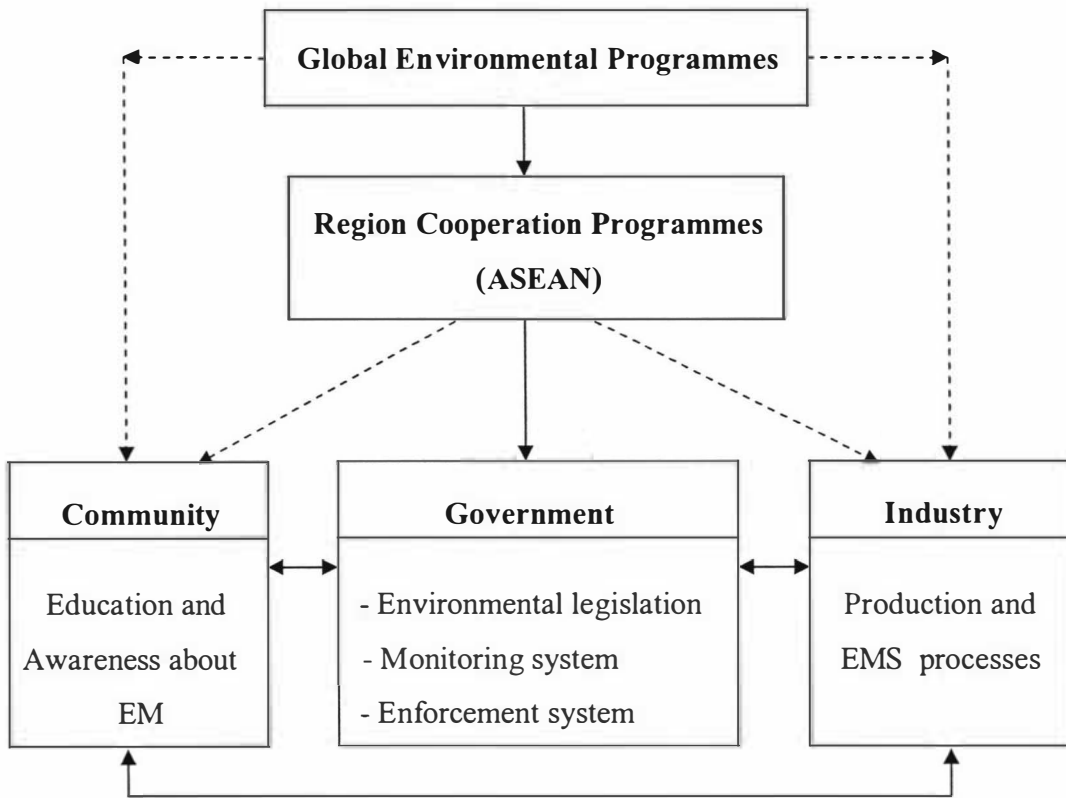
Figure 1.1 Actions of the Major Global Environmental Programmes



Sources: Ministry of External Relations and Trade, and Ministry for the Environment, 1992; Beazley, 1993; Babiker, 2002

Since the Earth Summit in 1992, there has been emphasis on conservation of natural resources and the environment at both regional co-operation and individual country level. Figure 1.2 presents environmental management programmes by linking the global environmental programmes (e.g. Earth Summit, Kyoto Protocol, Caring for the Earth), the regional co-operation programmes (ASEAN), the Thai government, and the industry and community in Thailand.

Figure 1.2: Environmental Management Programmes by Linking the Global Environmental Programmes, the Region Co-operation Programmes (ASEAN), the Thai Government, and the Industry and Community in Thailand



Source: By reviewing the literature

1.2 IMPLICATION FOR INDUSTRIES IN THE ASSOCIATION OF SOUTHEAST ASIAN NATIONS (ASEAN)

ASEAN countries (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam) have sought to accelerate economic growth and to promote matters of common interest in economic matters since 1967. Although there have been no joint initiatives for ASEAN countries to cooperate in regard to environmental matters, there is an increased awareness that something needs to be done in this part of Asia. After the 1992 Earth Summit, ASEAN Senior Environmental Officials (ADOEN) agreed on the development of a Strategic Plan of

Action for the Environment in July 1993 (ASEAN, 2000). This plan consists of five objectives (see below) and 10 strategies as itemised in Figure 1.3.

- To respond to specific recommendations of Agenda 21 requiring priority action in ASEAN;
- To introduce policy measures and promote institutional development that encourage the integration of environmental factors in all developmental processes, both at the national and regional levels;
- To establish long term goals on environmental quality and work towards harmonised environmental quality standards for the ASEAN region;
- To harmonise policy directions and enhance operational and technical cooperation on environmental matters, and undertake joint actions to address common environmental problems;
- To study the implications of the ASEAN Free Trade Area (AFTA) on the environment and take steps to integrate sound trade policies with sound environmental policies (ASEAN, 2000).

Figure 1.3: ASEAN's Strategic Plan of Action on the Environment

- Support the development of a regional framework for integrating environment and development concerns in the decision-making process.
- Promote government-private sector interactions that lead towards the development of policies that mutually support the thrust of each sector.
- Strengthen the knowledge and information data base on environmental matters.
- Strengthen institutional and global capacities to implement international agreements on environment.
- Establish a regional framework on biological diversity conservation and sustainable utilization of its components.
- Promote the protection and management of coastal zones and marine resources.
- Promote environmental sound management of toxic chemicals and hazardous wastes, and control of transboundary movement of hazardous wastes.
- Develop a system for the promotion of environmentally sound technologies.
- Promote regional activities that strengthen the role of major groups in sustainable development.
- Strengthen the coordinative mechanism for the implementation and management of regional environment programmes.

Source: ASEAN, 2000

Moreover, ASEAN has designated the year 2006 as ASEAN Environment Year with the theme "*Biodiversity: Our Life, Our Future.*" The official launch of the Environment Year 2006 was held on 18 May 2006 in Indonesia. The launch of ASEAN Environment Year 2006 aims to raise people's awareness of the region's rich biodiversity, and strengthen regional cooperation and implementation of actions on environmental conservation. It supports ASEAN's commitment to achieve the goals of sustainable development envisaged in ASEAN Vision 2020 on the establishment of a "clean and green ASEAN". The ASEAN Environment Year is celebrated every three years with the aim of promoting environmental awareness at all levels of society, highlighting ASEAN's environmental achievements, and strengthening partnerships among ASEAN member countries (as well as the private sector, civil society and nongovernmental organisations) in addressing environmental challenges in the region. A series of activities and campaigns addressing the theme of the 2006 Environment Year will be carried out in each ASEAN member country throughout 2006 (The ASEAN Secretariat, 2006). However, ASEAN targets are achieved through consensus. ASEAN does not have a central parliament to issue laws and regulations to its member countries, and there is no enforcement of joint initiatives. Thus, at present, the role of ASEAN is essentially as a guiding force. Each member country must play a role in implementing the various ASEAN instruments (ASEAN, 2000).

1.3 BACKGROUND OF THE DEMAND FOR QUALITY FROM THE EMS THAT ARE USED IN LARGE MANUFACTURING IN THAILAND

Since the King of Thailand spoke about environmental issues in 1990, the government began to pay specific attention to environmental problems and emphasize the protection and control of the natural resources and environmental management. A new Enhancement and Conservation of National Environment Quality Act was issued in order to reform the management of natural resources and environmental conservation, based on effective, transparent and accountable monitoring in 1992. The new Act also enhances public participation, decentralizing management authority to local authorities. The government also signed an international commitment to establish sustainable development at the 'Earth Summit' at Rio in 1992, to meet the recommendation contained within Agenda 21. For example, the Thai government has

developed the environmental performance indicators to evaluate results of the government policy, programmes, and plans, which measure the progress towards the goals of Agenda 21. This work was done in parallel with the development of information systems under the “National Operation Center” (information system center). The information systems will serve as an important tool for monitoring and evaluating the performance of the government policy, programmes, plans, activities, and compliances. These data are used for developing performance indicators at the national level, and also will apply in the budgeting and administrative process to follow up on the effectiveness and outcomes of the government agencies. The Earth Summit and other international environmental commitments not only have an effect on governments’ performance but also affect the business and community in increasing the awareness about environmental protection, and create a demand for a green production performance (Global Environmental Forum, 1999).

As a result of international environmental commitments and the environmental awareness of the community, world business today is highly competitive. Industries in Thailand need to develop good relationships with their customers. Environmental issues also influence the degree to which industries are able to build good relationships with customers, particularly in the manufacturing sector. Therefore, many manufacturing companies use an Environmental Management System (EMS) to demonstrate their commitment to good production and service for the government and their customers. The assessment of an EMS quality can be the result of complex interactions but it will ultimately depend on the perceptions of industry, customers and the community. The quality of the EMS, applied by the manufacturing industry, is also concerned with the perceptions of customers and the community, together with the views of government agencies that have responsibility for protecting environmental quality (Brown, 2002).

Government has the main responsibility for the environmental problems, as regulators and managers of economic policy, and as environmental experts. Also, by the international environmental commitment, government has a responsibility in providing information and education about environmental laws and regulations, environmental problems, and to develop awareness about environmental protection to both industries and the community. The World Bank also recognised the importance

of environmental legal systems for EM. However, some experts argue that the implementation of environmental legislation must be included with monitoring and enforcement systems (Laplante and Meisner, 2001).

Manufacturing industry has the main responsibility for developing cleaner operating practices in various sectors. For example, new Environmental Management Strategies (EMS) and technology is needed to clean up past mistakes and avoid future ones. (Chin, Chiu, and Tummala, 1999; Zutshi and Sohal, 2005). It can be demonstrated that a growing numbers of social problems and public health issues may be related to environmental degradation in industrial regions and unbalanced industrial development (Tinsley, 2001). According to the reports of the Ministry of Science Technology and Environment (2000) and the Environment Department of the World Bank (1995), the growth rates for manufacturing industries have increased, while natural resource and environmental quality have decreased (i.e. air and water quality – see Table 3.1). Health problems, such as allergy and cancer, have also increased. The Environment Department of the World Bank (1995) indicates that annual health costs of Particulate Matter (PM) and lead air pollution in Thailand are nearly three percents of Gross Domestic Product (GDP).

An EMS process usually involves the community through consultation, with a strong influence on companies through community buying power. Nowadays, international trade generally requires industry to adopt EMS practices. It means introducing processes that minimise the use of raw materials and energy, reduce waste, and prevent pollution. Moreover, many countries also encourage community members to take part in preparation of environmental standards (Wolf and Stanley, 2003).

In Thailand, the Government recognises the high priority of environmental issues, and has increased the budgets to solve, prevent and educate Thai people about environmental management (Chantadisai, 2004). However, the government also issued some economic programmes such as “Detroit of Asia”, to encourage the automobile industry; Deep-sea ports to promote the transportation industry; “Bangkok – city of fashion”, to promote the garment industry. Some of these industries are the major industries that produce pollution. Moreover, many global environmental programmes do not require specific goal for developing country such Thailand. It may

be because most of developing countries do not have many hi-technology industries that may produce much pollution (Babiker, 2002; Pimpisut and Staudte, 2004).

The management of industrial affairs has become increasingly complex owing to the expanding maze of environmental laws and regulations, and the growing public expectations regarding environmental protection. It is important to understand the role of the National Economic and Social Development Plan before studying Thailand's environmental administrative system, as most of the Government administrative systems are established through the provisions of the National Economic and Social Development Plan. Generally, the National Economic and Social Development Plan is focused on developing the Thai economy, more than social and environmental quality. However, the current plan, the Ninth Plan, shows that the government has tried to balance the development of the economy and the quality of life of the Thai citizen. The Ninth Plan also shows that the government has tried to solve the overlapping functions between the government agencies by reforming the public agencies in 2002. In addition, the government has separated the environmental protection and prevention functions out of the science and technology functions (from the MOSTE), and then established the MONRE to take over all the environmental functions. However, there are still some environmental functions in other ministries (e.g. the MOI and the MOPH) that the government needs to take over these functions and assign the MONRE to control them (Pimpisut and Staudte, 2004). The Plan also does not mention the environmental goals, and the roles, responsibilities and targets of all the government agencies that are concerned about environmental policy. Therefore, the government still has a problem of overlapping functions between agencies.

The responsibilities for industrial environmental management are shared primarily between the sectoral ministries. In particular, the MONRE, MOI, and MOPH, together with their constituent departments, enjoy broad jurisdiction over numerous industrial environment management sectors. A list of Government ministries concerned with industrial environmental control and an overview of Thailand's environmental administrative systems are present in Chapter Three.

As in many developing countries (e.g. Thailand, Indonesia, Malaysia, Vietnam), overlaps in administrative jurisdiction occur at the central level amongst government agencies, as well as between central and provincial agencies. One major problem lies in the division of competences and the lack of coordination amongst the departments in the same Ministry and different Ministries (Ministry of Science, Technology and Environment, 2000; O'Rourke, 2004, Varettoni and Boss, 2005; Roij, 2006). Therefore, the Thai government has reformed the public sector in 2002. The Ministry of Natural Resources and Environment (MONRE) was established under the Enhancement and Conservation of National Environment Quality Act. The Thai Government provides most of the environmental protection under the umbrella of the MONRE. The Ministry of Industry (MOI), and the Ministry of Public Health (MOPH) are also responsible for a small amount of environmental protection (see Figure 3.1).

The Enhancement and Conservation of National Environment Quality Act is Thailand's only main environmental law. The objective of the Act is to protect environmental quality and to control pollution, which has the potential to affect environmental quality, natural resources, the environment, and is harmful to the health of the Thai people (Public Health Law Administration Office, 2002), and also it enhances public participation in environmental monitoring systems (Chantadisai, 2004).

The Act currently in force now is the Enhancement and Conservation of National Environmental Quality Act, 1992. This Act covers four major aspects of environmental management important in guiding industry, namely: pollution control, environmental protection, environmental fund, and promotion measures (see details in Chapter Three) (Public Health Law Administration Office, 2002). In addition, Associate Professor Dr. Sunee Mallikamarl notes that there is still some legislation that is most closely concerned with the implementation of industrial pollution controls in Thailand, as follows (Global Environmental Forum, 1999, p. 22 – 32):

- The Factory Act
- The Industrial Estate Authority of Thailand Act (IEAT Act)
- Hazardous Material Act

- The Public Health Act
- The Enhancement of Energy Conservation Act

(see details of these Acts in Chapter Three)

Laplante and Meisner (2001) mention that environmental standards in Thailand are the same as for developed countries, because most of these standards are taken from the United States and the United Kingdom. It is generally recognised that polluters have little incentive to control and abate pollution. Indeed, the implementation of regulatory (command and control) measures has typically suffered from weak monitoring and enforcement. According to Barrow (2005), many researchers, who study environmental management systems in developing countries in Asia, said that most developing countries have good environmental standards, but many have problems concerned with monitoring and enforcement systems. For example, the Chinese and Vietnamese governments lack sufficient sanctioning power and technical capacity to enforce existing environmental regulations. Government inspections rarely happen unless the community has complained or the company has a history of violations. (O'Rourke, 2004; Rooij, 2006). The Thai government also has problems concerned with monitoring systems. This deficiency results from limited personnel and budget resources for factory monitoring (German Technical Cooperation Thailand (2001). The experience of many countries, both developed and developing, with existing regulation (command and control) measures has not been particularly positive. The implementation of existing regulations has been further hampered by the duplication and overlapping of responsibilities between numerous agencies and departments, which are involved in environmental pollution control (Laplante & Meisner, 2001). The inability of the "command and control" (regulations) approaches to bring about pollution control, and the increasing need of local communities to participate actively in the management of the quality of the environment, calls for the implementation of alternative tools to complement the existing command and control.

By 1972, manufacturing companies were spread throughout Thailand. Therefore, it was very difficult for the government to monitor and control the environmental pollution problems that are caused by manufacturing industry. The government had known about the problems needing solutions and in 1972, the government promoted

the *industrial town* concept. Through the industrial town programme, the Industrial Estate Authority of Thailand (IEAT) was established under the Ministry of Industry (MOI). The government used this programme to encourage manufacturers to locate in industrial towns, because it would be easier for the government to monitor and control any problems caused by manufacturing, including environmental pollution problems (Industrial Estate Authority of Thailand, n.d.).

In addition, the Thai government uses the IEAT in order to develop the country's economic objectives. The government invites investors, both domestic and overseas, to invest with manufacturers that locate in industrial areas, who then gain tax benefits from the government. However, manufacturers that locate within industrial towns have to comply with the regulations from both MOI and IEAT, thus incurring higher costs to comply with government legislation.

1.4 THE PURPOSE OF THE STUDY

As was mentioned earlier, Thailand has experienced high rate of industrialisation. This has come at a cost of environmental difficulties. So, the main purpose of the study was to identify the major dimensions of the environmental management quality, by sampling the perceptions of four groups of stakeholders – the government officers from the government agencies concerned about environmental policy; top management in the manufacturing organisations; the manufacturers' staff at management level; and the communities. As mentioned earlier, environmental management needs the interaction of all stakeholders (e.g. the government, manufacturers' staff, and the community).

One group of manufactures is located inside a designated industrial town. The second group of manufacturers is located outside the towns. This will enable an evaluation of the Thailand government's industrial town policy in order to determine whether manufacturing companies in industrial towns have better EMSs than manufacturing companies outside industrial towns.

Data were collected using different techniques – documents; individual interviews; observations; and a research questionnaire. Thus the study was a cross-perceptual analysis of the viewpoints of the four important groups with a stake in the delivery of environmental management quality for large size manufacturers in Thailand.

There are four research objectives:

- To evaluate EMS systems used by large size manufacturing companies in Amata Nakorn Industrial Town and compare them with EMS systems used by manufacturers outside Amata Nakorn Industrial Town.
- To analyse the major factors that may affect the quality of environmental management practices in Thai large manufacturing companies.
- To assess manufacturers' staff responses of inside and outside industrial town, in regard to environmental management requirements.
- To assess community responses to environmental pollution problems cause by large manufacturing industries.

Thailand has a great many manufacturers ranging from very small home-based industries to very large and highly technological industries. This study focuses on the large size manufacturers that are located in both Amata Nakorn Industrial Town and outside of the Town in the Chonburi Province area in 2005, the year in which the researcher collected the research data. A map of Amata Nakorn Industrial Town and the other three sample manufacturing companies situated outside of the Town is in Appendix One.

Amata Nakorn Industrial Town in Chonburi Province was selected as a study location because it is one of the largest towns that is located in the Eastern Seaboard Project area and also in the country. Amata Nakorn Industrial Town is a public company established in 1989 and listed on the Stock Exchange of Thailand. Its core business is the development and management of industrial estates on the Eastern Seaboard, in joint partnership with the IEAT. Amata Nakorn Industrial Town is one company under Amata Corporation Public Company Limited, the largest operator of industrial estates in Thailand (Amata Nakorn Industrial Town, 2001). In addition, this town has

an excellent environmental management system and has held the ISO 14001 certificate for Environmental Management since 2000 (Amata Nakorn Industrial Town, 2001).

Most of manufacturing companies in Amata Nakorn Industrial Town are large manufacturing companies. There are only a few medium size companies and no small companies, and if large companies have a poor EMS, they may have more effect on the environment than medium size companies. Therefore, the researcher has decided to focus on the EMSs that are used in large manufacturing companies only.

Chonburi Province is one of the important industrial areas in Thailand and it is located in the Eastern region. The Office of the National Economic and Social Development Board (2003) reported that the Gross Regional Production (GRP) exhibiting the highest growth was the Central region (15.9% in 2003). The Eastern region is the second (11.9% in 2003), which was driven by both agricultural and non-agricultural sectors. Manufacturing was also a major contributor to the high growth of this region.

The Thailand government made the development of the Eastern region, in the Fifth National Economic and Social Development Plan (1982 – 1986), a priority and actively promoted the foundation of the Eastern Seaboard Development Committee with the Prime Minister serving as chairman (Japan International Cooperation Agency, n.d.). The development of the Eastern region, in the Fifth National Economic and Social Development Plan, has resulted in industrial growth within this region. Industrialisation in the Eastern Seaboard region has progressed remarkably and the region has developed into the country's second largest industrial centre after the Bangkok metropolitan area. The Eastern Seaboard comprises of three provinces, Chachoengsao Province, Chonburi Province, and Rayong Province. These areas are a very suitable environment for industrial development, due to their proximity to the capital of Bangkok and the possibility for topographical deep-sea port construction (Japan International Cooperation Agency, n.d.).

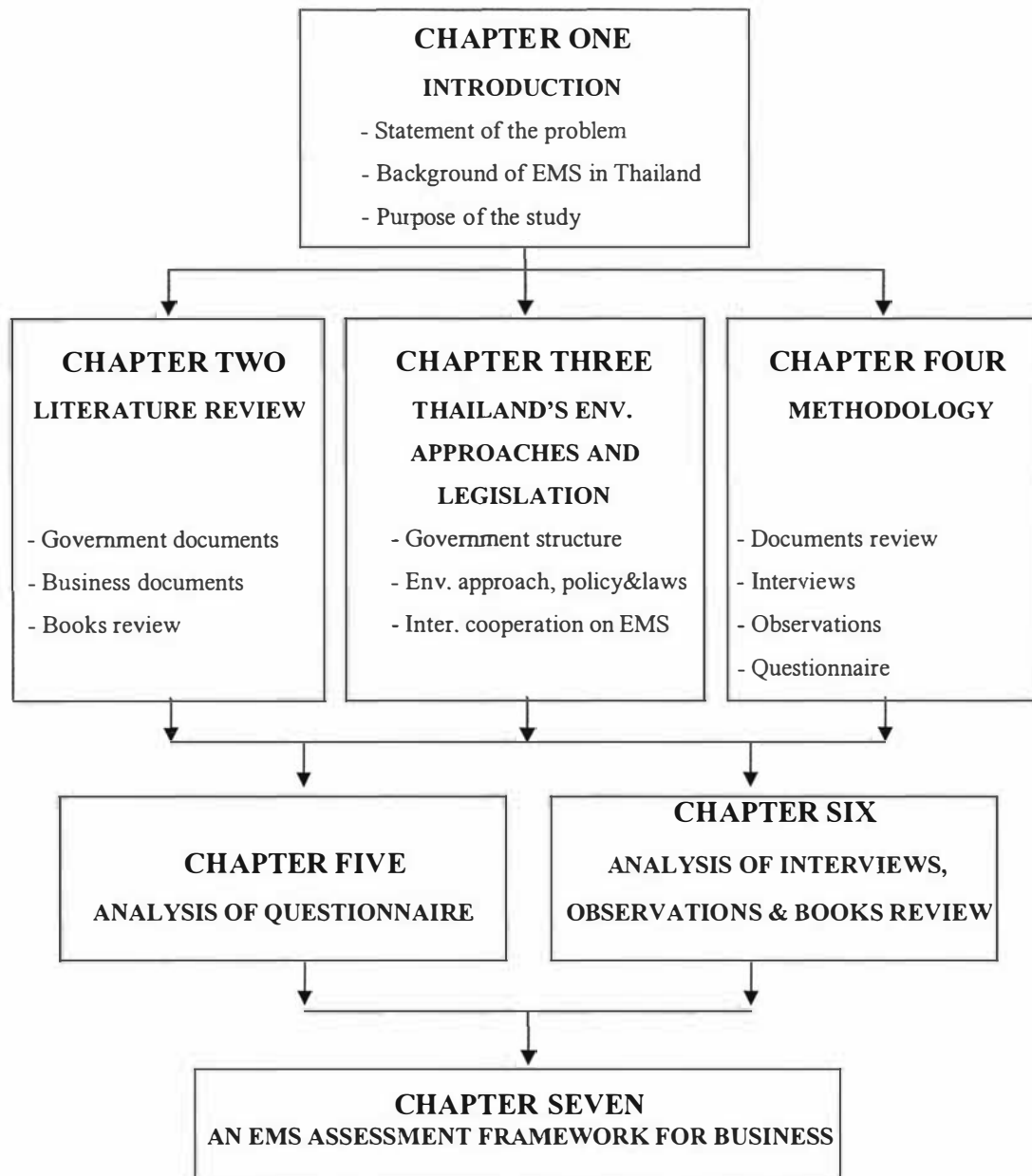
The East region is comprised of eight provinces. Chonburi Province is the leading city of the East region. Gross Provincial Production (GPP) of Chonburi in 2003 was 37.7% of the Eastern region of Thailand, in which manufacturing was a major

contributor of Chonburi Province (Office of the National Economic and Social Development Board, 2003). This research study is located in the area of Chonburi Province and Amata Nakorn Industrial Town which is within the Eastern Seaboard Programme. Amata Nakorn Industrial Town comes under the Industrial Estate Authority of Thailand (IEAT).

1.5 STRUCTURE OF THE THESIS

This thesis is composed of eight chapters. Table 1.1 summarises the thesis structure in a diagram. Chapter One introduces the study, describes the statement of the problem, the background of EMSs in Thailand, and the purpose of the study. Chapter Two provides a review of the literature relevant to the study. The purpose of the literature review is to guide the understanding of the basis of environmental management systems used in businesses and large manufacturers in Thailand and to provide a brief overview of Thailand's national environmental laws and regulations. Chapter Three focuses on Thailand's approaches to environmental pollution. Chapter Four is the chapter which discusses the methods used. The purpose of the methodology is to explain how the study was carried out and the importance and relevance of the methods, which were used to collect the information needed. Methods of triangulation are used to collect information for the purpose of this study. Chapter Five and Six contain the experimental results of the research. The study results comprise information gathered from questionnaires, interviews, observations, and document reviews from the four main groups of stakeholders – the government officers in the government agencies concerned about environmental policy; top management in manufacturers; manufacturers' staff at management level; and the local communities. The survey results of Chapter Five and Six aim to assess manufacturers' staff responses inside and outside industrial town, in regard to environmental management requirements, and community responses to environmental pollution problems caused by large manufacturing industries. Finally, Chapter Seven draws the research results together and concludes with the division of each EMS into three major factors, which are an EMS assessment framework for business that may affect the achievement of environmental management in large manufacturing companies. This Chapter also provides recommendations for further research.

Table 1.1: Structure of the Thesis



CHAPTER 2: ENVIRONMENTAL MANAGEMENT SYSTEMS

2.1 INTRODUCTION

This chapter presents the literature review that guides the direction of the study. The objectives of this chapter are: to review the theoretical basis for environmental management systems used in businesses; and to review the criteria by which environmental management systems are used by large manufacturers; to critique the degree to which current literature assists large business in deciding the appropriateness of EMS systems.

The first section presents a definition of the term “environmental standard” and introduces the important national environmental standards in Thailand. This section also includes a discussion about the need for the government to generate appropriate environmental standards to guide large manufacturer’s approach to Environmental Management (EM).

The second section explores environmental management and introduces the principle concept of environmental management from an industry’s perspective. It discusses the difference between environmental management and environmental science, the responsibilities of environmental managers and environmental users and the roles they play and it includes a definition of environmental management as a multi-layered process (e.g. management, economic, environmental science, policy).

The last section, section three, describes the four EMS systems that are most recognised and used generally by large manufacturers around the world. Several theories about the decision-making criteria used by companies to select an EMS are also presented along with a critique of various EMSs from a theoretical perspective. All the EMSs analysed are used by large manufacturers in and outside the industrial town in Chonburi Province, Thailand.

2.2 THE BACKGROUND TO THE STANDARDS

Within each country, there are many environmental and economic standards for measuring the socio-economic and environmental effects of human activities. Various national and international standards agencies, such as the British Standard Institution (BS 7750), the International Chamber of Commerce (ICC) and the United States Environmental Protection Agency (EPA) have set standards, which are then adopted by the appropriate industries (Nathanson, 2003). Barrow (2005) notes that a standard may be defined as a widely accepted example of something, against which others may be measured. They allow meaningful evaluation, exchange and comparison of data, improve objectivity of judgement, aid recognition of crucial thresholds and limits and support negotiation and law.

As defined by the International Organisation for Standardisation, standards are, “documented agreements containing technical specifications or criteria to be used as guidelines (and possibly legal requirements) to ensure materials, products, processes, and services are appropriate for their purpose” (Olson, 1999, p.135). In Thailand, the Enhancement and Conservation of National Environment Quality Act is used as a legal requirement standard to ensure that manufacturing industries will not discharge, to any appreciable degree, pollutants in to the community. The standards development process begins when a need is expressed to a national standards organisation, which may then develop and publish a standard or present the issue as a new system item to an international body, such as the International Organisation for Standardisation (ISO). The international standard organisations participate in the development of consensus and industry wide voluntary standards.

There are many ways of developing a standard to measure the impact of industry on the environment. Standards often rely upon indicators, data that can be relatively easily measured and which have specific meaning. Some indicators are precise and reliable, others are less so. It is therefore important that an environmental manager knows the characteristics of a standard, together with the levels of achievement measured by it. The methods of data collection, as well as the agreed units, must be standardised (Barrow, 2005).

Piper, Ryding & Henrison (2003) note many reasons why national and international environmental management standards are needed such as:

- The increasing costs of regulatory, customer and other stakeholder environmental performance compliance requirements.
- Many organisations seeking to proactively improve environmental performance through self-initiatives, rather than following external governmental and customer requirements.
- Organisations discovering the economic rewards and public relations value inherent in proactive approaches to environmental management.
- Organisations, operating internationally, are searching for ways to standardise often conflicting and redundant regulatory requirements, social expectations and implementation requirements.
- Stakeholders are pressuring organisations to improve their environmental performance.
- Organisations are focusing on expanding cost control and quality management initiatives within environmental management.

By reviewing the literature, researchers agree that environmental standards need to be used in guiding industries to approach EM in their companies (O'Rourke, 2004; Barrow, 2005; Rooij, 2006). Environmental standards may be divided into three broad groups: protecting human health and safety; maintaining environmental quality; and ensuring quality of consumer items (Barrow, 2005), although, as Speller (1996) argues, environmental standards do tend to stress the 'physical' environment rather than offering comprehensive societal, people and environmental coverage. Holt (1998) explains that environmental standards can be used to produce two broad outcomes. First, it is a systematic method of identifying and managing the interaction between the ecological environment and the company. Second, it is a way to prove, via an independent agent, to stakeholders that the company is committed to improving the quality of its interaction with its ecological environment. Barrow (2005) argues that each environmental standard plays a crucial part in monitoring and modelling to understand the environment and establish trends, negotiation, enforcement of rules, environmental auditing, and the maintenance of environmental quality (Barrow,

2005). According to Barrow's view, some researchers who study environmental management systems in developing countries in Asia believe that while many developing countries have good environmental standards, most have problems concerned with developing effective monitoring and enforcement systems. For example, the Chinese and Vietnamese governments lack sufficient sanctioning power and technical capacity to enforce existing environmental regulations. Government inspections rarely happen unless the community has complained or the company has a history of violations. (O'Rourke, 2004; Rooij, 2006). Therefore, it may be assumed that only having environmental standards (legislation) is not sufficient without monitoring, enforcement, and the co-operation of the government and the local community. Anecdotally, it is also assumed that Thai government environmental standards are observed by industry. Most of the Thai standards are taken from United States and United Kingdom research and government standards (Phongpaichit, 1996). However, the view of the Thai legislation (Chapter Three) shows that many of the Thai environmental laws and regulations have been established since 1992 and have not been reviewed since then. Generally, there are three major international environmental standards: water quality, air quality and waste management standards.

Brown (2005) notes that water quality standards, or ambient water quality standards, are the legal specifications of the minimum conditions which should be met, for a given indicator of water quality (i.e. turbidity) at a specified location along the stream. Water quality standards should combine the requirements for protecting human health and the maintenance of ecosystem structures and functioning. Water standard relies upon an assumed capacity of the receiving water body to receive and assimilate a certain amount of pollutants and still be of the quality desired for other uses (Vigil, 2003). It is suggested that an ambient standard is a fundamental measure to control water pollution, since it can account for both point source and non-point source discharge (Viessman, 2004).

Pollutants can enter the water environment from two input sources: "point sources" and "non-point sources". "Point sources" are pollutants which are discharged into the water environment from a pipe or drain. Most industrial wastewater is discharged into public water in this way. "Non-point sources" are pollutants which are discharged into the water over a wide area, such as agricultural and urban land use. Ophardt (2004)

describes that non- point source pollution is difficult to manage because of the problems inherent identifying who is responsible for the discharge of individual pollutants. As the pollutant passes through the receiving environment, further chemical changes occur also obscuring the source of the pollution. This research is concerned with manufacturing industries with identifiable outfalls of pollution. Therefore, non-point sources of pollution have been excluded from this study.

The advantages of using ambient water quality standards, to measure the effects of industry, accrue mainly to polluters. To enforce an ambient water quality standard, it is necessary to consider the natural ability to assimilate some waste materials, in order to reduce any adverse effect on its future use. Therefore, standards provide an incentive for industries to locate in areas where receiving water is less sensitive to pollution and thus this results in lesser pollution control abatement cost for any firm. The focus is on managing the quality of receiving water, in a way that ensures minimum interference with legitimate users of water (Mueller & Boyle, 2002).

Air pollutants that dissipate in the air cause, or may cause, cancer or other serious health problems such as those associated with reproduction or birth defects. Air pollution may also cause adverse environmental and ecological effects. Most air pollutants originate from human activities, but some may also be released in conjunction with natural events, such as volcanic eruptions or forest fires (Air Pollution Consultant - EPA, 2004, p. 1.9).

There are also different approaches to developing air quality standards. The United States Environmental Protection Agency (EPA) has established national ambient air quality standards (NAAQS) for monitoring six major criteria pollutants: nitrogen dioxide, ozone, sulfur oxides, particulate matter, carbon monoxide and lead (Air Pollution Consultant - EPA, 2004, p. 1.7). Both the Pollution Control Department (PCD) and The Office of National Resources and Environmental Policy and Planning (ONEP), under the Ministry of National Resources and Environment of Thailand, (MONRE) also monitor the same six major criteria pollutants as the EPA (Office of the National Resources and Environmental Policy and Planning, n.d.).

EPA also compiled an air toxics inventory, as part of the National Emissions Inventory (NEI), to estimate and track the United States' emission trends for the 188 toxic air pollutants which are regulated. In the NEI, EPA categorises emission sources into four types as follows (Air Pollution Consultant - EPA, 2004):

- Large industrial sources
- Area and other sources, which include smaller industrial sources such as dry cleaners, gasoline stations, as well as natural sources like wildfires
- On road mobile sources
- Non-road mobile sources such as aircraft, construction equipment

Finally, some countries are developing standards relating to waste management. For example, waste management in Scotland, which is part of the EU, are in a period of transition (Slater & Gemmill, 1999). Waste management has been transformed from a system which provides opportunities to create landfill to a regulatory process attempting to implement the waste hierarchy, with the overall aim of waste reduction. The current policy on disposal of industrial waste in the EU is to reduce waste at the original source. For example, EU industry is required by regulation to use reusable or recyclable packaging (Sarkis, 2001). However, the current policy in Thailand still relies on waste pollution using “end-of-pipe” solutions and individual consumer disposal of waste products associated with their purchases.

2.3 WHAT IS ENVIRONMENTAL MANAGEMENT?

Many researchers separate the meaning of “environment” and “management”. For example, Miller (2004) defines environment as all external conditions and factors, living and non-living, that affect an organism or other specified system during its lifetime, whereas Brown & Venus (2001) include even the built human environment in their definition. Similarly, “management” in relation to the environment has been defined in different ways. One view sees management as a means of allocating and conserving environmental resources (forest, minerals, etc.), whereas others emphasise management as a very structured process, that begins with goal setting and extends

through the functions of information systems, research, planning development etc. Bringing these two strands together, many researchers have also defined environmental management in various ways. Barrow (2005)'s definition is typical:

Environmental management is an approach to environmental stewardship which integrates ecology, policy making, planning and social development (p.18).

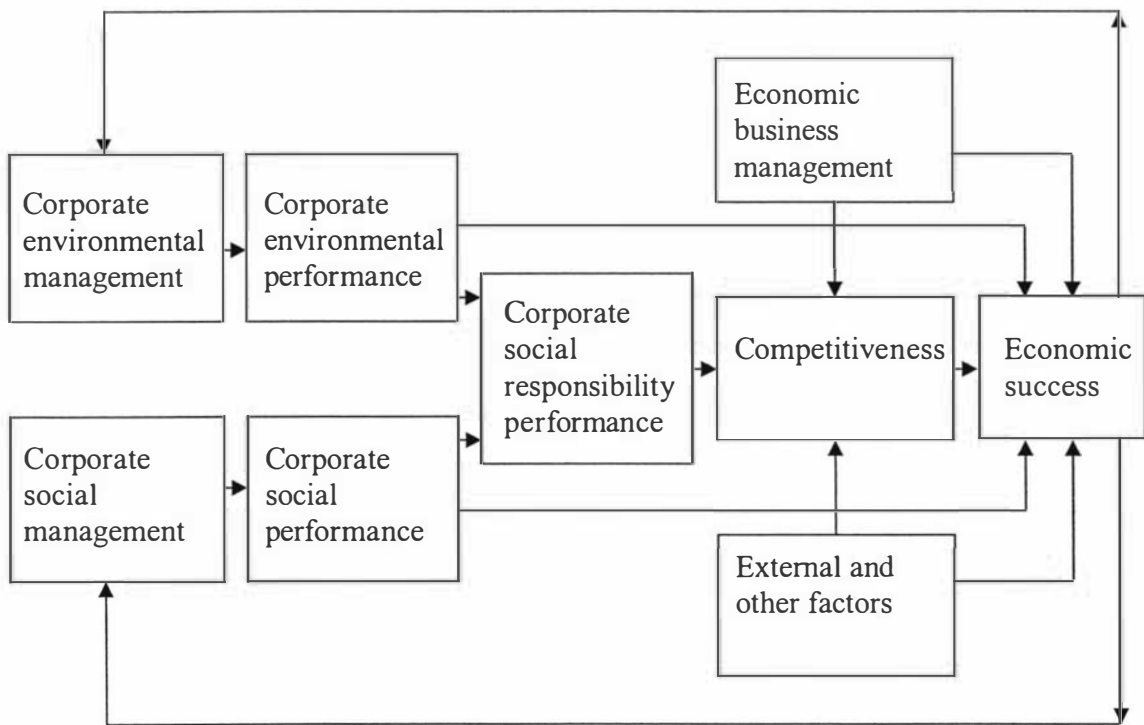
Burchell (2002) defines environmental management as a human creation. It centres on the activities of people and their relationships with the physical environment and the affected biological systems. The essence of environmental management is that, through systematic analysis, understanding and control, people may continue to evolve such technological control procedures without profoundly altering natural ecosystems.

Piper, Ryding & Henricson (2003) mention that it is very useful to distinguish between the words "environmental managers" and "environmental users". All human beings are environmental users, since all people interact with the environment in the pursuit of their needs and wants. However, not all environmental users are environmental managers. Environmental managers are the people who are concerned with environmental policy and process making and social development. However, many researchers argue that EM needs the interaction of all stakeholders (e.g. the government, manufacturers' staff, the community). For example, Prakash (1999) mentions that EM is associated with the interaction of state and non-state environmental managers with the environment and with each other. Environmental managers are those whose livelihood is primarily dependent on the application of skills in the active and self-conscious, direct or indirect manipulation of the environment, with the aim of enhancing predictability in a context of social and environmental uncertainty. Environmental users also have responsibilities to protect the environment. Skanavis and Sarri (2002) describe the importance of the community participation (environmental users) in the EM. The involvement of the local community members in the decision making process (in both companies' EMS policy and the preparation of environmental standards) is essential and advantageous. When the community members feel that they have contributed, they are respected in their

communities. In an effective EM system government and industries have a responsibility to provide information and education about EM to the community (Dowell, Hart, and Yeung, 2000; Zutshi and Sohal, 2005; Sarkis, 2001). This research also presents the interaction between the government, manufacturers, and the local community in the approach to EM.

Over the last decade, the relationship between environmental and economic performance and, more recently, the interaction between environmental management performance and business competitiveness, have received considerable attention from governments and businesses around the world. There is no doubt that EM has a substantial impact on the competitiveness and economic performance of a company. This has been documented in various widely reported cases such as when Shell wanted to sink the Brent Spar oil platform in 1995 (Friedman, 1997). There is, furthermore, no dispute that the activities of many companies in actual business practice exceed what can be considered economic in a purely financial sense. However, there is still substantial disagreement about whether management is obliged to focus on business in a more narrow sense relating all activities directly to economic performance or whether management has a social responsibility that requires voluntary social and environmental activities to exceed the compliance with regulations (e.g. Friedman, 1997; Crook, 2005). Schaltegger and Wagner (2006) explained the relationship between environmental and social management with competitiveness and economic success by the management of an environmental performance diagram.

Figure 2.1: Management of Environmental Performance



Source: Schaltegger and Wagner (2006), p. 36

In a company, successful management of environmental performance is achieved only if the management of environmental and social issues is in line with increased competitiveness and economic performance. As a consequence, environmental management requires an integration of environment, social and economic management thus covering all the links between non-market and economic issues. It deals with both the analysis and management of the effects of environmental and social activities on the competitiveness and economic success of a company, as well as with the analysis and management of the social and environmental effects of business activities (Schaltegger and Wagner, 2006). As the model in Figure 2.1 shows, it seems like there is present both a relationship and interaction between industry performance (corporate environmental performance) and the community demand on the environmental quality (social environmental performance). The corporate environmental performance can be defined as production process and EMS processes, and social environmental performance can be defined as education and awareness of stakeholders (e.g. community members, industries' staff, government officers).

However, many researchers argue that the government and environmental legislation are also important pressures perceived by manufacturing companies for them to adopt environmental practices. The environmental legislation is used as an environmental standards guide for manufacturers to manage their own environmental cleaning processes (Henriques and Sandusky, 1999; Watson and Stanley, 2003). Therefore I will apply the model from Schaltegger and Wagner together with the current survey results in an attempt to develop a new model of an EMS assessment framework for business.

Some researchers have considered the definition of environmental management as a multi process. As defined by Prakash (1999) and others (e.g. Emblemvag & Bras, 2001; Bennett, Bouma & Wolters, 2002), EM emerges as a process that tends to emphasise the application of science to specific environmental problems, usually under the auspices of the state. Conspicuously absent from such traditional accounts is any sense of the complex political economic and social interactions of the different types of players pursuing environmental management. As such, it can be argued that this understanding constitutes an inadequate basis for the conceiving of environmental management as a multi-layered process (Prakash, 1999; Emblemvag & Bras, 2001; Bennett, Bouma & Wolters, 2002). This research also considers the EM as a multi faceted process that requires a social interaction between stakeholders, such as the government, manufacturers' staff, and the local community.

Environmental management is a generic description of a process undertaken by systems – oriented professionals with a natural science, social science, or less commonly, an engineering, law or design background, who tackle problems of the human-altered environment on an interdisciplinary basis, from a quantitative and/or futuristic viewpoint (Tinsley, 2001).

At its simplest, an environmental management system must achieve in three areas. Firstly, it identifies goals for the company in managing their environment. Secondly, it establishes whether such goals are realistic and obtainable. Finally, it develops and implements the means to do what it deems possible, that is, to achieve the end result which is an unpolluted environment (Barrow, 2005).

One of the most significant disciplinary interactions relates to the link between environmental management and environmental science. The latter, which combines elements from such natural scientific disciplines as biology, chemistry and physics, developed separately around the same time as EM (Biel, Hansson & Martensson, 2003; Ennos & Elizabeth, 2000). A more complex set of disciplinary influences infuses the relationship between the social sciences and environmental management. This results from the conceiving of EM as a multi-layered process with a number of disciplines represented within it. It can be initially stated that certain disciplines are more important than others. For example, politics, economics or anthropology play a particularly critical role, whereas philosophy, history and psychology tend to be a secondary influence on EM (Piper, Ryding & Henricson, 2003).

Social and environmental uncertainty is the greatest problem facing environmental managers in multi-layered EM. Such uncertainty has certainly always been part of human environment interaction, but in recent years it has become more important. EM must deal with a large range of uncertainties. In this context, management must work to reduce uncertainty, whilst searching for the flexibility necessary to respond to changing social and political values and demands. The concept of uncertainty is useful as a means to explain the general social and environmental conditions that confront all environmental managers (Hancock, 2001).

By reviewing the literature, it is clear that EM is an important tool to help manufacturers to manage their environmental problems (Quazi, 1999; Hancock, 2001; Skanavis and Sarri, 2002; Barrow, 2005). However, there are a number of barriers that hinder implementation of an EM, such as inappropriate approaches to implementation; lack of company management commitment; lack of total employee involvement; cost of implementation; and unclear responsibilities of employees (Quazi, 1999). Skanavis and Sarri (2002) mention that EM is not working for manufacturers that do not provide enough education and awareness about the EM to their employees.

2.4 WHAT ARE THE ENVIRONMENTAL MANAGEMENT SYSTEMS USED?

At the end of the 19th century, a new concept for managing industrial development appeared in the “industrial estates”. In this concept, industrial estate operators provide central facilities for all manufacturers within their industrial estates. The first period of these industrial estates was established early in the 20th century, in both the United Kingdom and the United States of America (Industrial Estate Authority of Thailand, n.d.). A definition of an industrial estate, by Peddle (1997), is given below.

Industrial estate means a large tract of land, sub-divided, and developed for the use of several firms simultaneously, distinguished by its shareable infrastructure and close proximity of firms (p. 12).

One of the main objectives of industrial estates in most countries was to encourage large numbers of manufacturers to relocate out of overdeveloped urban areas which were essentially industrial towns. Congestion of both people and traffic and would be relieved in the city. Pollution in those areas would be reduced. Also, the industrial estate policy helped to promote the start-up of industrial activities in small towns or rural areas for environment purposes. The Thailand government also uses the industrial estates policy for encouraging overseas investors to invest in Thailand. The government believes that this policy can help the government in saving time and budget to spend on monitoring and controlling the industrial pollution problem when manufacturers are located in industrial towns (Industrial Estate Authority of Thailand, n.d.).

The growth of industrialisation has resulted in an increase in environmental problems, inefficient use of energy and the lack of comprehensive environmental management. Recently, environmental quality factors are becoming an essential component for manufacturing organisations’ competitiveness. Communities demand the increasing attention of top management and management level staff (Angell & Klassen, 1999, Levy & Newell, 2005.). The environmental situation of companies is a very dynamic process which may evolve from a reactive position, that exclusively seeks compliance with legislation, to the decision to adopt an environmental management system

resulting in the obtaining of certification, in order to take advantage of the opportunities that attention to the environment offers (Henriques & Sadowsky, 1999, Klassen & Angell, 1998, Elliott, 2004). These opportunities range from foreign investments to the Thai companies to accessibility to overseas markets.

Manufacturing industry managers, concerned with best practice, now perceive that they cannot ignore the influence of community demand for better environmental quality. Actions being promoted are directed towards controlling the environmental impact generated by the industry. However, when managers perceive that the influence of community demand implies opportunities, they begin to favourably judge protection of the environment and thus foster the development of advanced environmental management actions (Dyckhoff, 2000). Managers also have some technologies which can help them manage their company's environmental objectives.

Klassen (2000) divides environmental technologies into three broad groups that are: pollution control technologies; pollution prevention technologies; and environmental management system (EMS) technologies. Manufacturing industry managers must determine which technology is the most effective for their company's environmental objectives. Firstly, the pollution control technologies (e.g. waste water treatment plant, dust collector, noise retaining wall) were introduced in the early 1970s. Most of the environmental regulation directed at manufacturing has focused on the manufacturing process. The lack of significant customer and public demand created 'command and control' regulations, with specific prescribed limits promulgated for the level of pollutants that a manufacturing company may emit (Portney, 1990; OECD, 1995). Command and control standards generally were developed using a combination of two approaches: performance-based standards that set ambient quality levels, with regulators extrapolating the limits from the ambient level (Klassen, 2000).

Based on the premise that the release of pollutants must be controlled after creation, pollution control technologies are defined as structural investments, such as equipment and processes that capture pollutants at the end of a manufacturing process. Once captured, these wastes may require further treatment or disposal. Pollution control technologies may be further characterised as end-of-pipe pollution control. End-of-pipe pollution control refers to operations that are added as a final

process step to capture pollutants and wastes prior to their release into the environment (OECD, 1995).

Secondly, with pollution prevention technologies (e.g. green technology, waste minimize technology), the concept of pollution prevention has attracted a great deal of attention, motivated by public policy (Freeman et al., 1992). The EPA defined pollution prevention technology as the use of materials, processes or practices that reduce or eliminate the creation of pollutants or wastes at the original sources (Freeman et al., 1992). Pollution prevention can be implemented through adapting either the product design or production process. Generally, both product design and production process are often interrelated, and pollution prevention frequently requires a basic rethinking of both. (Klassen, 2000). 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 (e.g. reuse, recycle). Production process adaptation refers to fundamental changes that reduce any negative impact on the environment during material acquisition, production or delivery process (e.g. increasing the recycled content of materials, closed-loop recycling of waste water). Green technology is one of the pollution prevention technologies that is used by many manufacturers around the world. This technology offers managers more environmentally friendly solutions. Green technology involves four major goals, which need to be achieved to improve both environmental quality and the economics of production. These goals are waste reduction, materials management, pollution prevention and product enhancement (Billatos & Basaly, 1997).

Thirdly, EMS technologies (e.g. ISO 14001, TQM/TQEM, EMAS) affect the way manufacturing operations are managed at both tactical and strategic levels. Management systems practices include putting an operating executive in charge of environmental health and safety, providing the environmental reports, tying in compensation to environmental performance, measuring environmental costs and benefits, publishing an environmental performance report, having strong environmental commitment at all levels of management (Leake and Kainz, 1994; Industry Week, 1998; Sarkis, 2001).

An EMS is a tool to monitor, protect, measure and improve the environment. It is not a set of goals or performance standards to be achieved, although it does include a process for setting performance goals. Levy & Newell (2005) note that the International Organization for Standardisation (ISO) defines an EMS as part of the overall management system, which includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy.

An EMS provides a systematic way of addressing and managing the immediate and long-term impact on the environment of an organisation's products, services and processes and gives order and consistency to address environmental concerns, through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes. The EMS can be implemented in many different ways, depending on the precise sector or activity and the needs perceived by management. However, several common core elements should be present in any EMS. These elements include an environmental policy; an environmental programme or action plan to implement policy; an organisational structure which allocates responsibility for EMS implementation; integration of EMS into operations; a documentation system to collect, analyse and monitor corrective and preventive environmental action; EMS audits; management review; training; and external communications with relevant community organisation and government (Nathanson, 2003). Barrow (2005) suggests that there are many management tools for the management team to use, when making decisions about environmental management, such as P-D-C-A cycle, cause and effect diagram, control chart, flow chart, histogram, benchmarking and teamwork.

An EMS creates an overall site specific management system that addresses the environmental concerns of a company, through the allocation of resources, assignment of responsibilities and ongoing evaluation of practices, procedures and processes in order to achieve a sound environmental performance (Levy & Newell, 2005).

Each EMS is created by a site-specific team of employees and takes into account the geographic location, stakeholder and employee concerns, past uses of the site, corporate goals and other factors, when designing goals and objectives to achieve positive environmental and financial results. An EMS describes what will be accomplished, how it will be implemented and by whom. It includes bench marking and process improvement.

According to Hillary (2000), the outcomes of an EMS within a company are described as follows:

1. An EMS is a performance agreement for the company's environmental programme and relates to implementation of the company's EMS goals to performance improvement, identifying the customers, the commitment of the management team, and definition of roles and responsibilities of the company's staff.
2. An EMS provides a plan for company transformation implementation. Implementation includes authorities of employees reviewing performance of the environmental system, Training, improving awareness and competence of employees is also important.
3. The company standards and processes are prescribed - They include controlled documentation of core elements, reference to related environmental documents, operational control, emergency preparedness for handling accidents, and tracking performance of the company in achieving its objectives and targets.
4. Company management provides for a continuous improvement process in the company operations – Calibration and maintenance of monitoring equipment is critical. Also taking corrective measures or preventative equipment, keeping records and EMS audit, including a review of the EMS by management for its continuing suitability and effectiveness.

In order to obtain certification of an environmental management system, manufacturing companies need to focus resources on its implementation. It is necessary for companies to invest in training and qualifications for personnel and management in respect of many of these aspects (Dale, 2003). However,

manufacturing companies know the importance of the environment which greatly encourages the decision to make advances from an environmental prospective, and to succeed finally in adopting and achieving certification of an environmental management system (Klassen & Angell, 1998; Bechtel & Churchman, 2002; Afuah, 2003). Shrivastave (1995) mentions that EMS certification is a market requirement, demanded by governments and consumers in developed countries. Many large manufacturers in Thailand export their products to developed countries which require certification of EMS.

By reviewing the literature on environmental management, it is possible to identify criteria to be considered when choosing an EMS appropriate to a company's needs. For example, the study from Pun and Hui (2001), who examined an analytical hierarchy process assessment for applying EMS in the Hong Kong context which attempts to classify the hierarchy of the decision criteria into five areas which are: operation costs of the company; company image; market trend; company performance; and environmental conservation. Table 2.1 provides a list of decision criteria to select an EMS.

Table 2.1: Decision Criteria and Factors to Select an EMS from Pun and Hui (2001)

Decision Criteria	Factors
Operation costs of the company	Process costs, material costs, labour costs, overheads costs, and other associated costs.
Company image	Product and service quality, and social responsibility.
Market trend	Government policies, market pressure, customer requirements, and investors' interest.
Company performance	Operational effectiveness, sales turnover, customer satisfaction, and emergency preparedness
Environmental conservation	Waste reduction, waste reuse, waste recycle, waste treatment, and energy conservation

Source: Pun and Hui (2001), p. 4 - 6

Pun and Hui's (2001) hierarchy of decision criteria is interesting as it covers interaction of relationships between the government, industries, and the local community. However, the purpose of this current research is to understand the differences between the EMSs used by manufacturers in and outside of a Thai industrial town. Many of the criteria in Table 2.1 are not relevant in an analysis of Thai manufacturing industries because environmental management issues in Hong Kong and Thailand are different. Both the government and industries in Thailand are more concerned with economic issues than environmental issues and they have little experience of providing detailed information about environmental operations (Chantadisai, 2004). Such a difference in information has significant effects on the nature of a study of Thai manufacturing companies. This study also gives recommendations for the Thai government and large manufacturing companies in Thailand to improve the quality of industrial environmental management. The study of Pun and Hui does not show the information of the interaction between manufacturers, the government, and community. Therefore, use of their methodology

would not facilitate analysis of the linkages between industry, government departments and local community groups.

Whereas Hufhey, Tait, and Connell (2005) describe the decision criteria to select an EMS and broadly categorise them across four areas as shows in Table 2.2. The criteria are clear and easier to understand than those prescribed by Pun and Hui (2001). The details of the decision criteria to select an EMS from Hufhey, Tait, and Connell are described after Table 2.2.

Table 2.2: Decision Criteria and Factors to Select an EMS from Hufhey, Tait, and Connell (2001)

Decision Criteria	Factors
Comparative environmental and social effectiveness	Benefits and disadvantages of each system, reasons for choosing the EMS, and the driving force behind the implementation of an EMS
Business implications	The scheme best fitted with existing practices, flexibility to evolve, product quality, environmental management quality, and customer and investors' interest.
Environmental management system issues	Regulatory demands, cost factors, and competitive requirement.
Environmental sustainability and management issues	Environmental conservation, environmental protection and prevention.

Source: Hufhey, Tait, and Connell (2001), p. 3 - 6

Firstly, comparative environmental and social effectiveness is concerned with the benefits and disadvantages, the main reasons for choosing an EMS, and is the driving force behind the implementation of an EMS. Companies that are conscientious about environmental management concerns would, in the mind of the customers, promote a

reputable company image (Banerjee, 2001). Generally the community has several environmental concerns (such as air pollution, water pollution, and waste disposal problem) in conjunction with the performance of a company. Companies have to compare between the benefits and operation costs that may occur when they adopt an EMS. The operation costs are of environmental significance and need to be carefully examined (Clements, 1996; Tali, 1997). They are composed of the process cost, material cost, overheads and other costs associated with environmental audits, the initial set-up cost, maintenance and improvement of an EMS. The operation costs cover the provision of hardware and software facilities and tools for establishing the EMS in compliance with the EMS standard. They also include the costs of maintaining and continually improving the system (Chin, Chiu & Pun, 1998). In addition, there may be other factors that force a company to adopt one EMS over another system. For example, many large manufacturers in Thailand have Japanese investors, and TQM/TQEM is commonly used by Japanese investor companies as the EMS system. Therefore, it would usually be the EMS of choice for Japanese companies established in Thailand (Global Environmental Forum, 1999).

Secondly, in regard to implications for businesses, in general, each EMS is believed to have improved the efficiency of business, by providing structure and information and aiding documentation and understanding of the environmental management process. Implementation of some EMSs appear to be more difficult than others, largely due to the time and paperwork involved in making the necessary changes. Moreover, companies have to be concerned about workforce-related aspects which resist new technological change and may displace jobs or require significant retaining, and the cost of financial support during the initial set-up and continuous improvement process. The companies have to choose the scheme best suited to the company practices.

Provision of quality product, service, and commitment of social responsibilities, often are positive image-builders, and, in turn, become the mandatory elements for doing business (Clements, 1996). Thus, it is crucial for today's companies to be able to manufacture and deliver quality products cost-effectively and minimise the adverse impact on the environment. Customer and investor's interest is also one of

determinants that govern the business operation and strategy formulation of most organisations today.

Thirdly, companies that adopt environmental management systems could help improve their operational effectiveness and public relations with close relationships with the community and government. The operating efficiency can be improved by reduced environmental pollutant emissions, less waste production, and lower risks of environmental incidents (Chambre, 1997). Moreover, the government and the local community may rely on manufacturers with an EMS and can be confident that they will deal quickly with any environmental problems resulting from their manufacturing processes. Today, many customers are becoming more environmentally aware and are looking for EMS certification that gives an indication of the manufacturer's environmental commitment (Clements, 1996). Besides, compliance with government policies and regulation on environmental protection and other health and safety areas often pushes a company to adopt an EMS (Sayre, 1996).

Finally, with environmental sustainability and management issues, manufacturers could enhance their competitive position through effective environmental conservation. The need for environmental protection and prevention (e.g. waste minimization, pollution prevention, energy conservation) has become more mandatory (Denton, 1994).

There are several other factors that determine company management attitude towards environmental practice. External environmental pressures (e.g. customer demand, government policy, legislation) have led manufacturing companies to take environmental actions (Banerjee, 2001). Environmental pressures come from communities or from measures imposed by those who exert a direct influence on the mentality of managers with assigned responsibilities in the environmental field. This can arise either from fear or convenience and it influences the configuration of the strategic objectives of the company and the decision to advance environmental actions. Some external pressures are highly restrictive on manufacturing companies that carry out polluting activities (Bansal & Roth, 2000, Cordano & Frieze, 2000, Flannery & May, 2000).

Henriques and Sadorsky (1999) mention that environmental laws and regulations are the most important pressures perceived by manufacturing companies and adopted in their environmental practices. However, O'Rourke (2004) argues that command and control (legislation) type strategies are not working in some countries where the government agencies lack sufficient sanctioning power and technical capacity to enforce existing regulations. Rooij (2006) mentions that Chinese environmental legislators have problems with implementation and enforcement. The local government agencies do not share the environmental concerns of the national regulations and have stopped regular enforcement.

As the laws and regulations become stricter, a higher level of knowledge and environmental action is demanded. In the same way, community responsibility in environmental matters is a manufacturing company's responsibility towards the community and society in general.

Chin, Chiu, and Tummala (1999) examine analytical factors that have an affect on the quality of an EMS implementation, and mention that the success factors may be classified for an EMS implementation into four areas, which are: management attitude; organisational change; external and social aspects; technical aspects. Table 2.3 presents the success factors for an EMS implementation.

Table 2.3: Success Factors for an EMS Implementation

Factors	Sub-factors
Management attitude	<ul style="list-style-type: none">● Top management commitment and support● Appropriate environmental policy● Regular management reviews
Organisation change	<ul style="list-style-type: none">● Structure and responsibility● Training and awareness● Communication● Documentation and control● Emergency preparedness
External and social aspects	<ul style="list-style-type: none">● Environmental legislation● Market pressure● Employee relations
Technical aspects	<ul style="list-style-type: none">● Environmental specialist assistance● Monitoring and measuring equipment● Production process enhancement

Source: Chin, Chiu, and Tummala (1999)

However, this model is confusing and may have some overlap. For example, top management commitment and support (in Management attitude) should include the commitment to provide training programmes for company staff, to set up a communication line within the company, and to comply with the environmental legislation. Also, this model does not provide for participation of the local community.

In general, it is accepted by researchers that EMSs assist manufacturers to manage their environment and save production costs, and many EMS models work well in most industries. However, all applications of EMS are voluntary systems. Therefore, success is dependant on the company's management team to make a decision to adopt an EMS or not. The management team needs to make sure that the company is required to focus resources on implementation of an EMS.

Klassen (2000) and other researchers point out that there are some barriers in development and implementation of an EMS. For example, a new prevention technology may have an effect on the current manufacturing process optimised for product quality (e.g. from change of materials); cost (setting up cost, training cost, audit cost); resistance to change by the existing workforce; and the financial constraint which focuses on short-term profitability and limits research and development (R&D) expenditures to develop new technology (Freeman et al., 1992; Ashford, 1993; OECD, 1995; Klassen 2000). Manufacturers should consider these barriers and compare between different systems before making the decision to select an EMS. In addition, Dyckhoff (2000) also describes that an effectiveness of both internal and external communication is also an essential foundation of an EMS. Communicating relevant information about the EMS means sharing the power for implementing, maintaining, and improving an EMS. Informed and knowledgeable employees can be active participants in an EMS. Conversely, when communications are inadequate and information is missing, an EMS is weakened.

Research by Martin & Edgley (1998) identified an entire range of the EMS systems. They focused on four systems which they studied in detail as these are the most recognised and commonly used by large manufacturers world wide. They are:

- Total Quality Management (TQM) and Total Quality Environmental Management (TQEM) systems
- ISO 14001 – International Standard for Environmental Management Systems
- EMAS – Eco-Management Audit Scheme
- International Chamber of Commerce (ICC) Principles

All of these EMS systems are voluntary standards for providing guidance on the establishment and maintenance of environmental quality and monitor the implementation performance towards environmental goals. Voluntary environmental initiatives have received great attention from both the government and community because of their win-win approach to environmental protection; that is, they have been recognized as a means to simultaneously manage the environment (Porter & Van der Linde, 1995). Voluntary initiatives that vary with the degree of government

intervention across different countries, provide opportunities to transform traditional conflictual relationships between government and companies (Harrison, 1999). This has implications for the regulatory framework as discussed in Chapter Seven.

2.4.1 Total Quality Management (TQM) and Total Quality Environmental Management (TQEM)

Total Quality Management (TQM) represents an integrative approach to pursuing customer satisfaction (Chin, Pun & Hua, 2001). However, facing the intense pressure of global competition, organisations need to consider incorporating the idea of environmental management in TQM, in order to sustain their competitive advantage.

Over time, the main focus of quality gradually moved from product control to process improvement, thus shifting the emphasis from inspection to prevention. The continued commitment and involvement of top management is crucial to ensure the full integration of quality into business strategy and plans and also the adequate deployment of quality throughout the organisation (Zairi, 2002).

Nowadays, businesses have to concentrate more on environmental effects and global competition is forcing most companies to rethink their strategies towards environmental issues. Managers are compelled to experiment and implement innovative ideas in the running of their operations.

Total Quality Management (TQM) is an approach known for its wide applicability to management systems, the work environment and manufacturing processes, as manufacturers awake to the fact that good environmental practices are consistent with both short term and long-term goals of well-integrated manufacturers. TQM's principles are being integrated into their environmental management system and pollution prevention programmes (Marash, Berman & Flynn, 2003).

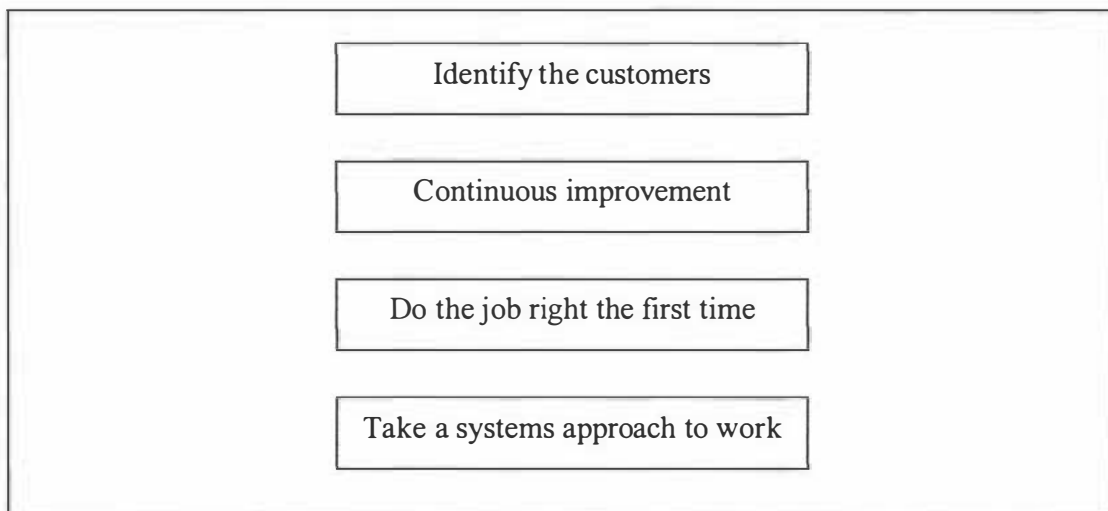
Prior to using the TQM / TQEM system organisations have to provide education about the TQM / TQEM concept and the benefits to all their employees. However, it is not easy to require all employees to be willing and able to learn TQM / TQEM, and to insist they accept this system (Shipton, Dawson, West & Patterson, 2002). Also,

organisations' top management level staff have to provide support with equipment, technology and people to achieve the organisations' targets.

The Global Environmental Management Initiative (GEMI) is the first organisation to marry environmental management and total quality management. This primer outlines methods of applying TQM to corporate environmental strategies that the GEMI's process has identified as Total Quality Environmental Management or TQEM (International Institute for Sustainable Development, 2005).

Oliver (n.d.) notes, "the main principle of TQEM is achieving effective sustainable management of natural resources by transforming it into a learning organization". A TQEM system does not happen overnight. It is advantageous to begin with small steps and build support and a record of success. However, as these steps are taken, it is necessary to bear in mind that TQEM is a programme of continuous improvement, in which the entire system works together to meet a company's requirements and anticipate their future needs. The implementation of TQEM consists of four basic elements (Natural Logic, n.d.) as shown in Figure 2.1.

Figure 2.1: The Basic Elements of TQEM



Source: Natural Logic (n.d.)

Identify the Customers: TQM / TQEM is based upon measuring customer satisfaction. Quality is defined by what the customer wants. Customers here can be

both internal (i.e. employees in the same or other departments within the company at all level of positions) and external (i.e. consumers, legislators and the community).

Continuous Improvement: Employees are motivated to seek innovative ways to continuously improve their jobs. TQM / TQEM is a system to improve business processes, with no endpoint. The P-D-C-A cycle is one of the systematic tools used in continuous improvement process, that is based on understanding a situation before changing any processes (Dale, 2003). The four factors that make up the P-D-C-A cycle are:

- *Step One: Plan* - The organisation identifies customers and the customers' requirements and then creates an improvement plan to meet the customers' requirements
- *Step Two: Do* - Follow the plan in step one. If some things have to be changed, then go back to step one and plan again
- *Step Three: Check* - Observe and measure the effects of the plan. May use statistical tools to measure the results
- *Step Four: Act* - Make changes in the process to reflect what the organisations has learned and translate the learning into a systemic improvement. Continue to repeat the P-D-C-A cycle.

Do the Job Right the First Time: In the TQM / TQEM system, manufacturers need to recognise and eliminate environmental problems before their products are produced. Prevention is better and has a lower cost than solving environmental problems. Customers and the community do not like manufacturers that produce pollution.

Take a systems approach to work: TQM / TQEM system monitors each part of the environmental management system. This system must include all the manufacturers' equipment and the employees who work for the company. in order to achieve the desired objectives and targets (International Institute for Sustainable Development, 2005).

Aboulnaga (1998) notes that implementation of TQM/TQEM as a production monitoring system, places strong emphasis on the stages of the production process. However, companies are not required to undertake an external audit of their production processes. Therefore, it is more flexible than, for example, the ISO system. Many of the large manufacturing companies in Thailand which attract investment from Japanese investor companies use a TQM/TQEM system as their EMS because of the strong preference for total quality management as an EMS in Japanese companies (Industrial Estate Authority of Thailand, 1998).

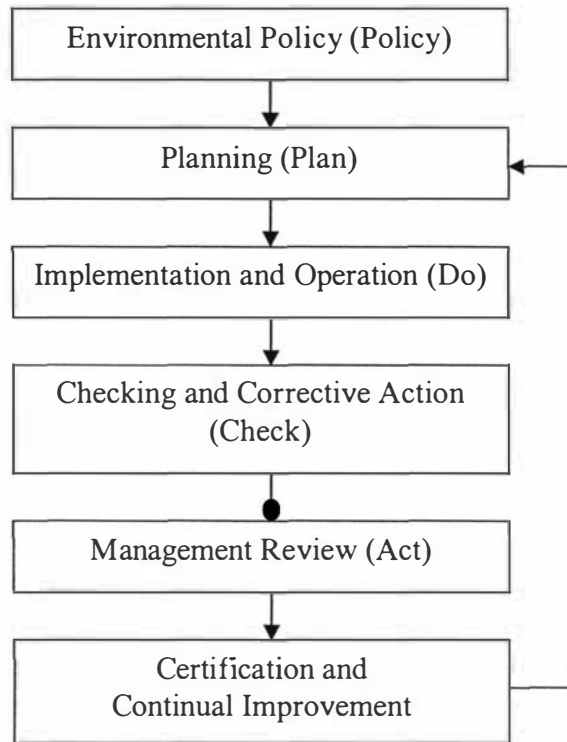
2.4.2 ISO 14001

In the realm of environmental management, ISO 14001 is a voluntary EMS system that manufacturers may adopt and subsequently implement as part of environmental policy programmes. ISO 14001 is an EMS by which manufacturers can evaluate and improve their environmental practices (Welford, 1996; Delmas, 2002). It allows manufacturers to deal with pollution in an effective manner, improving environmental performance (i.e. by recycle materials, reusing part of a product, and efficiently use of packing materials) (Porter & Van der Linde, 1995; Darnell, Gallager, Andrew & Amaral, 2000). ISO 14001 adoption helps manufacturers to voluntarily reduce pollution and can improve a corporate's 'green image'. Manufacturers may use this green image not only in response to the market pressure from green consumers, but also to generate a comparative differential advantage by which manufacturers may enjoy price premiums in selling their products (Russo & Fouts, 1997; Rivera, 2002). However, Quazi (1999) argues that there are several barriers of implementation of an ISO 14001. These include, complexity of ISO 14001 standards, inappropriate approach to implementation, lack of management commitment, lack of total employee involvement, cost of implementation, unclear responsibilities of employees, and more time and money spent on the documentation system.

The ISO 14000 standards describe the basic elements of an effective environmental management system, routinely referred to by the acronym EMS (Piper, Ryding & Henrison, 2003). An effective environmental management system can help an organisation manage, evaluate and improve the environmental aspects of its operations. It can lead to a more efficient compliance with mandatory and voluntary

environmental requirements. Also, it can help the organisation effect a culture change as environmental management practices are incorporated into its overall business operations (Ken, 2004).

Figure 2.2: The Basic Elements of ISO 14001



Source: Adapted from Piper, Ryding & Henricson, 2003

The European Commission Environment Directorate-General (2001) notes that the key elements of an ISO 14001 are:

1. *Environmental Policy* – this is the environmental policy and includes the requirements to pursue environmental management policy via objectives, targets, and environmental programs;
2. *Planning* – the analysis of the organization’s environmental aspects. All significant environmental impacts of products services, or activities along with legal and other standards, must be identified;

3. *Implementation and Operation* – the implementation and organisation of processes to control and improve operational activities that are critical from an environmental perspective;
4. *Checking and Corrective Action* – the system verification and recording activities, including the monitoring, measurement and recording of characteristics and activities that can have a significant impact on the environment;
5. *Management Review* – review of the EMS by the organisation's top management to ensure its continuing suitability, adequacy and effectiveness;
6. *Continual Improvement* – the ongoing efforts to improve the EMS.

Levy & Newell (2005) suggest that ISO 14000 guidance is useful for organisations that want to initiate or improve their existing environmental management systems. Use of ISO 14001 is intended for registration bodies and for third party certification. The third party auditor certification involves an evaluation by the certificate body, with the supplier agreeing to maintain its environmental management system for the community.

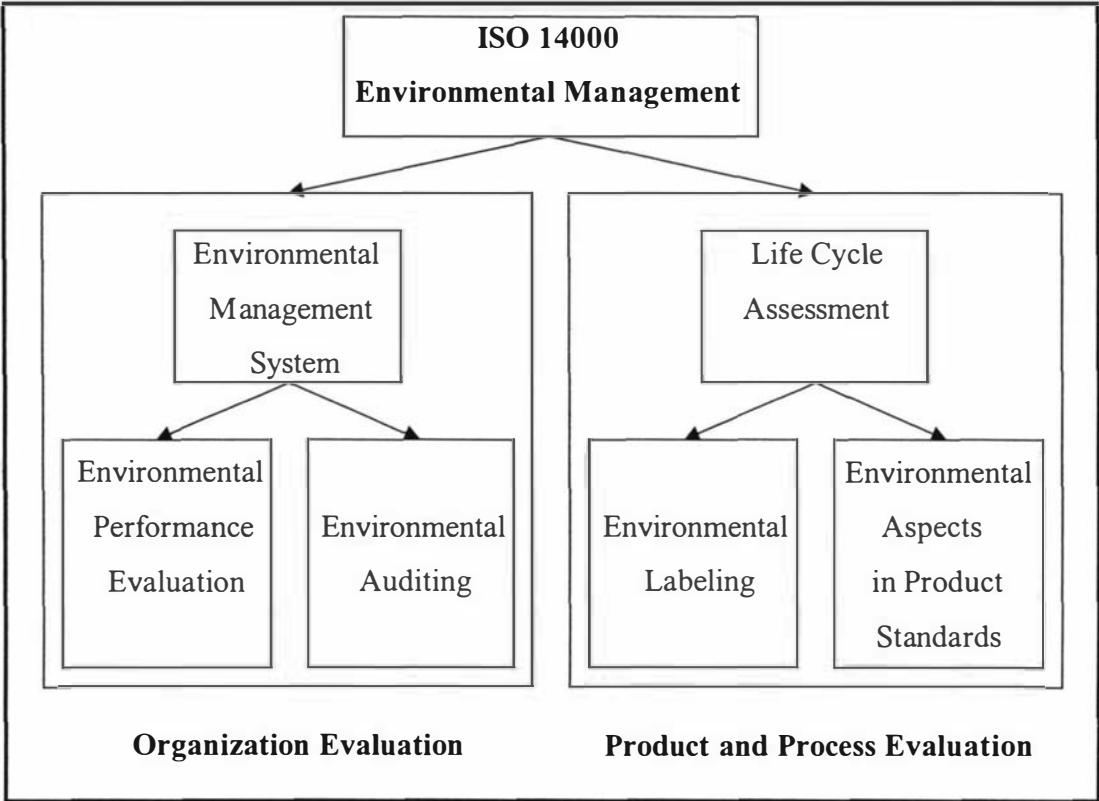
The environmental management of ISO 14001 encompasses standards in seven major areas (Hartman, 2001):

- Environmental management systems (EMS).
- Environmental auditing (EA).
- Environmental performance evaluation (EPE).
- Environmental labelling.
- Life cycle assessment (LCA).
- Environmental aspects in product standards (EAPS).
- Terms and definitions.

These seven areas fall into two general groups, as shown in Figure 2.2. The first group, organisation evaluation, includes EMS, EA and EPE. The EMS standards provide the basic framework for the management system. Environmental auditing (EA) and environmental performance evaluation (EPE) are tools, that play a critical

supporting role in the successful implementation of the environmental management system. The second group, product and process evaluation, includes LCA, EAPS and environmental labelling. These groups play an important role in evaluation and analysis of product and process characteristics (Piper, Ryding & Henricson, 2003). Figure 2.3 shows the ISO 14000 series of environmental management standards.

Figure 2.3: The ISO 14000 Series of Environmental Management Standards



Source: Hartman, 2001

Today, many companies consider the environment in designing production processes to improve their company’s image, within the business environment in which they carry out their activities. If this is undertaken with real support from management, it may become a good distinguishing factor, that provides considerable business advantage in the market place. Implementation and certification of an environmental management system is a means to achieve these objectives (Afuah, 2003). ISO 14001 is one of the most universally recognised environmental management systems (Olson, 1999; Marash, Hartman, 2001; Berman & Flynn, 2003).

Other factors, which influence manufacturing companies choice of ISO 14001 certification, are the benefits of exploiting market requirements derived from the influence of “green” consumers. These may offer a company opportunities to compete in new market niches (Klassen & Angell, 1998). Moreover, environmental management system, ISO 14001, can enable companies to improve the efficiency of their production. For example, by using productive processes, companies may consume less material resources or energy, or they may recycle or reuse generated wastes. Also, clean practices can involve saving in legal actions, sanctions, the cost of cleaning and retaining a good company image by demonstrating civil responsibility (Dooley & Fryxell, 1999).

The ISO 14001 standard is an environmental management system that can help manufacturers improve an external image, gain better access to new market niches and even show an increase in their efficiency. ISO 14001 certification is really a first step, although not always necessary, in relation to Total Quality Environmental Management (TQEM) (Marash, Berman & Flynn, 2003).

In general, ISO 14001 and EMAS are very similar, because the developers of ISO 14001 used EMAS as a starting point for the development of the ISO 14001 standard. EMAS is generally perceived as more demanding and performance focused, but industry is increasingly appreciating the flexibility and clarity of ISO 14000. Both ISO 14001 and EMAS are standards that certify organisations. Currently, many government authorities, companies, and organisations are using ISO 14001 as a guideline (Olson, 1999).

2.4.3 EMAS – The EU Eco-Management and Audit Scheme

In Europe, The EU Eco-Management and Audit Scheme (EMAS) has set standards for several years because of its wide acceptance and the fact that in Europe certification to the standard has been required across industries. World wide, the need for environmental certification is market driven. In some industries, an environmental certification is more important than in others (Piper, Ryding & Henricson, 2003). ISO 14001 and EMAS are very similar but they still have some basic differences. ISO 14001 has gained wide acceptance, in part because it is less prescriptive than EMAS.

Many organisations are using it as the tool to achieve their environmental and business goals, rather than a goal in itself (Osterloh, 2005).

The EMAS is a management tool for European companies and other organisations to evaluate, report and improve their environmental performance. The EMAS has been available for participation by companies since 1995 and was originally restricted to companies in industrial sectors (Olson, 1999).

Since 2001, EMAS was revised to integrate ISO/EN ISO 14001 (International/European Standard for Environmental Management System) as its EMS component and the scheme has been open to all economic sectors, including public and private services (European Commission Environment Directorate-General, 2001).

The aims of EMAS not only favor and diffuse positive and proactive actions in the industrial system, but they also stimulate external communication and a transparent relationship between the company and its stakeholders. EMAS requires systematic interaction between the production site, the government authorities and the community living near the industrial location (Barrow, 2005).

In terms of EMS, all of these groups are interrelated and impact on the other factors. It is the government's main responsibility to provide both manufacturing industries' staff and community members with sufficient information relating to environmental legislation, education about natural resources and environmental management, and develop environmental legislation. Manufacturing industries' staff at both top management and management level have responsibilities to comply with environmental legislation, and produce good production and environmental management processes to improve environmental quality in their companies. Finally, community members have an important responsibility to help the government to monitor manufacturing industries' activities that may discharge pollutants to community and report back to the government. Both manufacturing industries and the community should also participate with the government in preparation of environmental standards and legislation (European Commission Environment Directorate-General, 2001).

The EU objective is to promote collaboration between companies, institutions and the public, with the aim of improving environmental quality. Participation is voluntary and extends to public or private organisations operating in the European Union and the European Economic Area (EEA), Iceland, Liechtenstein and Norway. An increasing number of candidate countries are also implementing the scheme in preparation for their accession to the EU. A company that wants to participate in the EMAS must organise an environmental system oriented towards continuous improvement. This system includes a sequence of several management steps: initial review, policy, programmes, activity implementation, audit and statement. Company commitment must be documented and validated by an external verifier. Initiatives, objectives and methods of action are left to the company (Hillary, 2000).

Environmental concerns, growing public pressure and regulatory measures are changing the way of doing business around the world. Both customers and companies are increasingly demanding environmentally-friendly products and services that are delivered by socially responsible companies. It is becoming increasingly important for organisations to demonstrate that not only their philosophies but also their investment strategies and day-to-day operations are sustainable.

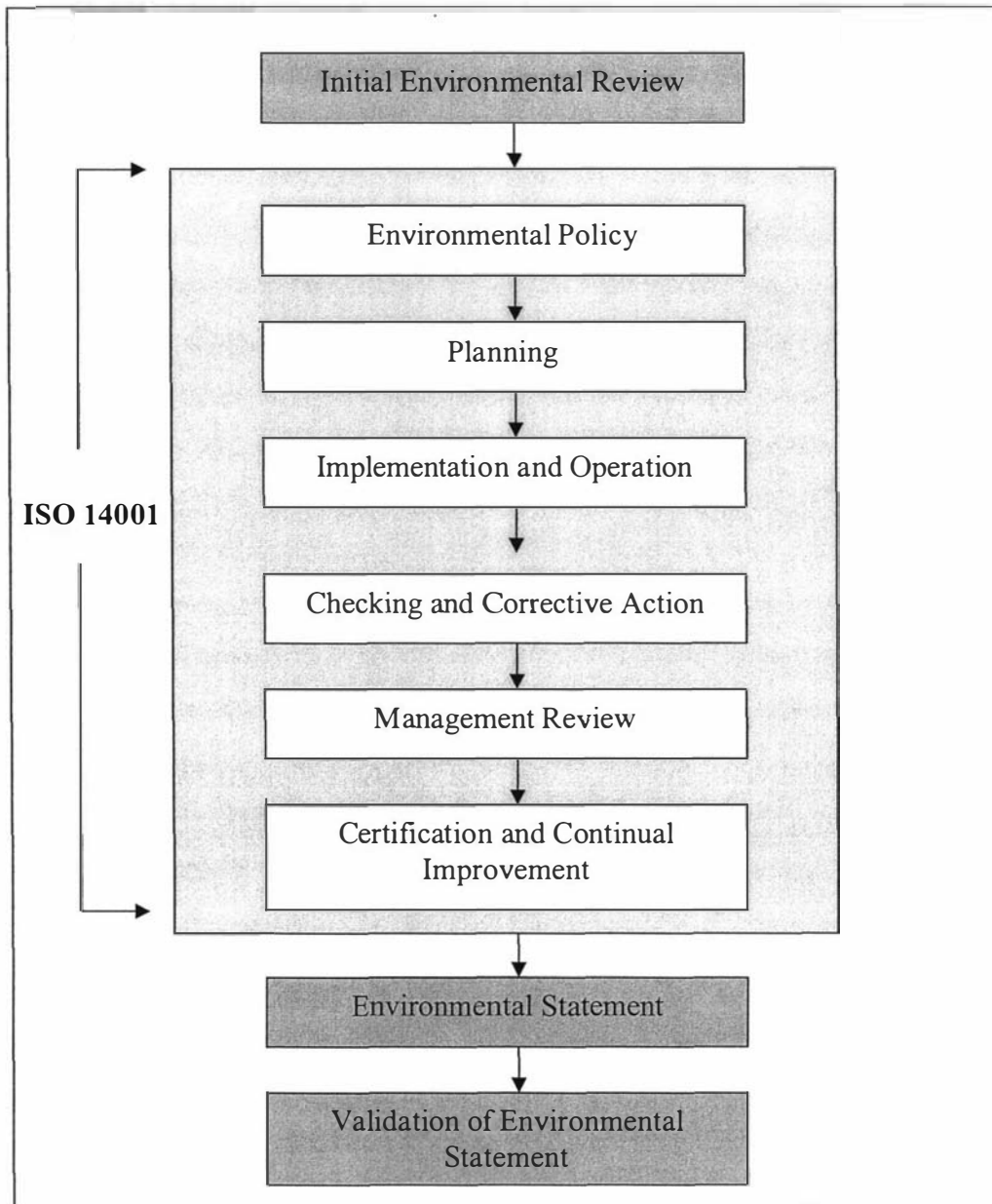
Barrow (1999) mentions that implementation of the EMAS scheme may offer some or all of the following benefits:

- *Quality environmental management, due to the use of a highly developed scheme*
- *Contribution to the environmental risk management of the organisation*
- *Resource savings and lower costs, according to the organisation's needs*
- *Reduction of financial burdens, due to reactive management strategies such as cleanups and paying penalties for breaches of legislation*
- *Financial benefits through better control of operations*

- *Incentives to eco-innovate production processes whilst the environmental impact is rising world wide*
- *Compliance check with environmental legislation by EMAS verifier*
- *Learning from the good examples of other companies and organisations*
- *New business opportunities in markets where green production processes are important*
- *Added credibility and confidence with government authorities and other businesses and customers*
- *Improved relations with the local community*
- *Improved quality of workplaces, employee morale and incentives for team building*
- *Marketplace advantage and improved company image by improving stakeholder relations (p. 31-36).*

The core of the EMAS scheme is the “continuous improvement circle” or “P-D-C-A circle” as TQM system (International Network for Environmental Management, 2004). Osterloh (2005) describes ISO 14001 and EMAS as not being “different versions of the same thing”, but rather different in a number of ways. The two schemes are complementary but EMAS places more emphasis on formulating review objectives and evaluating the effectiveness of environmental statement (European Commission Environment Directorate-General, 2001). The elements of the EMAS circle are presented in Figure 2.4.

Figure 2.4: The EMAS Elements of Environmental Management System



Source: European Commission Environment Directorate-General, 2001, p. 3

The European Commission Environment Directorate-General (2001) explains that the EMAS involves eight action steps as follows:

1. *Environmental Review:* Review the site that the company wishes to register in order to identify all its environmental aspects and judge their significance. Compare this to company stated policy and to environmental regulations and identify what needs to be improved.

2. *Environmental Policy*: Before working towards any improvement of the company's impact on the environment, formalise the nature of the overall approach and produce an environmental policy for the company.
3. *Planning*: The EMAS scheme has requirements on environmental aspects that may need to be addressed within the EMS.
4. *Implementation and Operation*: The requirement of EMAS is the active participation of all employees, suppliers and contractors in the environmental improvement programme.
5. *Checking and Corrective Action*: It is necessary for the company to check that the audit cycle is compliant with EMAS regulations but this must not take longer than three years. The programme's progress must be audited at regular intervals. Some activities, such as the treatment of effluents and hazardous waste, should be audited more often than others. These audits must be objective, systematic and fully documented.
6. *Management Review*: The top management level of the company has to review the company's environmental management system to ensure adequacy and effectiveness.
7. *Continual Improvement*: The company must keep improving the EMS.
8. *Environmental Statement*: EMAS requires all participating companies to issue a public statement linked to the audit, outlining in clear and concise language exactly how they have met their stated objectives. Summary data on the environmental impact needs to be in this statement.
9. *Validation*: Prior to publication, an accredited verifier, who is independent of the site's auditor, must validate the environmental statement (P. 1-2).

With the basic elements of EMAS, this system has more requirements to comply with than ISO 14001. Therefore, ISO 14001 is more widely adopted than EMAS. Many countries also have their own individual national environmental systems and standards. Examples include the American National Standards Institute (ANSI), the Commission for Environmental Cooperation (CEC) and the Environmental Management Secretariat for Latin America and the Caribbean (LAC) (Olson, 1999, p. 334 – 337). Thailand also has a national environmental management system body standard, the Thai Industrial Standards Institute (TISI) – Environmental Management Standards.

2.4.4 International Chamber of Commerce (ICC) Principles

The International Chamber of Commerce (ICC) publishes the 16 ICC Principles of Environmental Management (International Chamber of Commerce, n.d.). These principles are designed to provide a method of guiding an organisation to achieve and sustain performance, in accordance with established goals and in response to constantly changing regulations, environmental risks and financial, economic and competitive pressures.

ICC provides a list of principles which are designed to assist a business to improve its environmental performance. It comprises of 16 ICC principles for environmental management to address the Agenda 21 targets for industry and commerce outlined in Figure 2.5. These may be also be related back to the general P-D-C-A cycle later in this Chapter. The ICC principles are mostly adhered to by the EU countries and although the system is not as widely used, as for example ISO 14001, it is of interest in this research as some Thai companies have links with European organisations.

Figure 2.5: The ICC Principles for Environmental Management

- **Corporate Priority** – to recognize environmental management as among the highest corporate priorities and as a key determinant to sustainable development; to establish policies, programmes and practices for conducting operations in an environmentally sound manner.
- **Integrated Management** – to integrate policies, programmes and practices fully into each business as an essential element of management in all its functions.
- **Process of Improvement** – to continue to improve policies, programmes and environmental performance, taking into account technical developments, scientific understanding, and customer needs.
- **Employee Education** – to educate, and train employees to conduct their activities in an environmentally responsible manner.
- **Prior Assessment** – to assess environmental impacts before starting a new activity or project and before decommissioning a facility.

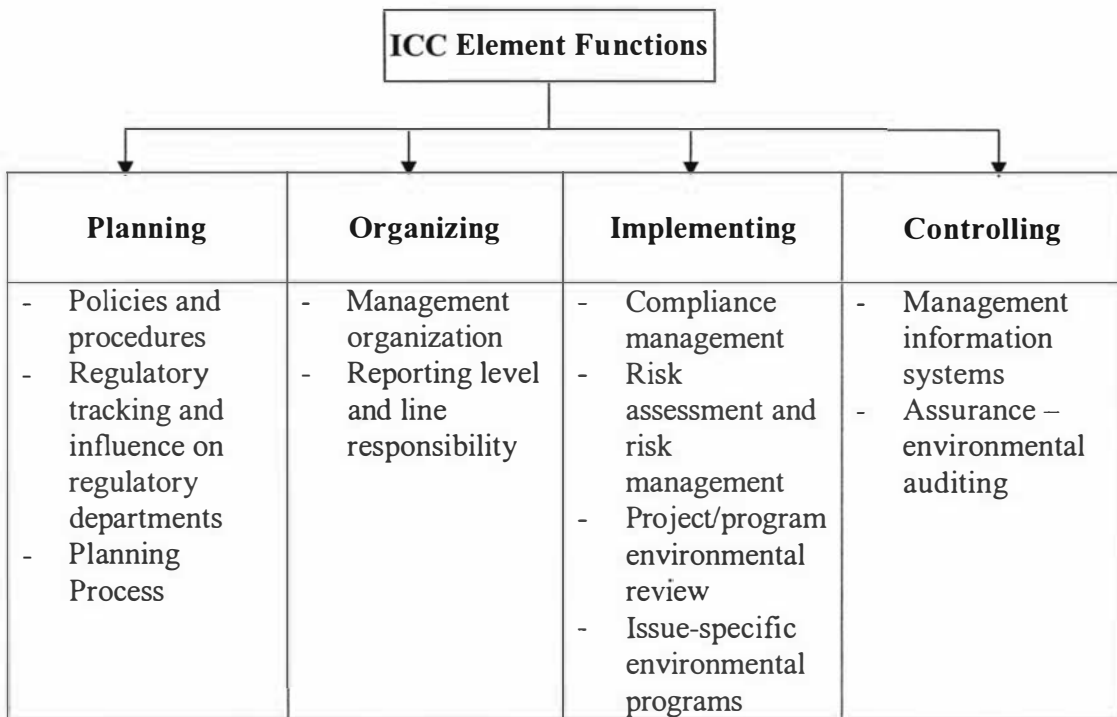
- **Products and Services** – to develop and provide products or services that have no undue environmental impact and which are safe in their intended use, are efficient in their consumption of natural resources, and can be recycled, reused, or disposed of safely.
- **Customer Advice** – to advise, and where relevant, educate customers, distributors and the public in the products' safe use, and to apply similar considerations to provision of services.
- **Facilities and Operations** – to develop and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, and the safe and responsible disposal of residual wastes.
- **Research** – to conduct or support research on the environmental impacts of raw materials, products, processes, emissions and waste associated with the enterprise.
- **Precautionary Approach** – to modify the manufacture, marketing or use of products and services, or the conduct of activities, all consistent with scientific and technical understanding, to prevent environmental degradation.
- **Contractors and Suppliers** – to promote the adoption of these principles by contractors acting on behalf of the enterprise, and where appropriate, to encourage the wider adoption of these principles by suppliers.
- **Emergency Preparedness** – to develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with emergency services, government, and the local community.
- **Transfer of Technology** – to contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.
- **Contributing to the Common Effort** – to contribute to the development of public policy and to business, governmental programmes and educational initiatives that will enhance environmental awareness and protection.

- **Openness to Concerns** – to foster openness and dialogue with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations, production, wastes or services, including those of transboundary or global significance.
- **Compliance and Reporting** – to measure environmental performance; to conduct regular environmental audits, and assessments of compliance with both company and legal requirements (p.1-2).

Source: International Chamber of Commerce, n.d.

The ICC system consists of four functions: planning, organising, implementing and controlling (International Chamber of Commerce, 1991). These four functions look similar to the P-D-C-A cycle (Plan-Do-Check-Act). Figure 2.6 presents the ICC elements of the environmental management system.

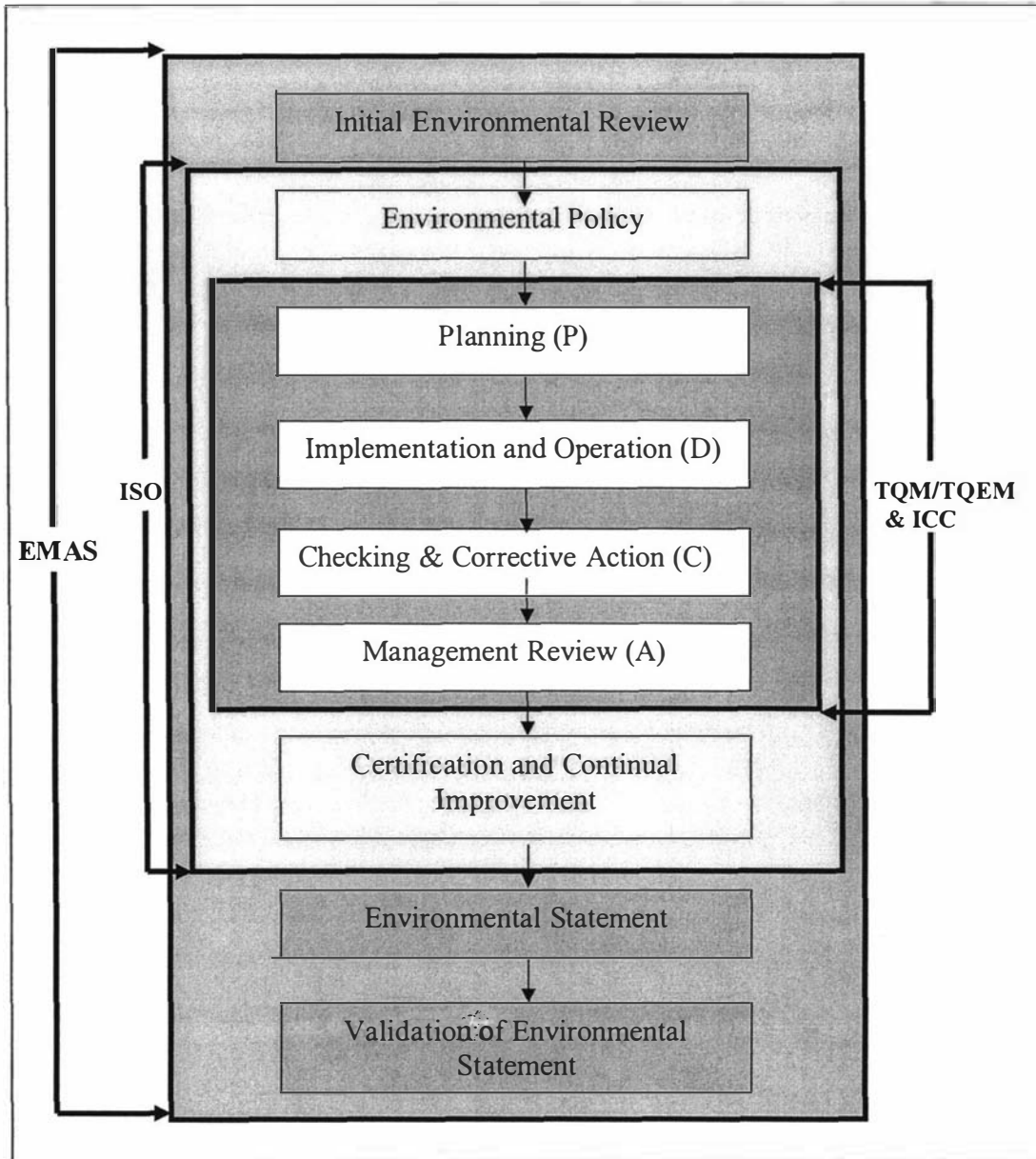
Figure 2.6: The ICC Elements of Environmental Management System



Source: International Chamber of Commerce, 1991, p. 7

In general, all of these four EMS systems (TQM/TQEM, ISO 14001, EMAS, ICC) are similar, because they use a base type of P-D-C-A cycle as their basic elements. They all require participating companies to provide education and training about EMS for company staff; and they all provide for “continuous improvement process”. However, there are some differences between the systems. ISO 14001 requires an external audit of company compliance. EMAS requires manufacturers to have interaction with the government and community in generating and monitoring standards; and TQM/TQEM requires participating companies to meet “customer satisfaction” (Sarkis, 2001). Figure 2.7 is a summary of the basic element of the TQM/TQEM, ISO, EMAS, and ICC systems. Figure 2.7 demonstrates the different levels of commitment to the bases elements of full EMS. For example, TQM/TQEM requires the least commitments to environmental elements and EMAS would be the best system from an environmental perspective.

Figure 2.7: Summary the TQM/TQEM; ISO; EMAS; ICC Elements of EMS



Source: Adapted from Dale, 2003; Piper, Ryding & Henricson, 2003; European Commission Environment Directorate-General, 2001; and International Chamber of Commerce, 1991

CLASSIFICATION OF INDUSTRIES

The literature also demonstrates that the size of industry influences the types of EMS used (Amata Nakom Industrial Town, 2001). Therefore, in this study, classification of industry is an important consideration. Industries may be classified using many methods. There are generally three major methods of classifying industries: (1)

classification of industries, based on size of industry; (2) classification of industries, based on activities from the International Standard Industrial Classification (ISIC); and (3) classification of industries, based on technology (Organisation for Economic Co-operation and Development (OECD), 1999; United Nations Industrial Development Organisation (UNIDO), 2002).

In classification of industries based on size of industry, many countries break down industries by size, based on statistics received from different countries. In most countries, the breakdown by size divisions, for manufacturing industries, is very uneven. It also varies from country to country.

In particular, a country may use a classification by number of employees or capital. A classification by number of employees is divided into three industry groups: (1) small and micro enterprises (1 to 99 employees); (2) medium size enterprises (100 to 499 employees); and (3) large size (500 employees or above) (Organization for Economic Co-operation and Development (OECD), 1999). The Thailand Government classifies industries by capital into three divisions: (1) small size enterprises (less than 1 million Thai Baht); (2) medium size enterprises (1 million to 199 million Thai Baht); and (3) large size enterprises (200 million or over Thai Baht) (Amata Nakorn Industrial Town, 1999).

Classification of industries based on activities, the original version of the International Standard Industrial Classification of All Economic Activities (ISIC), was adopted in 1948. All ISIC member governments make use of the International Standard Industrial Classification of Economic Activities, either by adopting this system of classification as a national standard, or rearranging their statistical data in accordance with this system, for purposes of international comparability (Damay, 1995).

Wide use has been made of ISIC, both nationally and internationally, in classifying data, according to the type of economic activity in the fields of population, production, employment, national income and other economic statistics. Several countries have utilised the ISIC as the basis for devising their industrial classification scheme. Substantial comparability has been attained between the industrial classifications of many other countries and the ISIC by ensuring, as far as practicable,

that the categories, with detailed levels of classification in national schemes, fit into only one category of the ISIC. An increasing number of countries have arranged their statistical series according to the ISIC. The United Nations, the International Labour Organisation, the Food and Agriculture Organization, the United Nations Educational, Scientific and Cultural Organization and other international bodies have utilised the ISIC for publishing and analysing statistical data (United Nations Industrial Development Organisation (UNIDO), 2002).

In 1958, the first revision of the ISIC was issued in the publication, *Statistical Papers, Series M, No. 4, Rev.1*. The second revision was issued in 1968 as, *Statistical Papers, Series M, No. 4, Rev.2*. The present publication sets out the third revision of the International Standard Industrial Classification of All Economic Activities. It was considered and approved by the Statistical Commission at its twenty-fifth session in February 1989. The third revision classifies industries into 61 groups (Damay, 1995).

Using classification of industries based on technology, it is commonly argued that technological change and in particular innovation is a major engine of long-run economic growth. This means that a nation's economic prosperity depends in large part on its capacity for innovation, for which technological innovation is a key driver in advanced countries. Technology is a key factor in enhancing growth and competitiveness in business.

Recently, a technology classification, using the second revision of the ISIC based industries, has been widely used. The methodology adopted is based on the evaluation of industry ranked by three indicators of technology intensity reflecting, to different degrees, the "technology producer" and "technology user" aspects: (1) R&D expenditures divided by value added; (2) R&D expenditures divided by producer; and (3) R&D expenditures, plus technology embodied in intermediate and investment goods divided by production (Organisation for Economic Co-operation and Development (OECD), 2001). The classification of industries, based on technology, divides manufacturing industries into four major levels: (1) high technology; (2) medium-high technology; (3) medium-low technology; and (4) low technology (Organisation for Economic Co-operation and Development (OECD), 1999).

Many researchers mention that large manufacturing companies have been able to appropriate the concept of environmental management, in many cases small and medium enterprises (SMEs) interaction with the environment differs from large companies. SMEs have less environmental data, less environmental expertise, and fewer resources (Bruijn and Hofman, 2000; Suh, Lee, and Ha, 2005). This study aims to assess the quality of EMSs that are used by large manufacturing companies in and outside of industrial towns in Chonburi Province, Thailand. There are only a few medium size companies and no small companies in industrial towns in Thailand, so I have had to choose between large and medium companies. Accordingly, this research focuses only on large manufacturing companies, because if the large companies have a poor EMS, they may have more effect on environment than the medium size companies.

2.5 CONCLUSION

This chapter has examined the definition and concept of both environmental management (EM) and environmental management system (EMS) and looked at the four main EMS systems, namely TQM / TQEM, ISO 14001, the Eco-Management and Audit Scheme (EMAS), and the International Chamber of Commerce (ICC), which are most commonly found and used throughout the world, which have influenced the interpretation and assessment of quality of EMS.

By reviewing the literature on EMS, the four broad EMS systems (TQM/TQEM, ISO 14001, EMAS, ICC) are similar, because they all use a type of P-D-C-A cycle as their basic elements. They all require participating companies to provide education and training programmes about EMS for company staff; and they all provide for a 'continuous improvement process'. However, there may be some differences. For example, ISO 14001 requires an external audit of company compliance; EMAS requires manufacturers to have interaction with the government and community in generating and monitoring standards; and TQM/TQEM requires participating companies to meet 'customer satisfaction'.

In Thailand, some systems are used by industry and these include ISO 14001, TQM / TQEM and the national environmental management system of Thailand. The national environmental laws and regulations of Thailand also strongly influence the industry environment management systems and they have formed the interpretation and assessment of the quality of EMS in this study. As stated by Hillary (2000), implementation of an EMS consists of a four major phases: performance for the environmental programme; plan for transformation implementation; standards and processes; and continuous improvement process. These four major phases of an EMS are used to develop a questionnaire survey of this study. A brief of each phase is provided below.

Firstly, the performance agreement for the environmental programme, relates to how the company prepares a performance agreement within the environmental programme. The questionnaire asks the respondents about the characteristics of customers in term of EM and the commitment of the management team. Secondly the plan for transformation implementation reflected questions to respondents about employee requirements to do individual jobs, the record of customer feedback, and the decision-making tools that management teams use in making decision about EM. The next phase about setting standards and processes relates to the nature of the production process and quality standards. The questions here deal with the EMS audit, any emergency plans, and the potential result of equipment breakdowns. The last phase is concerned with the continuous improvement. The questionnaire asks about companies' budgets for training about EM, use of environmental records to implement changes in the manufacturing process, and the preventative actions that companies use to avoid environmental incidents. The literature review also informs the debate about who should be interviewed in relation to measuring the degree to which companies have generally tried to implement an EMS (see Chapter Four).

This study aims to assess the quality of EMSs that are used by large manufacturing companies in and outside of industrial towns in Chonburi Province, Thailand. There are only a few medium size companies and no small companies in industrial towns in Thailand, so I have had to choose between large and medium companies. Accordingly, this research focuses only on large manufacturing companies, because if the large companies have a poor EMS, they may have more effect on the environment

than the medium size companies. This research used the basic elements of ISO 14001 and TQEM, from the Global Environment Management Initiative, to develop the questionnaire for this study; and used the decision criteria to select an EMS from Hufhey, Tait, and Connell (2001) to evaluate the quality of EMSs that are used by sample large manufacturers in and outside of the industrial town. Since government regulations are a major influence on the nature of the EMSs applied by industry, the Thai government environment system is discussed in Chapter Three.

CHAPTER 3: BACKGROUND OF THAILAND'S GENERAL ENVIRONMENTAL APPROACHES AND LEGISLATION

3.1 INTRODUCTION

This chapter provides a discussion of the context for environmental management and legislation in Thailand. The objectives of this chapter are to briefly review the evolution of Thailand's approaches to sustainable environmental management and to examine the government structures and environmental legislation which directly affects the type of environmental regulation faced by large manufacturing industries in Thailand.

As well as providing an overview of the institutional context governing the environmental management approaches established by industries, a brief account of Thailand's international cooperation on environmental management is provided. In addition, information is provided about Thailand's performance in the "ASEAN Environment Year" program of 2003, the theme of which was "Together Towards Sustainable Development" (Association of Southeast Asian Nations (ASEAN), n.d.).

3.2 OVERVIEW OF THAILAND'S ENVIRONMENTAL MANAGEMENT SYSTEMS

Until three decades ago, the Thai people have enjoyed their life with beautiful green rice fields, forest, slowly running streams, and rivers. However, when western culture and high technology came to Thailand, many rice fields were changed into industrial towns. Toxic fumes from industries and vehicles now overwhelm the environment of all big cities (Phongpaichit & Baker, 2004).

Thailand was the first among the Southeast Asia nations to promote an industrialisation policy. Thailand's structural changes, moving from an agriculture

economy to industrialisation since the latter half of the 1980s, include acknowledgement of the cost of various environmental pollution problems. For example, there are continuing decreases in forest land and agricultural areas. Conversion of land to industrial use areas also continues. The result of these activities has been increases in temperature, lower rainfall and lower flows in rivers. Most importantly, there are fewer trees to absorb the carbon dioxide produced by industry (Phongpaichit & Baker, 2004).

Also, poorly treated industrial discharges are polluting air, water, and soil. The Global Environmental Forum (1999) believes that the most critical environmental problems facing Thailand at present relate to management of water and air pollution. These problems are similar to those faced in many Southeast Asian countries, such as Malaysia, Indonesia, and Vietnam. These pollution problems are the result of transferring old production technologies and the hazardous waste of developed countries (e.g. Japan, the United States) to developing countries which lack environmental pollution experience. However, since the Thai government has been committed, with international agency partners, to give priority to pollution prevention control, natural resources management and other programmes for enhancement and conservation to increase the environmental quality. The government has received funding grants and technical advisory help from the UN, the World Bank and other organisations. As a result of these commitments, the World Bank (2002) environmental report indicates that air and water quality have actually improved significantly in the past decade in Thailand and Malaysia. However, the World Bank (2002) report shows that environmental quality in Vietnam and Indonesia has not improved (Energy Information Administration, 2003). In Thailand, environmental contamination caused by the discharge of hazardous waste threatens to become the country's worst environmental problem in the future (Pollution Control Department: 8, n.d.).

Since the King of Thailand addressed environmental issues in 1990, the government has started to emphasize the protection and control of natural resources and environmental management, in policy and spending decisions. The Enhancement and Conservation of National Environment Quality Act (National Environment Quality Act, 1992) was gazetted to engender reform of natural resource managements and

environmental conservation. The Act initiated processes to ensure that environmental management and decision-making is effective and transparent, and that monitoring ensured accountability for poor environmental practice. The National Environment Quality Act has also enhanced public participation and decentralized environmental management authority to local authorities wherever possible. In another important initiative, the government signed up to an international commitment to establish sustainable development at the 'Earth Summit' at Rio in 1992, a commitment which requires Thailand to meet targets contained within Agenda 21. At the same time, it was recognised that indicators should be developed to be an appropriate tool for evaluation of sustainable development, and to measure the progress towards Agenda 21 goals and targets (Global Environmental Forum, 1999; Chantadisai, 2004).

After the public sector reform in 2002, the MONRE was established under the National Environment Quality Act, 1992. Several resources-oriented departments were then established. The systematic monitoring and evaluation of environmental outcomes is conducted in the Office of Natural Resources and Environment Policy and Planning (ONEP) and is coordinated with general national monitoring and evaluation of government policy performance. However, Chantadisai (2004) argues that there are still some overlapping responsibilities concerned with environmental protection under the MOI and MOPH. For example, the MOI still has responsibility to monitor manufacturers' activities, including environmental management performance. The MOPH has a responsibility to protect human health that may become affected by the pollution problems.

Thailand's economic crisis in 1997 – 1998 (Ministry of Foreign Affairs, 2002) also affected Thailand's environmental performance. During the economic crisis, many industries including large manufacturing plants were closed. The crisis forced many manufacturing companies to downsize operations and cut down on environment sustaining investments (Piboolsravut, 2004). The researcher tried to search environmental indicators data before the economic crisis; however, the information is not available. Table 3.1 presents core environmental indicators of Thailand which measure the adverse effects of this transformation on people and environment.

Table 3.1: Core Environmental Indicators of Thailand

ENVIRONMENTAL INDICATORS	1998	1999	2000	2001	2002
1. LAND AND LAND USE					
A. Total land (Sq. km.)	513,115	513,115	513,115	513,115	513,115
- Forest land (%)	25.3	25.3	25.3	33.5	NA
- Area of agricultural holding	34.8	34.6	34.1	NA	NA
- Others (%)	39.9	NA	NA	NA	NA
2. FOREST					
A. Forest land (Sq.km.)	129,722	129,722	129,722	172,050	NA
B. Percentage of protected area per total land	15.8	16.9	17.8	17.6	NA
C. Proportion of wood product per domestic wood-apparent (%)	4.7	3.4	3.1	2.9	NA
3. WATER					
A. Percentage of effective storage capacity per active storage	61.7	31.5	73.4	81.2	84.9
B. Percentage of raw water use to pipe of water per total					
- From surface water	79.7	79.7	NA	NA	NA
- From subsurface water	7.0	6.5	NA	NA	NA
C. Average pipe water consumption (Cu.m./case/month)					
- Bangkok (Cu.m./case/month)	55.4	51.6	52.2	53.9	NA
- Other provinces (Cu.m./case/month)	23.8	21.8	21.8	22.6	NA
4. HAZARDOUS WASTE AND WASTE					
A. Total waste (1,000 tons)	13,594.8	13,825.8	13,932.1	NA	NA
- In Bangkok (%)	22.8	23.7	23.9	NA	NA
- Municipality and Pattaya (%)	32.7	32.6	30.9	NA	NA
- Non-municipality (%)	44.5	43.7	45.2	NA	NA
B. Total hazardous waste (1,000 tons)	1,637	1,600	1,650	1,650	NA
- Industrial hazardous waste (1,000 tons)	79.7	78.1	78.2	77.6	NA
- Domestic hazardous waste (1,000 tons)	20.3	21.9	21.8	22.4	NA

5. WATER POLLUTION					
A. Chao Phaya river					
- Dissolved Oxygen (DO)(mg/l)(≥2)	1.0	1.8	2.0	NA	NA
- Biochemical Oxygen Demand (BOD) (mg/l) (≤4.0)	2.8	3.3	2.6	NA	NA
- Total Coliform Bacteria (TCB) (MPN/100ml) (-)	14,500	44,156	63,000	NA	NA
B. Thachin river					
- Dissolved Oxygen (DO)(mg/l)(≥2)	1.3	1.0	1.0	NA	NA
- Biochemical Oxygen Demand	2.0	4.1	4.0	NA	NA
- Total Coliform Bacteria	2,400	97,846	100,000	NA	NA
C. Bang Pakong river					
- Dissolved Oxygen (DO)(mg/l)(≥2)	4.7	4.8	3.9	NA	NA
- Biochemical Oxygen Demand	0.9	1.6	1.7	NA	NA
- Total Coliform Bacteria (TCB)	195	8,945	6,200	NA	NA
6. AIR POLLUTION					
A. Emissions per GDP at 1988 prices (Gramme/Baht)					
- Carbon Dioxide	52.3	51.6	49.1	NA	NA
- Nitrogen Oxide	0.2	0.2	0.2	NA	NA
- Sulfur Dioxide	0.3	0.3	0.2	NA	NA
B. Air quality on road side in Bangkok (Average)					
- Total Suspended Particulate Matter (24 hrs.) (mg./cu.m.)	NA	0.2	0.2	NA	0.2
- Suspended Particulate Matter PM-10 (24 hrs.) (microgramme/cu.m.)	NA	80.1	82.6	NA	57.8
- Carbonmonoxide (8 hrs.) (ppm)	NA	2.3	2.2	NA	1.9
- Ozone (1 hr.) (ppb)	NA	6.9	7.6	NA	8.8
- Sulfurdioxide (24 hrs.) (ppb)	NA	8.2	9.2	NA	7.7

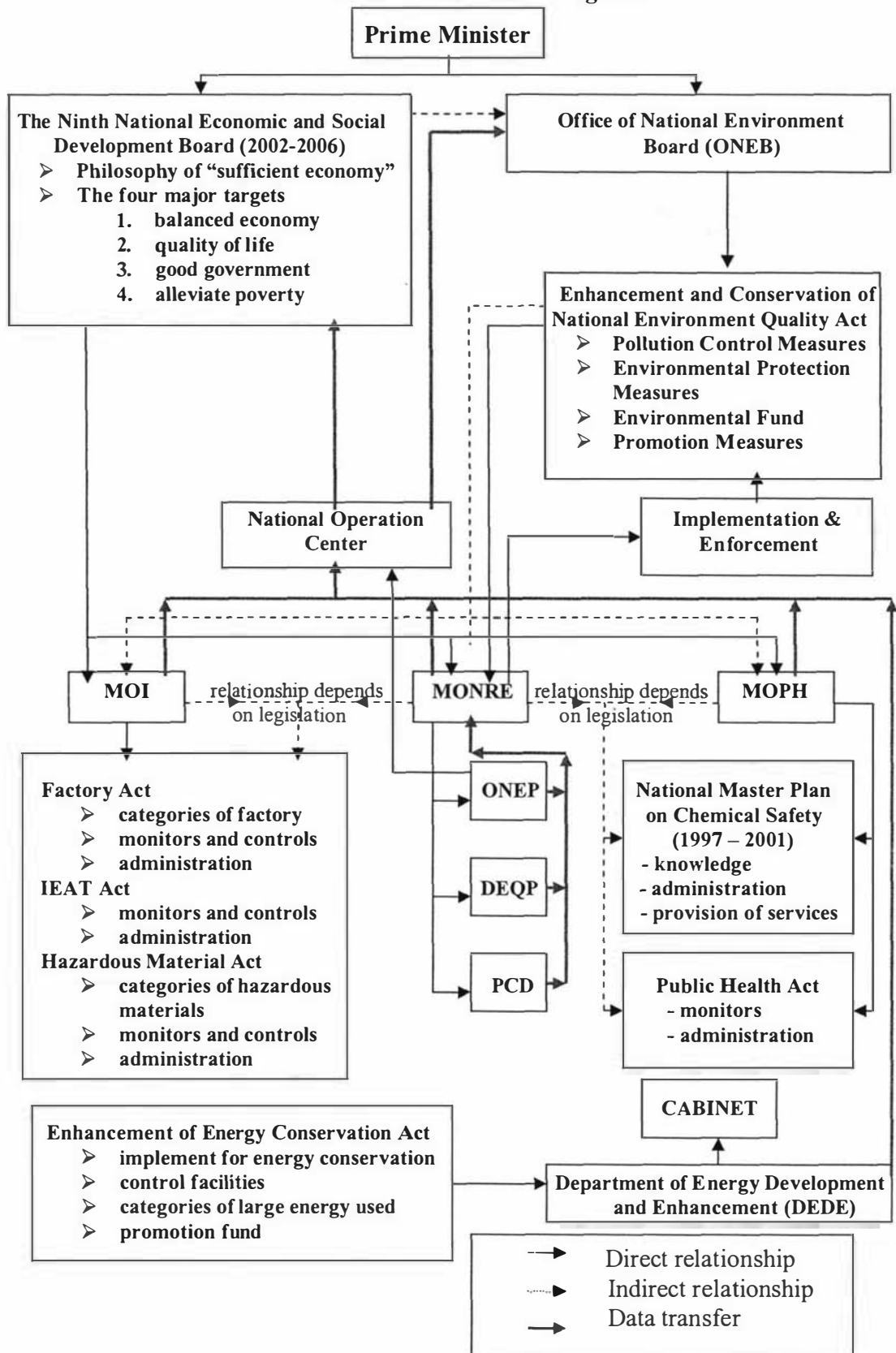
Source: National Statistical Office, 2004

Table 3.1 demonstrates Thailand's emphasis on measuring ambient environmental quality, using simple indicators (i.e. measure of Dissolved Oxygen or Biochemical Oxygen Demand to indicate water quality). It should also be noted that there has been very little monitoring of ambient environmental quality indicators since 2000, with the most recent monitoring relating to air pollution.

The results of measuring core environmental indicators in Table 3.1 highlight the fact that agricultural areas continue to decrease. However, the Government has initiated many projects in the last decade to encourage reforestation and retention of traditional agricultural practices. Some NGOs forestry projects receive the patronage of the Thai royal family (Asia-Pacific Centre for Environmental Law, 1998). 2001 was the first year in which forests increased in area (see Table 3.1). Water quality in the main rivers also improved in 2001. The water quality improved in the Bang Pakong River – the main river flowing through the study area in Chonburi province. On the other hand, total hazardous waste and waste continued to increase (see Table 3.1). Hazardous waste and waste problems in Thailand is mainly caused by industrial waste. Heavy metal pollution in rivers and the air involves copper, zinc, cadmium, lead, and mercury. Almost all of the heavy metal pollutants are from discharged industrial activities (Phongpaichit & Baker, 2004). Most of the industrial discharges would come from areas outside government developed industrial towns, which all have plants in which industrial effluent is treated before discharge to the environment. All manufacturers in Thailand have to comply with environment protection laws and regulations from both the MONRE and the MOI. These laws and regulations generally make up the national environmental management system of Thailand, which is described next.

Many manufacturers in Thailand produce export products in addition to those products available to the Thai market. Therefore industries are loathed to reply simply on the Thai national environmental management system because they also need to be responsive to environmental standards in the countries with which they trade. Most of the large manufacturers used TQM and ISO 14001 system with the Thailand national environmental management system (refer to the research in Chapters Five and Six). Since 1998, IEAT has promoted ISO 14001 for use by manufacturers in industrial towns (Amata Nakom Industrial Town, 2001). Today many of manufacturers in industrial towns use ISO 14001 (refer back to the research results in Chapters Five and Six).

Figure 3.1: Overview of Thailand's Environmental Administrative System as at 2005 that Relevant with Environmental Legislation



Source: Review of Thailand's Government Structures

3.3 THE ENVIRONMENTAL ADMINISTRATIVE SYSTEM IN THAILAND

Thailand is a constitutional monarchy, with His Majesty the King Bhumibol Adulyadej as the Head of Country. The Prime Minister is the leader of the Government, who presides over a Cabinet of Ministers. The Thailand's parliament is the supreme law-making authority, and consists of the Senate, whose members are selected for six years terms, and the House of Representatives, whose members are selected for four years terms. The structure of governance is divided into national, provincial, and district levels. The hierarchy of legislation has three level including; the constitution, any "Act" issued by the Parliament, and "Regulations" and/or "Notifications" issued by the respective ministries (Asia-Pacific Centre for Environmental Law, 1998). The Bangkok Metropolitan Region has its own governmental authority known as the Bangkok Metropolitan Authority.

The Thailand Government recognises the high priority of environmental issues, and has increased the budget to solve, prevent and educate Thai people about environmental management (Chantadisai, 2004). Also, the management of industrial affairs has become increasingly complex owing to the expanding maze of environmental laws and regulations and the growing public expectations regarding environmental protection. It is important to understand the role of the National Economic and Social Development Plan before studying Thailand's environmental administrative system because most of the Government administrative systems are established through the provisions of the National Economic and Social Development Plan.

In Thailand, the responsibilities for industrial environmental management are shared primarily between the sectoral ministries. In particular, the MONRE, MOI, and MOPH, together with their constituent departments, enjoy broad jurisdiction over numerous industrial environment management sectors. Table 3.2 is a list of Government ministries concerned with industrial environmental control, and Figure 3.1 presents an overview of Thailand's environmental administrative system.

Table 3.2: Government Ministries Concerned with Industrial Environmental Control

MOPH	MONRE	MOI
- Bureau of Environmental Health, Occupation Health Division, Department of Public Health	- Pollution Control Department (PCD) - Office of the Natural Resources and Environmental Policy and Planning (ONEP) - Department of Environmental Quality Promotion (DEQP)	- Industrial Estate Authority of Thailand (IEAT) - Department of Industrial Work (DIW)

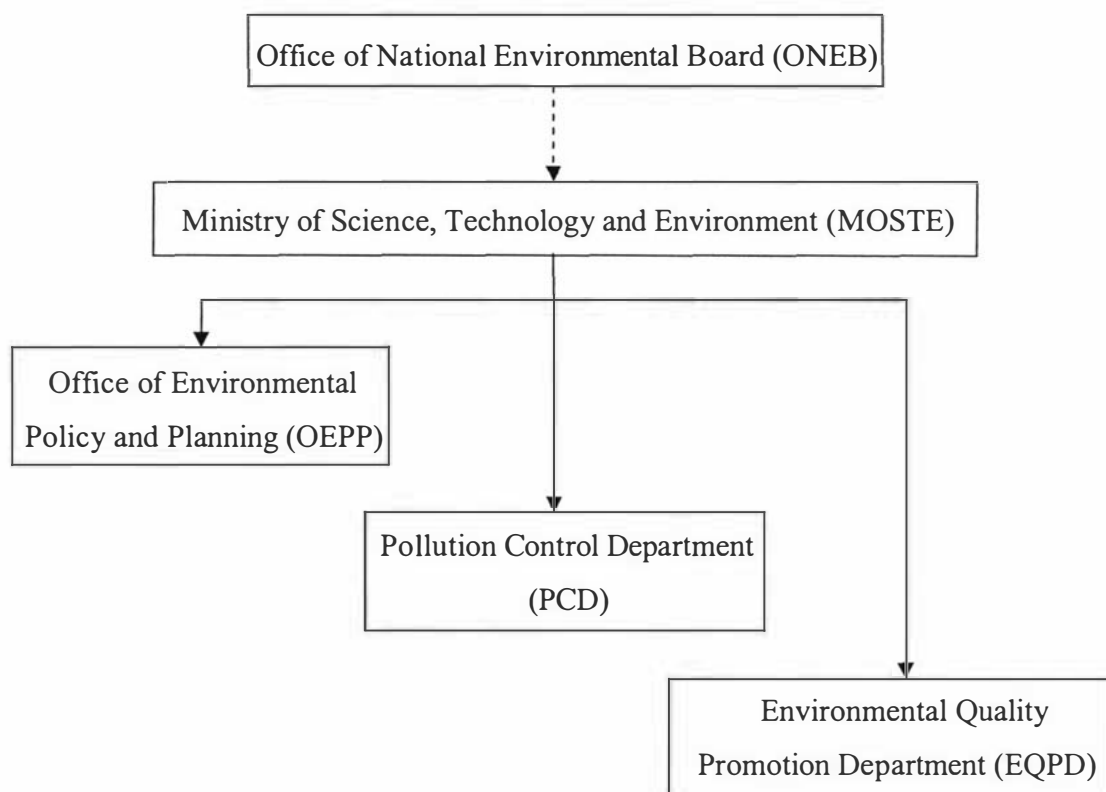
3.3.1 The Ninth National Economic and Social Development Plan of Thailand

The Office of National Economic and Social Development Board is a state enterprise established in 15 February 1950 under the Office of the Prime Minister. This office is chartered to prepare national economic and social development plans every five years. The Government uses these plans as the basis for developing Thailand in both economic and social terms. The most recent plan, the Ninth National Economic and Social Development Plan (October 2002) shall remain in effect until September 2006 (Office of the National Economic and Social Development Board, n.d.).

Since the First National Economic and Social Development Plan (1961 - 1966), national plans mostly focus on economic issues with no priority being given to management of natural resources and environmental management generally. However, after the King spoke about environmental issues in 1990, the Office of the National Economic and Social Development Board began to emphasize the protection and control of the natural resources and environmental management in the Seventh National Economic and Social Development Plan (1991 – 1996) (Global Environmental Forum, 1999).

As the result of the Seventh National Economic and Social Plan (1991 – 1996), the Government issued a new Enhancement and Conservation of National Environmental Quality Act, the Enhancement and Conservation of National Environmental Quality Act 1992. The Office of National Environmental Board (ONEB) was dismantled and its functions were integrated into the renamed the Ministry of Science, Technology and Environment (MOSTE). The major functions of ONEB were split into three major departments concerned about environment in the MOSTE. These are the Office of Environmental Policy and Planning (OEPP), The Pollution Control Department (PCD), and the Environmental Quality Promotion Department (EQPD) (Global Environmental Forum, 1999). Figure 3.2 presents the Government Agencies concerned with the environment under the Seventh National Economic and Social Plan (before the Government reforms on October 2002).

Figure 3.2: The Government Agencies Concerned with the Environment under the Seventh National Economic and Social Plan (1991 – 1996)



Source: Global Environmental Forum, 1999

The OEPP has taken over the ONEB's function of policy formulation, and is also preparing an environmental master plan based on the five-year National Economic and Social Development Plan. The OEPP coordinates with other national and provincial agencies in the development and implementation of the five years plans. The OEPP also coordinates the implementation of Environmental Impact Assessment (EIA) system in the country, and is responsible for international cooperation. (Office of the Natural Resources and Environmental Policy and Planning, n.d.)

The PCD brings together, under one umbrella, all pollution control functions, previously spread over various administrative organisations. In addition to the three environmental management divisions, all of which are responsible for water quality, air quality and noise pollution, and hazardous substances and solid waste, the PCD takes charge of pollution issues and is the body charged specifically with implementing pollution control laws and emission standards. (Pollution Control Department: 1, n.d.)

The EQPD is responsible for disseminating information about environmental administration to the public, and for gathering and administering environmental information. In addition, it acts as an intermediary between private NGOs and the MOSTE (Department of Environmental Quality Promotion, n.d.).

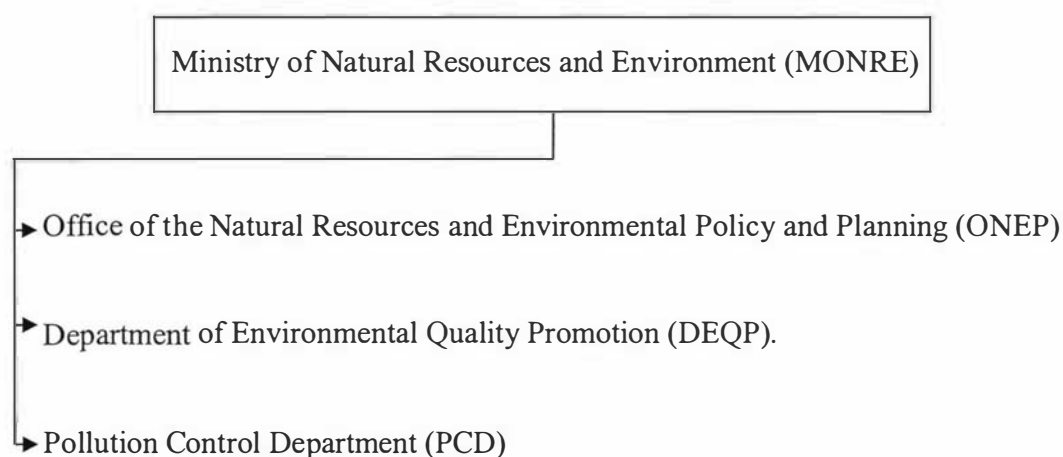
In 2002, the National Economic and Social Development Board issued the Ninth National Economic and Social Development Plan (2002 – 2006). This Plan adopts the philosophy of “Sufficiency Economy” that was given by the King, to his subjects as the guiding principle of national development and management. Sufficiency Economy is “a philosophy that stresses the middle path as the overriding principle for appropriate conduct and way of life” (Piboolsravut, 2004).

The current plan is a medium term national strategic plan that is consistent with the country's long-term vision. It builds on achievement of the Eighth Plan, which advocated a holistic people-centred development approach. In the Ninth Plan, major emphasis is placed on balanced development of human, social, economic, and environmental resources (Office of the National Economic and Social Development Board, 2002) and the plan outlines the need to develop monitoring and evaluation

systems at all levels in order to ensure continuous plan implementation, greater transparency, and more opportunities for public participation in monitoring and evaluation (Chantadisai, 2004). The Ninth plan sets the four major targets in developing the country, which are; to establish a balanced economy, to improve the quality of life, to establish good government, and to alleviate poverty (Office of the National Economic and Social Development Board, 2002).

Following the “Good Governance” initiative reforms of the Public Services brought about in 2002 by the Prime Minister Thaksin Shinawatra’s Government a new ministry, Ministry of Natural Resources and Environment (MONRE) was established. It took over all of the responsibilities that concerned the environment from the MOSTE. The MOSTE was renamed to the Ministry of Science and Technology (MOST). As a result of the transfer of the responsibilities concerned with environment to the MONRE, some government departments concerned with the environment were renamed. Figure 3.3 presents the Government agencies concerned with environmental policy under the MONRE.

Figure 3.3: Main Functions of ONEB that were Split into Three Departments under the MONRE (after Government reform in 2002)



Sources: Adapted from Global Environment Forum, 1999 and Ministry of Natural Resources and Environment, n.d.

The OEPP was renamed as the Office of the Natural Resources and Environmental Policy and Planning (ONEP). The EQPD was renamed as Department of

Environmental Quality Promotion (DEQP). The PCD kept the same name. However, apart from these three government agencies, there still remain the main bodies operating under the umbrella of the MONRE (Ministry of Natural Resources and Environment, n.d.). In addition, the responsibility over natural resource management resides with the MONRE.

Generally, the National Economic and Social Development Plan is focused more on developing the Thai economy, than on protecting social and environmental quality. However, the Ninth Plan shows that the government has tried to balance the development of the economy and protection of the Thai quality of life. The Ninth Plan also shows that the government reformed some public agencies in 2002 in an attempt to solve the problem of overlapping functions between the government agencies. In addition, the government has separated the environment protection and prevention functions from the science and technology functions (from the MOSTE), and then established the MONRE to take over all the environmental functions. However, there are still some environmental functions in other ministries (e.g. the MOI and the MOPH) that the government needs to take over these functions and assign the MONRE to control. Finally, the lack of consideration of environmental goals and targets for environmental management in the Plan, means that the overlapping functions have not been a serious focus of current economic policy.

3.3.2 The Enhancement and Conservation of National Environment Quality Act, 1992

The Enhancement and Conservation of National Environment Quality Act is Thailand's only main environmental law. The objective of the Act is to protect environmental quality and to control pollution, which has potential effect on environmental quality, natural resources, environment, and harmful to health of the Thai people (Public Health Law Administration Office, 2002) also enhances public participation in environmental monitoring systems (Chantadisai, 2004). The translation of the Enhancement and Conservation of National Environment Quality Act into policy, programs, plans, and compliances was then undertaken in a compartmentalized, segmented manner according to the functional responsibility of each government agencies that concerned with environment (Chantadisai, 2004). This

Act is a fairly substantive piece of legislation, which contains several progressive provisions designed to enhance the protection of the environment by amending the previous environmental legislation Acts of 1975, 1978, and 1979 (Global Environmental Forum, 1999).

The key feature for effectiveness of the first national Environmental Quality Act (1975) was establishing the Office of National Environmental Board (ONEB), which was set up to develop environmental policies, and embark on the planning of environmental conservation policies, prescription of air and water quality standards and the establishment of environmental monitoring systems. The Environmental Quality Act empowering the ONEB is headed by the Deputy Prime Minister. This emphasizes the government's concern about the environmental issues at the ministerial level. However, the ONEB has failed to achieve these goals because of budgetary constraints, shortage of human resources, and the complexities of coordination with related governmental agencies (International Network for Environmental Compliance and Enforcement (INECE), n.d.).

The Act currently in force now is the Enhancement and Conservation of National Environmental Quality Act, 1992. This Act covers four major aspects of environmental management important in guiding industry, namely: pollution control, environmental protection, environmental fund, and promotion measures:

- *Pollution Control Measures* set emission or effluent standards for control of wastewater discharge, polluted air emissions, specifying types of point sources, hazardous waste, and designation of pollution control area.
- *Environmental Protection Measures* established environmental standards, formulation of on environmental quality management plan, designation conservation and environmentally protected areas and specifying types and sizes of projects or activities to be submitted as an Environmental Impact Assessment (EIA) report.
- *Environmental Fund*, which can be used as grant, loan or aid for the establishment of waste management facilities to government agencies and local government.

- *Promotion Measures* are used to contribute to establishment of waste management in which the owner or possessor of any “point sources” of pollutions (The definitions of “point sources” and “non-point sources” are shown in chapter 2.3). Also, this Act entitled the owner or possessor of polluters to request for exemption of taxes to import necessary machineries, equipments appliances or materials, and permission to bring foreign experts into the country to carry out works concerning the installation, monitoring, control and operation of any pollution problems.

(Public Health Law Administration Office, 2002)

According to the Enhancement and Conservation of National Environmental Quality Act 1992 aspects, the Government has paid much attention to develop a better environmental indicative system for evaluating results of government policy, programs, plan and activities in various development sectors as well as on natural resources and environmental management (Chantadisai, 2004). Moreover, the ONEP has launched a project during 2001 – 2002 to develop an environmental database system, and environmental indicators under the National Operation Center. This environmental database system has served as an important tool for monitoring and evaluating the Government’s performance. The National Operation Center depends on its information on government departments and ministries. Every consecutive ministry and department must set up a “ministry operation center” and “department operation center” and provide all information necessary for decision making to the National Operation Center (Chantadisai, 2004).

The 1992 Act is comprehensive and contains seven chapters having 111 sections and another four sections as interim provisions, a total of 115 sections. The main government agency enforcing this act is the Ministry of Natural Resources and Environment (Pollution Control Department: 2, n.d.). The full version of the Enhancement and Conservation of National Environment Quality Act, 1992 is in Appendix Six.

Section Six of the Act outlines the purpose of public participation. This Act or governing law related thereto may accord the following duties to individual persons as provided:

- To be informed and obtain information and data from the government service in matters concerning the enhancement and conservation of environmental quality, except that information or data are secret intelligence pertaining to the nation security, or secrets pertaining to the right to privacy, property rights, right in trade or business of any person which are duly protected by law.
- To be remedied or compensated by the State in case damage or injury sustained as a consequence of dangers arisen from contamination by pollutants or spread of pollution. Including, incidents caused by any activity or project initiated, supported or undertaken by government agency or state enterprise.
- To petition or lodge complaint against the offender in case of being a witness to any act committed in violation or infringement of the laws relating to pollution control or conservation of natural resources.
- To co-operate and assist government officials in the performance of duty relating to the enhancement and conservation of environmental quality.
- To strictly observe the provisions of this Act or other laws concerning the enhancement and conservation of environmental quality.

(Pollution Control Department: 2, n.d.)

Pimpisut & Staudte (2004) believe that the results of the Thailand Environment Institute (TEI) research show that the Government urgently needs to improve communication with industries and communities to increase more public participation. The environmental group, comprising stakeholders from industries; central Government; local authorities; local communities; and NGOs, have to work in partnership to develop public participant might be by improve information system and complaint system.

Section Seven of the Act provides for non-governmental organizations (NGOs) such as Thailand Environment Institute (TEI), Green World Foundation (GWF), and Wildlife Fund Thailand (WFT) (in liaison with government agencies established) to directly engage in activities concerning environmental or natural resources protection. In the next section, Section Eight, the NGOs that have been registered pursuant to section seven may request for assistance and support from government in the following matters:

- The organization of volunteers to assist in the performance of duty of government officials.
- Public relations campaign and dissemination of information or data to promote public awareness.
- Providing assistance to people in certain areas of the country to initiate projects or activities for environmental protection of natural resources in such areas.
- Conducting study and research concerned about environment and natural resources and bring suggestions back for the attention of the government.
- Providing legal aid to people who are in jeopardy of or afflicted by pollution damages.

(Public Health Law Administration Office, 2002)

The environmental NGOs are involved in many activities to protect the environment in Thailand. Some of these NGOs receive the patronage of the Thai royal family. One of the most well-know organisations in Thailand is the Thailand Environment Institute (TEI), which plays a catalytic role in coordinating governmental, non-governmental, academic, private sector, media and general public action in relation to environmental management (Asia-Pacific Centre for Environmental Law, 1998).

3.3.3 The Principle Laws and Regulations Relating to Industrial Pollution

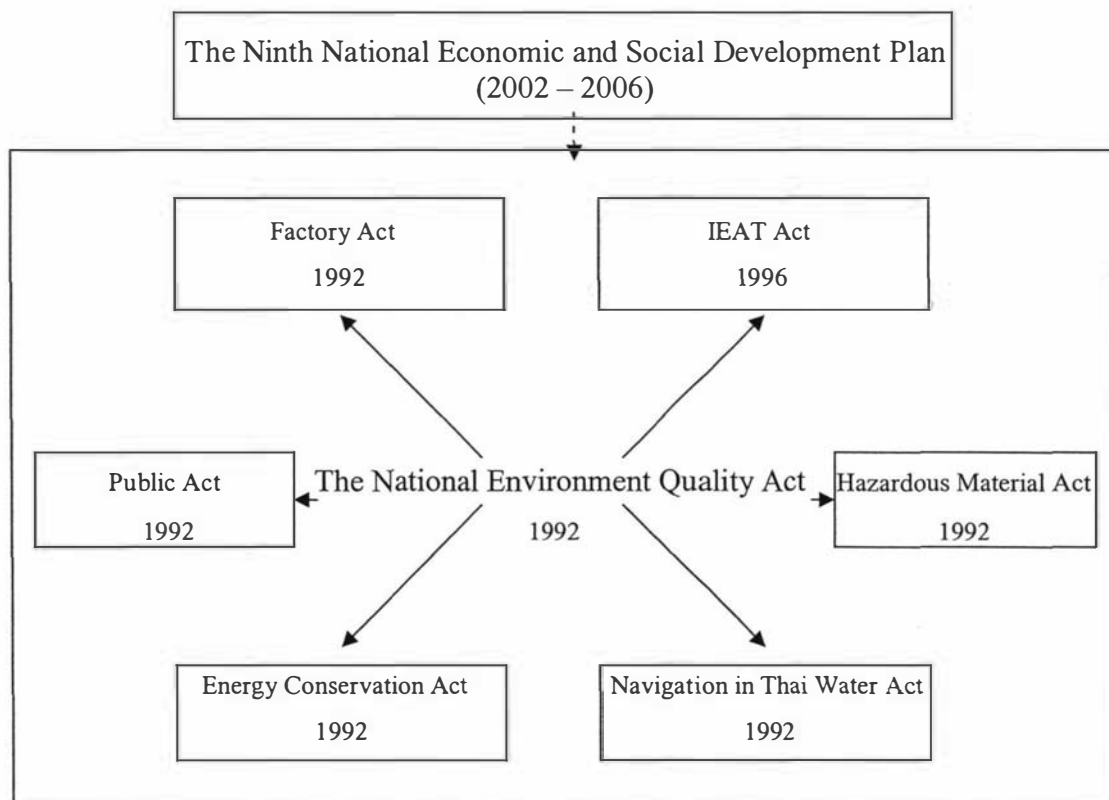
As in many developing countries, overlaps in administrative jurisdiction occur between central government agencies and between central government and local authorities. One major problem lies in the division of competences and the lack of coordination amongst the government agencies. Working rather independently from one another within each jurisdiction, they each implement the environmental laws and regulations that fall within the nation (Global Environmental Forum, 1999). The Thai Government tried to solve this problem by government reorganization in the year 2002.

Associate Professor Sunee Mallikamarl notes that there are still have some legislation that are most closely concerned with the implementation of industrial pollution controls in Thailand as follows (Global Environmental Forum, 1999, p. 22 – 32):

- The Factory Act
- The Industrial Estate Authority of Thailand Act (IEAT Act)
- Hazardous Material Act
- The Public Health Act
- The Enhancement of Energy Conservation Act

Although there is a lot of legislation influencing environment practices in large manufacturers. Only the Factory Act is relevant to manufacturers located outside of towns, and only the Industrial Estate Authority of Thailand Act for manufacturers located in industrial towns. However, there are still some parts of other acts that large manufacturers have to comply with as following. Figure 3.4 presents the relationship between the environmental legislation that influences environmental practices in large manufacturing companies in Thailand. This Figure displays the National Economic and Social Development Plan, and the Enhancement and Conservation of National Environmental Quality Act, and the relationships to the other regulations that support them.

Figure 3.4: The Relationship between the Environmental Legislation that has Relevance with Large Manufacturers in Thailand



Source: Adapted from Associate Professor Dr. Sunee Mallikamarl’s notes in Global Environmental Forum, 1999

There are few problems concerned with implementation of the above laws and regulations because most of them have the same standards established in the National Environment Quality Act (1992). As mentioned earlier, the problems of overlapping of responsibilities between the government agencies may be solved by gathering up all the environmental functions, and assigning them to the MONRE.

3.3.3.1 Environmental Legislation under the MORNE

The Enhancement and Conservation of National Environment Quality Act is the main environmental legislation that has been used by the MONRE. However, the MONRE has authority to issue the Ministerial regulations to protect Thailand’s environment.

The MONRE contained three departments that were spited from ONEB functions are ONEP, DEQP, and PCD (see Figure 3.3).

The MONRE also has a responsibility to implementation all activities from both household and industries that may discharge pollutant to public. In addition, the MONRE still has responsibilities to gathering, researching, administering environmental information, and reporting environmental quality data to the Office of National Environment Board (ONEB) (Department of Environmental Quality Promotion, n.d.).

3.3.3.2 Environmental Legislation under the MOI

As the results of many literatures mention that many environmental pollution problems is mainly cause by industrial such as water pollution, waste and hazardous waste problem (Global Environmental Forum, 1999, Laplante & Meisner, 2001, National Statistical Office, 2004, Phongpaichit & Baker, 2004), MOI published some regulations to control environmental management in manufacturing companies. These are Factories Act, Industrial Estate Authority of Thailand Act, and Hazardous Materials Act.

The Factory Act, 1992

The Factory Act deals directly with manufacturers that operate in Thailand. The Department of Industrial Works, Ministry of Industry, administers this Act. The Ministry is empowered to issue regulations as ancillary provisions. The Factory Act classifies factories according to their types and sizes into three categories, which are:

- Category One – factory is a factory of certain type and size allowing its operation to begin immediately by the factory operator.
- Category Two – factory is a factory of certain type and size the operation of which can be carried out only after the licenser is notified of the operation.
- Category Three – factory is a factory of certain type and size which requires a setting up license prior to its setting up.

(Global Environment Forum, 1999)

The categories given above differ from the classifications used with in this research (classifications used in this research are listed in Chapter Two).

The Ministry of Industry can publish the Ministerial Regulations that concern solid waste disposal, discharge and emission of air and wastewater from manufacturers, guideline manufacturers about treatment facilities, and establish noise level standards for manufacturers but not exceed the standard of the National Environmental Quality Act (International Network for Environmental Compliance and Enforcement (INECE), n.d.).

One objective of the Factory Act is to control the engagement in factories. With regard to the environment, the Act considers the following:

- Water discharge and polluted air shall be treated to meet standard requirements prescribed by law before discharging outside the factory.
- Noise shall not exceed noise quality level as prescribed by law.
- Hazardous waste is materials contaminated with chemicals and is required to be disposed of in safe and closed container.

(Global Environmental Forum, 1999)

Factories are required to comply with the Act. Failure to comply is punished by administrative and legal measures. Administrative penalties span several levels of severity such as warning, restraining order, improvement order, the sealing off of machinery, and factory closure. However, German Technical Cooperation Thailand (2001) mentioned that monitoring system is weak. This deficiency results, amongst others, from limited personnel and budget resources for factory monitoring.

The Industrial Estate Authority of Thailand Act, 1996

The Industrial Estate Authority of Thailand (IEAT) is authorised to control industrial operations in any industrial town. The IEAT is responsible for the quality of environment of all factories that are located in any industrial town. The Act requires all industrial towns to provide central wastewater treatment facilities, solid and

hazardous disposal, control air pollution emission, and other pollutants that may discharge from factories. However, if preferred, a factory may construct its own treatment facilities (Kasemsri, 2000).

The IEAT is empowered to enter the industrial premises during working hours to inspect any document, production activities, and anything related to industrial activities. Factories located within industrial towns are required to comply with IEAT's regulations issued by the Board of the Industrial Estate Authority of Thailand to regulate the operation of industries (Global Environmental Forum, 1999).

The Hazardous Material Act, 1992

This Act was issued to control all hazardous materials by providing proper control regulations and procedures, as well as administrative systems among government agencies concerned with supervision and control of all hazardous materials that are used in the country. The Ministry of Industry (MOI) may prescribe area or areas within which the possession, distribution, or use of any hazardous material is permitted (Pollution Control Department: 3, n.d.).

Moreover, the Act is divided into three categories of hazardous materials, and the control procedures of each category varies and are as follows:

- Hazardous Material that requires compliance with prescribed regulation and procedures.
- Hazardous Material that requires prior notification to competent official as well as compliance with prescribed regulations and procedures.
- Hazardous Material that requires a license.

(Global Environmental Forum, 1999).

Also, Hazardous Material Act describes hazardous substance control criteria for import, production, transportation, consumption, disposal and export not to influence and danger to human, animals, plants, properties and environment. The Ministry of Industry categorizes the hazardous substances into four major types for correct

control. In addition, the Ministry of Industry established Hazardous Substances Information Center to coordinate with other government agencies in part of hazardous substances information (Pollution Control Department: 3, n.d.). Some of the participant manufacturers in this research have used some dangerous chemicals in their production processes. However, the participant companies in this research have good safety processes (Refer to interview results in Chapter Six).

3.3.3.3 Environmental Legislation under the MOPH

The MOPH has a few responsibilities concerned with public health quality and industrial environmental issues, so the MOPH used the Public Health Act to administration and monitor manufacturing companies' activities that may impact to public health. In addition, the MOPH also has responsibilities concerned with chemical safety from both household and industries.

The Public Health Act, 1992

The main purpose of this Act is to maximize the good quality health of the Thai people, which is enforced by local administrative organisation. Some parts of the Act deal with garbage, sewage, solid and hazardous waste, and odour. Also, the law prohibits the operating of factories without air ventilation, water drainage, hazardous material control, failure to control foul odor, hazardous mist emissions (Pollution Control Department: 3, n.d.).

3.3.3.4 The Enhancement of Energy Conservation Act, 1992

In 1992, The Enhancement of Energy Conservation Act was announced in order to implement and administer a comprehensive energy efficiency programme (ASEAN Centre for Energy, n.d.). The main objective of the Enhancement of Energy Conservation Act is to encourage the enhancement of energy conservation, or for the manufacturing of high efficiency machinery and equipment for conservation of energy. This Act supports any factories that invest and carry out energy conservation, or tackle environmental problems regarding energy conservation, by the benefit of a

special fee exemption or from grants from the Energy Conservation Funds, Ministry of Finance (Global Environmental Forum, 1999).

To gain these benefits, the factory is required to prepare an energy conservation plan and must be the one using larger than 1000 watt / 175 kilo ampere power meter. The Act requires the factory to: arrange one person responsible for energy with qualifications as stipulated by law; submit information on production, energy consumption and conservation to the Department of Energy Development and Enhancement; arrange to have records of energy consumption and equipment which affects energy consumption; set targets and plans about energy consumption and conservation and submit to the Department of Energy Development and Enhancement; and examine and analyse the achievement of the energy conservation targets and plans (Global Environmental Forum, 1999). Some of the participants manufacturing companies have the requirement to prepare energy conservation plans but all of the participant companies are trying to save costs. Energy cost is one of the important costs that all industries want to save.

The Act has four major functions: to implement energy conservation, to control facilities, to identify large energy used, and to promote a fund (ASEAN Centre for Energy, n.d.). The fund provides financing for energy conservation, renewable energy and co-generation projects and support training, technical assistance, promotion, monitoring, and evaluation, research and demonstration, technology transfer, and related activities that improve environmental conditions (ASEAN Centre for Energy, n.d.).

Table 3.3 showed the sectoral electricity consumption in Thailand in 2000 – 2003. As the result of Table 3.3 presents that the electricity consumption is continue increasing ever year, and industrial sector is a major electricity user (45%), followed by business (24%) and residential sectors (22%).

Table 3.3: Electricity Consumption in Thailand by Sectors (UNIT : GWH)

Year	Residential	Business	Industrial	Agriculture	Others	EGAT Direct Customer	Total
2000	19,393	21,050	39,472	154	5,776	1,752	87,597
2001	21,168	22,129	41,587	179	6,086	1,717	92,866
2002	22,045	23,693	44,727	192	6,523	1,943	99,123
2003	26,518	28,208	53,321	291	7,760	2,270	118,368

Note: Figures are rounded-off

Source: ASEAN Centre for Energy, n.d.

3.4 THAILAND'S GENERAL ENVIRONMENTAL APPROACHES

The Ministry of Science, Technology and Environment (2000) noted that, in the past two decades, Thailand's rapid industrialisation has been achieved at the cost of various types of environmental pollution. In particular, Bangkok and the surrounding provinces have serious air pollution caused by industries and motor vehicle emissions, wastewater pollution from both household and industries, and industrial hazardous wastes. According to the State of the Environment in the year 2000, developed by the MOSTE, "the state of the environment remains in crisis or near crisis for most resource sectors" (Ministry of Science, Technology and Environment, 2000). Laplante & Meisner (2001) considers that Thailand's Government has achieved significant progress in term of setting in environmental legislation. However, the implementation of regulatory measures has not been effective because the weakness of monitoring and enforcement systems. Also, the implementation of legislation has been hampered by the duplication and overlapping of responsibilities between Government agencies involved in environmental control and policy.

The mission statement of the United States Department of Commerce, International Trade Administration (ITA) on March 29 – April 6, 2004, mentions that Thailand would need to invest approximately US\$ 1.2 – 1.5 billion to attain universal coverage

for safe water and sanitation by 2020. Investments required for improving air quality are estimated at US\$ 350 – 500 million, and US\$ 300 – 400 million for solid waste management over the next decade (International Trade Administration, n.d.).

3.4.1 Air Pollution Approaches

The degree of the air pollution problem depended on the kinds of sources, number of sources and quantities of air pollutant levels emitted from each source. Factories are the most important sources of serious air pollutants. The best prevention and mitigation of industrial air pollutants are best done at the emission sources (Global Environmental Forum, 1999).

The amount of industrial pollutants released into the air is very high in the Bangkok metropolitan and urban areas such as Chonburi, Rayong, Nakhon Pathom, Pathum Thani, Saraburi, and Samut Parkan, where many manufacturing and industrial towns are located (Global Environmental Forum, 1999). Some polluting industries have been threatened with closure. Levels of pollution differ. For example Chonburi Province pollution levels are not critical as in provinces such as Saraburi Province and Samut Parkan Province (Pollution Control Department: 4, n.d).

Pollution Control Department (PCD) publishes daily air quality report, using Air Quality Index (AQI) online at PCD's website. AQI is easy for the general public to understand, and it has used in many countries such as the United States, Australia, and Singapore. AQI divides has a five point scale; very good, good, few effect to human, effect to human, dangerous condition. The AQI results showed that both Saraburi and Samut Parkan Provinces are in the third level. It means some people especially children and the older should not participate in strenuous outdoor activities because of the poor breathing capacity (Pollution Control Department: 4, n.d.). However, Pollution Control Department cannot attribute pollutants to industries, vehicles or other sources. The Government has initiated a number of programmes to improve the quality of air. Also, the government planning includes a nationwide network of measurement stations to monitor air pollutions both in the general and industrial areas (Energy Information Administration, 2003).

Generating power for manufacturing plants, contributes to Thailand's air pollution problems. Most of the older manufacturers in Thailand use coal and lignite as industrial fuel. Coal and lignite are more polluting than natural gas and oil. Mae Moh Electricity Plant is one of an example case study of industries that discharged pollutants into the air that cause by using coal and lignite as the energy supply. The area surrounding Mae Moh Electricity Plant has recorded a large number of deaths from heart failure and a high occurrence of chronic respiratory problems (in 1992). "The excessive levels of sulfur dioxide being emitted in the Mae Moh valley can be attributed to 13 coal-fired power plants at the complex". The affect from Mae Moh Electricity Plant's environmental incidents sent more than 1,200 local residents to the hospital (Energy Information Administration, 2003). However, in the recent years many factories and facilities now use natural gas and oil as industrial fuel, but many factories still lack any means of preventing air pollution, such as dust collectors (Energy Information Administration, 2003). One of the research participant companies also has a dust problem that occurs from production processes but the company has a dust collector system in production line to solve this problem.

The Government has prepared four main targets on air pollution prevention and education under Thailand's policy, and the prospective plan for the Enhancement and Conservation of National Environmental Quality Act, 1992 (still in use). These are:

1. To accelerate the reduction of air pollution initially from vehicles, industrial, construction, and transportation.
2. To maintain air quality in areas that have air quality that is within designated standards, not allowing it to be degraded below such standards.
3. To promote and support utilisation of low pollution transportation systems.
4. To promote participation among the government and private sectors and the general public, including polluters and affected people, for the conservation of air quality.

(Pollution Control Department: 2, n.d.)

The Government plans to manage air pollution problems by establishing eight management guidelines as in the following measures:

1. To separate industrial zones from communities and residential areas by rigorously implementing master city plans, and prepare facilities for control of air pollution from the emission sources.
2. To continuously monitor, check, analyse, and construct a database of the overall ambient air pollution and emission of air pollutants from its sources.
3. To formulate prevention measures and prepare emergency plans for protection communities.
4. To assign local government agencies and to prepare master and action plans for continuous reduction of air pollution in local areas.
5. To promote collaboration among government agencies, and the private sector to control and prevent air pollution problems.
6. To establish buffer zones around industrial estates and industrial zones in order to control and reduce air pollution conditions arising from industrial activities.
7. To control and reduce any substances those are a danger for the atmospheric ozone layer.
8. To use tax measures to promote investment, activities, facilities and equipment that contribute to mitigating and preventing air pollution problems.

(Pollution Control Department: 5, n.d.)

Environmental Report from World Bank in 2002 notes that air quality in Thailand has actually improved significantly in the past decade. The World Bank praised many of the Government initiatives, such as the phasing out leaded gasoline, improving diesel quality, and using clean technology to reduce pollution. However, Thailand still needs to concentrate more on the problem of fine particulate matter (PM –10). The PM-10 is dust with a diameter of less than 10 micro meters, it comes mainly from diesel engine emissions and open fire (Energy Information Administration, 2003).

Ambient air quality standards in Thailand were summarised from the Notification of the National Environmental Board, No.10, 1992 under the Enhancement and Conservation of the National Environmental Quality Act, 1992 (still use). Standards are defined regarding air pollution, covering seven pollutants: Carbon monoxide (CO), Nitrogen Dioxide (NO₂), Sulfur Dioxide (SO₂), Total Suspended Solid (TSS),

Particulate Matter ($<10\mu$) (PM-10), Ozone (O^3), and Lead (Pb) (Pollution Control Department: 5, n.d.). This standard is also used by EPA.

3.4.2 Waste Water Pollution Approaches

Industrial wastewater pollution is one of the most critical environmental problems facing Thailand at present (Laplante & Meisner, 2001), one third of Thailand's water and coastal resources are of poor quality (German Technical Cooperation Thailand, 2001). Control of water pollution therefore has the highest priority in the Government's environmental programmes (Public Health Law Administration Office, 2002).

A number of programmes have been implemented to prevent wastewater pollutions of the major rivers in Bangkok and urban areas. Under notifications issued by the Ministry of Natural Resources and Environment (MONRE) and under the Bangkok regulations, buildings over a certain size are required to install water purification tanks, and sewage treatment plants to treat waste are beginning to be constructed. In addition, the Government established the Wastewater Management Authority, mandated to build efficient and economical wastewater treatment facilities and administer them. However, these government initiatives have not brought much practical benefit as yet (Wastewater Management Authority, n.d.).

Thailand's industrial wastewater standards (1996) were created by the Ministry of Science, Technology and Environment (MOSTE) under the Enhancement and Conservation of National Environmental Quality Act, 1992 are still in use. However, the country still has another regulation over industrial wastewater standards that have been published by the Ministry of Industry (MOI) in 1996 (still in used), which are authorised over activities in factories. Indeed, Thailand uses double environmental standards to control industrial activities but these two sets of standards are identical and can be considered as one standard for practical purposes (Public Health Law Administration Office, 2002).

The Enhancement and Conservation of National Environmental Quality Act, 1992 also refers to policies on water pollution prevention and education, including:

1. To accelerate the rehabilitation of water quality in important water sources throughout the country.
2. To reduce and control water pollution originating from community activities, agriculture, and industry.
3. That producer of polluted water must be responsible for paying for the management of water pollution.
4. To promote and support private sector participation in co-investing and management to solve water pollution problem.

(Pollution Control Department: 6, n.d.)

Pollution of rivers from both household and industrial wastewater is a serious issue, particularly in the Bangkok and other large heavily populated city regions in Thailand. The Ministry of Natural Resources and Environment has prescribed water quality standards for some major rivers such as Chao Phraya River, Thachin River, Mae Glong River, and Bang Prakong River (see Table 3.1), encompassing 20 indicators such as Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), and Total Coliform Bacteria (TCB) (Pollution Control Department: 7, n.d.). The Government continues to monitor pollution levels of all major rivers.

German Technical Cooperation Thailand (2001) believes that industrial wastewater pollution originates from the discharge of organic substances, hazardous chemicals including heavy metals and non-biodegradable material. Discharge of untreated wastewater containing organic material reduces the dissolved oxygen level in natural water resources. Some industries such as sugar, tapioca starch, rubber, palm oil, paper production contribute significantly (up to 25%) to the organic pollution load of natural water resources. Industrial manufacture in Thailand also increasingly produces high amounts of toxic waste containing complex chemicals and heavy metals that are a serious threat to public health because of their longevity and highly hazardous qualities.

Water quality is analysed using methods approved by the United States Environmental Protection Agency (EPA). Any factory is required to regularly report water analysis results to the controlling government agency, and a government-

approved laboratory must carry out the analysis. A laboratory seeking approval must apply to the MOI, analyse an unknown sample and return the results, and be granted approval depending on the evaluation (Global Environmental Forum, 1999).

Water quality standards in Thailand were summarised from the Notification of the Ministry of Science, Technology and Environment, No.3, 1996 under the Factory Act, 1992 and the Enhancement and Conservation of the National Environmental Quality Act, 1992. Standards are defined for each class of water body, covering a total of 27 parameters, 15 parameters plus 12 heavy metals, from colour and temperature through to heavy metals (Pollution Control Department: 7, n.d.).

3.4.3 Hazardous Waste Disposal Approaches

Thailand's industrial development has brought with it increases in hazardous waste pollution every year. Most hazardous waste in the country is from manufacturing activities, coupled with increasing hazardous waste resulting from Thailand's expanding economic activity. Thailand's capacity for hazardous waste disposal is approximately 100,000 tons/year; the major hazardous waste groups in Thailand are heavy metal, sludge solid and oils (United Nations, n.d.).

Further, due to a lack of treatment facilities, the increasing volumes of hazardous substances generated by the thriving industrial activities are mostly simply dumped without proper treatment. Unless treatment facilities are built, environmental contamination caused by hazardous waste threatens to become Thailand's worst environmental problem in the future (International Trade Administration, n.d.).

At present, General Environmental Conservation Public Company, or GENCO, has a monopoly on industrial waste disposal in Thailand. Free of competition, the 25% this government owned company has only two facilities that can properly process industries hazardous wastes: The Bang Khunthien Plant in Bangkok, and The Mab Ta Phut Plant in Rayong Province (General Environmental Conservation Public Company Limited, 2002). However, these two plants do not have enough capacity to manage hazardous waste and are located a considerable distance from factories in Northern and Southern regions of the country. It is importance to know that Mab Ta

Phut industrial waste disposal plant is not far from Chonburi Province, and all of the research participant companies have been using services from GENCO.

Most hazardous waste from factories is either stored on site, or mixed with general waste and disposed of illegally. The Thailand government recognises this problem and plans to build seven new hazardous waste treatment facilities nationwide. But construction is often delayed because of intense opposition from local residents in all the planned areas, and several of the construction projects have been shelved because local communities' residents believe a hazardous waste treatment plant will result in further pollution in their communities. Due to the slow progress in building treatment facilities, the illegal dumping of hazardous wastes from factories is increasing (Pollution Control Department: 8, n.d.).

The Enhancement and Conservation of National Environmental Quality Act, 1992 contained the policy on hazardous waste pollution prevention, which is:

1. To install an efficient hazardous waste management system that will cover the processes of imports, exports, transport, separation, collection, treatment, and eradication.
2. To establish an emergency system to prevent and mitigate major hazardous waste accidents in the industrial sector, in transportation, and in storage of hazardous waste.
3. To promote and support private sector investments or participation in management of hazardous waste at all stages.

(Pollution Control Department: 8, n.d.)

The Government plan to manage hazardous waste problems by setting up the five management guidelines as in the following:

1. The formulation of standards and criteria for collection, transportation, treatment, recycling, and destruction of hazardous wastes.
2. Support for NGOs to undertake continuous monitoring, inspecting, controlling and evaluating of hazardous waste management from original sources.
3. The development of an information network about hazardous waste.

4. The application of the polluter pays principle for collection, treatment, and destruction of hazardous waste.
5. Support for factories to establish hazardous waste treatment and eradication systems.

(Pollution Control Department: 8, n.d.)

According to the Government guideline German Technical Cooperation Thailand also mentioned that data and information network for industrial hazardous waste management is very important because large amounts of highly hazardous substances pose a serious threat to public health and environment (German Technical Cooperation Thailand, 2001). Department of Industrial Work (DIW) is establishing a data and information management scheme, utilising the Geographical Information System (GIS). The information system allows precise definition on which type and amount of hazardous waste are being produced by which industries. Also, the hazardous waste information system enables DIW to set up the required logistics and facilities for collection, transport, intermediate storage, and treatment or disposal of industrial hazardous waste (German Technical Cooperation Thailand, 2001).

3.4.4 Other Environmental Pollution Approaches

Other environmental pollution problems often generated by industry in Thailand include noise pollution, solid waste pollution, odour pollution, oceans pollution, and each of these pollutions could be cited as matter of prime concern. Thailand currently has an environmental noise pollution standard not exceeding 70 decibels as the average noise level over 24 hours (The Royal Thai Government under the Majesty King Bhumibol Adulyadej, 1997).

Thailand Government does not have any laws and regulations that directly concern odour pollution from industries. Although there are no regulatory standards, but local resident can claim against manufacturers that discharged odour pollutant by adapting the Public Health Act. Most of large factories have embarked on a major odor control program because they have to take care their companies' image and do not want the local resident complaints their companies.

In Thailand, solid waste pollution problems have become quite serious especially in Bangkok and the Eastern regional provinces, where the generation of solid wastes rate tends to increase every year. The Government does not yet have a long-term master plan, or cooperative planning for solid waste. The Government responsible has not been able to identify suitable disposal sites for the long-term. Also, there is limited investment capital, lack of materials, equipment and knowledgeable operators. In addition, the existing laws and regulations were not supportive; including the lack of collection systems of a basic structure for recycling solid waste, and public cooperation (Pollution Control Department: 9, n.d.). Therefore, analyse of solid waste issues is excluded from this study.

Surprisingly, Thailand does not yet have a national policy on ocean pollution. However, the country has a programme for integrated management and sustainable development of coastal and marine areas. Any activities under this programme are rated as “important” and “very important” by the United Nations (n.d.). EIA is a mandatory requirement in the Marine Protected Area Programmes for specific major investing activities, which may cause significant adverse impact on the environment, including ocean pollutions. Moreover, ASEAN’s environmental activities and UNEP’s Regional Seas Programme are activities requiring international cooperation for sea-based activities (United Nations, n.d.).

3.5 CRITIQUE OF THAILAND’S ENVIRONMENTAL ADMINISTRATIVE SYSTEM

Thailand’s government approach to environmental protection has been piecemeal. For the most part, it has taken the form of separate charters being prepared by many departments whose goals relate to the protection of environment, public health, welfare and safety, and finally, the conservation or exploitation of natural resources (Phongpaichit & Baker, 2004). As in many developing countries (e.g. Thailand, Vietnam, China, Indonesia, Malaysia), there are overlaps in administrative jurisdiction occurring between agencies at the central or national level of government and between national and provincial agencies. One major problem lies in the division of competences and the lack of coordination amongst the departments in the same

Ministry and different Ministries (Ministry of Science, Technology and Environment, 2000; O'Rourke, 2004, Varettoni and Boss, 2005; Roij, 2006).

In this respect, the Thai government has attempted to introduce some measure of coordination by establishing multi-representational, interdepartmental committees. This would ensure ostensibly that lines of communication exist throughout the relevant agencies and that the interests of all departments would be coordinated in formulating government policy. Figure 3.1 illustrates examples of such committees including the National Environmental Board (NEB) and the Pollution Control Committee (Ministry of Natural Resources and Environment, n.d.). However, Chantadisai (2004) argues that the work of such inter-agency bodies becomes even more critical in the management of natural resources. For example, because the Enhancement and Conservation of National Environment Quality Act is principally directed at industrial pollution control, it does not contain far-reaching provisions on natural resource conservation and management.

In practice, these inter-agency arrangements do not always work optimally. Several environmental standards have yet to be prescribed due in part to the NEB's infrequent meetings. Channels of communication between government agencies and provincial governments are difficult to maintain, especially in the more remote regions (Global Environmental Forum, 1999). From an even broader perspective, the provisions for multi-agency cooperation are hampered by the realities of political administration in Thailand. Thai governments are regularly formed by coalition and the respective sectoral ministries may be headed by officials from different political parties with disparate interests. Hence, there is often considerable difficulty in bringing about common policies for administration. Administrative policies lack continuity due to frequently changing governments, and this results in a lack of a consistent environmental policy. Operational conflicts also occur as a result of many policies being formulated by bureaucrats. Also, as in many developing countries, decision-making is influenced to a considerable extent by the vested interests of industrialists, political parties, corporations and local authorities. As a result, officials involved in operational implementation are often confused by inconsistencies in policy directives emanating from politicians and bureaucrats, and the environmental problems are still unsolved (Global Environmental Forum, 1999; Chantadisai, 2004).

Since the public sector reform in 2002, the Thai Government provides most environmental protection under the umbrella of the MONRE. The MOI and the MOPH are also responsible for a small amount of environmental protection. Figure 3.1 presents an overview of Thailand's environment administrative system as at 2005 indicating the environmental legislation relevant to large manufacturing companies. This Figure demonstrates the relationship between departments and responsibility for implementing legislation and plans including the National Economic and Social Development Plan, and the Enhancement and Conservation of National Environment Quality Act.

The MONRE was established in 2002. Its mandate includes the establishment of environmental management policies and quality standards that encompass the broad environment: water quality, air quality, soil quality, conservation of natural resources, waste management, land use, utilization of ground and surface water, preservation of national resources, population-environment balance, integration of environmental education, and provision for tax incentives for the importation and manufacture of pollution control equipment and devices. The MONRE contains several government agencies, each one assuming a lead role and direct responsibility according to its area of expertise, and the others lending a helping hand (Ministry of Natural Resources and Environment, n.d.).

A review of MONRE documents and an analysis of interview results as discussed in Chapter Six, indicates that there are still overlapping functions between the government agencies within MONRE and other Ministries. For example, does the Department of Environmental Quality Promotion (DEQP) have a responsibility to train all the agencies in the MONRE about EM, or should each agency provide training programmes for their staff? Which agency has the main responsibility to monitor EM on individual manufacturing premises? One adverse effect of the overlapping of functions between government agencies could be an increase in the environmental audit cost experienced by manufacturers.

Further research would be needed to determine whether or not these problems may result from the lack of environmental goals, roles, responsibilities and targets for all the government environmental agencies in the National Economic and Social

Development Plan. The problem of unclear direction in the Plan also results in Thailand having various environmental laws and regulations under several agencies from different ministries, for example, MONRE, MOI and MOPH (Global Environmental Forum, 1999; Chantadisai, 2004; Environmental Policy and Planning, n.d.).

Various laws and regulations may confuse manufacturing company managers, the local community members, and potential foreign investors who are interested in economic opportunities in Thailand. Moreover, this problem also cause an increase in the environmental audit cost of manufacturers from inspections by several government agencies, and the government has to increase the budget for each agency to inspect the manufacturers (Global Environmental Forum, 1999; Laplante & Meisner, 2001; Phongpaichit & Baker, 2004).

Even though there are various laws and regulations under several ministries concerned with environmental protection, each regulation may has different purposes. For example, the Public Health Act is used to monitor manufacturers' activities that may impact on public health; the Enhancement of Energy Conservation Act is used to encourage the conservative of energy use by manufacturers (Global Environmental Forum, 1999).

The National Environment Quality Act, 1992 incorporated a number of new measures aimed at implementing effective environmental regulations. This Act established the Pollution Control Committee; creating more stringent environmental standards and setting proper systems; established the Environment Fund to assist polluters in controlling and eliminating their pollutants, provided promotional measures, established civil liability and penal provisions, introduced the Polluter Pays Principle; and encouraged the participation of environmental non-governmental organizations (NGOs) (Office of the Council of state, n.d.). However, introduction of a Polluter Pay Principle process has not yet resulted in changes to government monitor of pollutants.

Environmental legislation under the MOI, The Factory Act and the Industrial Estate Authority Act are authorised to control industrial operations in Thailand. But they also contain a part that is concerned with environmental protection. The Factory Act

was issued in 1992 to control all manufacturers in Thailand (under the DIW), whereas the Industrial Estate Authority of Thailand Act was issued in 1996 to control all industrial estate companies and all manufacturers located in industrial towns (under the IEAT). Both the Factory Act and the Industrial Estate Authority Act contain air, water, noise, and waste and hazardous waste disposal standards. In addition, the MOI has another Act, Hazardous Material Act, to control all hazardous materials that are used by industries (under the DIW) (Global Environmental Forum, 1999; Kasemsri, 2000; International Network for Environmental Compliance and Enforcement (INECE), n.d.). By reviewing these three Acts, they will have the same standard as the National Environment Quality Act, 1992. These results may be used to confirm that the government has a problem concerned with overlapping in administrative jurisdiction occurring between the government agencies in the same ministry.

The Public Health Act is the principle tool used to deal with a factory that is emitting foul odour in local communities, and disturbing the peaceful living of the communities residing close by the factory, since there is no law dealing with odour in Thailand. Some manufacturing companies that have odor problem were claimed against by the Public Health Act because other Acts did not cover odor approach. The Public Health Act is one Act that directly deals with the community's health quality and the manufacturers' activities that may discharge pollutants. Therefore, in many cases community members use the Public Health Act to claim against manufacturers.

The Enhancement of Energy Conservation Act is the only one Act that may encourage manufacturers to develop an EMS, by requiring manufacturers to prepare an energy conservation plan, so as to earn the benefit of a special fee exemption or from grants from the Energy Conservation Funds. It is a good concept that requires manufacturers to prepare an environmental prevention and management plan because each company has different environmental problems and the company's management teams know their company problems better than the government, and the government should apply this concept to use in other Acts. However, the government should also require manufacturers to have environmental management targets, EM processes, and a continuous improvement process in the plan. Requiring manufacturers to prepare an environmental prevention and management plan may benefit both the government and manufacturers to understand each other better, and to encourage coordination of

working between the government and industries, to better assist manufacturers to adopt an EMS.

The variety of solutions to environmental problems are of benefit to the government in solving the overlapping functions between the government agencies and in saving time and budgets spent on inspecting manufacturers. It also benefits manufacturers, the local community members, and investors in an easier understanding of the Thai environmental administrative system and legislation, and they may be happier to work in partnership with the government.

In addition, the National Environmental Quality Act does not mention about the communication channels between the central government and the provincial agencies that may affect the efficiency on monitoring and enforcement processes. According to the study of the German Technical Cooperation Thailand (2001), The Thai environmental standards established under the provisions of the National Environmental Quality Act are adequate. But government agencies responsible for monitoring and enforcement systems have experienced difficulties in establishing the systems that enable them to be effective in monitoring environmental outcomes. The government needs to establish a communication system between the central government and local agencies. A good communication system will help government agencies provide more targeted education and information to assist local communities and encourage them to take part in the preparation of environmental standards and in reporting offending industry.

Moreover, the study of Laplante & Meisner (2001), indicates that industrial wastewater pollution (BOD and TSS emissions) are accounted for by a very limited number of industrial sectors, typically only four or five industrial sectors account for more than 80% of total releases of industrial BOD and TSS emissions. These sectors typically include the following ones: Iron and steel; Pulp, paper and paperboard; Distilled spirits; Dairy products; Sugar factories and refineries; and Fish products. As these results, the government should require these types of industries to adopt an EMS, and prepare an environmental management plan. Laplante and Meisner (2001) also found that manufacturers located in industrial towns contribute only a small percentage of industrial emissions of BOD and TSS. It might be because many

manufacturers located in industrial towns have been monitoring by both industrial town operators and IEAT. On the other hand, manufacturers located outside of industrial towns have been monitoring by MOI only. Also, MOI has the responsibility to monitor manufacturers that located cross the country, but IEAT monitors only manufacturers located in industrial towns.

3.6 THAILAND'S INTERNATIONAL COOPERATION ON ENVIRONMENT

Even though Thailand's economic growth has been rapid, environmental concerns still require the attention of domestic and international partners. Thailand is a participant in many international agencies and discussions that are concerned with environment, trade, and development issues. Also, Thailand was an early member of the United Nations (UN) and all its relevant organisations, Association of Southeast Asian Nations (ASEAN), the World Bank, and Asian Development Bank (ADB).

The Thailand Government has agreed with international agency partners to give priority to pollution prevention, pollution control, natural resources management, and other programmes for enhancement and conservation increasing the environmental quality. In last decade, the Government of Thailand has received funding from several developed countries such as Japan and the United States. Also, Thailand still receives grants funding and technical advisory help from ADB, the World Bank, the United Nations Environment Programme, and United Nations Development Programme (United Nations, n.d.).

To promote international cooperation in the Southeast Asian region, Thailand is a member of ASEAN. ASEAN inaugurated its environmental cooperation in 1977. One of ASEAN awareness of the environment programmes used by the member nations is the designating of the ASEAN Environment Year. This initiative started in 1995 and the programme will be held every three years (Association of Southeast Asian Nations (ASEAN), n.d.).

The theme of the year 2003 was "Together Towards Sustainable Development". The programme emphasises the cooperation and commitment between member nations in

working together to achieve sustainable development. In addition, ASEAN still has other programmes concerned about environmental quality such as ASEAN Vision 2020 and ASEAN Strategic Plan of Action on Environment (SPAEE). The SPAEE recognises that environmental problems are beyond national boundaries, and that the problems cannot be solved unless ASEAN works collectively (Association of Southeast Asian Nations (ASEAN), n.d.).

Moreover, the Government of Thailand signed several international legal agreements concerning environmental prevention and control. The list of major international agreements signed with participating countries is included within Appendix Seven.

3.7 CONCLUSION

This chapter has reviewed the background concerning environment issues in Thailand Government agencies and international organizations such as the United Nations (UN), Association of Southeast Asian Nations (ASEAN), and International Network for Environmental Compliance and Enforcement (INECE).

Much of the material has focussed on the issues associated with the rapid industrialisation of the nation and resultant significant environmental problems. The Government has acknowledged all environmental problems and is trying to deal with them. However, it is very important that the Government clearly understands the implications of the environmental approaches, environmental management systems, and the practices of the various government agencies concerned with implementation and monitoring of environmental policy. Where possible proactive tools to be used to avoid some environmental problems being experienced, rather than simply relying on remedying problems.

Environmental functions are mainly managed by the Ministry of Science, Technology and Environment (MOSTE), with some functions given other ministries such as MOI and MOPH. The MOSTE contains too many functions concerned with science, technology, and environment. Which although complementary, take up much of MOSTE's resources. In 2002, it seems like the Government knows of this problem,

and has started reforms of various structures within which a new Ministry to manage an environment was established. As the result of the Government reform in 2002, the Ministry of Natural Resources and Environment (MONRE) was established to directly control and gather all functions concerned with environmental management and policy in one ministry. The MONRE took over all functions concerned with environment from the MOSTE, and MOSTE was renamed to the Ministry of Science and Technology (MOST).

The Government believes the environmental problems will be solved by the MONRE. However, there are still have some overlap functions between ministries such as overlap functions concerned with industrial pollution problems between the MONRE and MOI. In addition, any ministry is empowered to issue regulations as ancillary provision such as the MOI has Factory Act and the Industrial Estate Authority of Thailand Act. As the results of many regulations concerned with environment, there are still have some different environmental standards and monitoring standards between manufacturers in industrial towns and outside of the towns. However, any environmental legislation and EMS in Thailand have to comply with the Enhancement and Conservation of National Environment Quality Act.

In the next chapter, Chapter Four, the researcher explains the research design that use triangulation methods to compare the EMS that select by industry in industrial towns and industries located generally in other areas of the Chonburi Province. Also, the researcher provides information about the researcher population and the methodology that this study uses to analyze both quantitative and qualitative data. Moreover, the chapter explains a definition of validity and reliability, and the methods that this research uses to improve the quality of the study.

CHAPTER 4: METHODOLOGY

4.1 INTRODUCTION

This chapter provides an overview of the methodology used in the study. The purpose of this chapter is to explain the methods that were used in the research and to provide information about the data analysis methods. There are a number of theoretical considerations which influence the choice of information gathering methods and analytical techniques in any study. All methods have strengths and weaknesses that should be explored before a methodology is adopted. The chapter is divided into two major parts that firstly reflect general matters and secondly the nature of the defining methodology.

The first part of the Chapter (section 4.2) explores the theoretical considerations for the methodology. This section discusses the meaning of qualitative and quantitative methods and the advantages and disadvantage of each approach and it introduces the triangulation method of the study. It also presents a definition of validity and reliability, a difference between validity and reliability and how to use both qualitative and quantitative approaches in order to increase both the validity and reliability of any study. The section concludes with a discussion of the ethical issues associated with the methods of collecting data in this research.

The second part of the Chapter (section 4.3) outlines the various methods used which were, a questionnaire, individual interviews, observations and documentation used in this study. In addition, it outlines the methods used to collect data from different sources so that the reliability and validity of the study are increased.

4.2 THEORETICAL CONSIDERATIONS FOR METHODOLOGY

Some writers argue that the distinction between qualitative and quantitative research is an artificial one. For example, Crotty (1998) argues that “in most research textbooks,

it is qualitative research and quantitative research that are set against each other as polar opposites. Just as the student of Latin is taught very early on via the opening lines of *Caesar's Gallic Wars* that 'All Gaul is divided into three parts', so every beginning researcher learns at once that all research is divided into two parts-and these are 'qualitative' and quantitative', respectively. Our model suggests that this divide-objectivist research associated with quantitative methods over against constructionist or subjectivist research associated with qualitative methods-is far from justified". In this research, for ease of discussion I will assume that there is a distinction and follow the argument put forward, among others, by Cassell and Symon (2004). They note that there are two major philosophical positions from which research methods are derived in the social science studies area. The first of these is *positivism*, that is based on the assumption that there is an objective truth existing in the world, which can be revealed through scientific methods. It asserts that social science research should be measured by using objective means to gather facts. It relies on quantitative methods and measurements should be valid, reliable and generally stable.

The second position is *phenomenology*, which emphasises an explanation, based on appreciating and understanding the different constructions and meanings that depend on experiences. There is no objective or clear-cut reality and researchers use qualitative methods to gather data, which they then attempt to accurately describe and interpret (Ghauri & Gronhaug, 2002).

The main differences between qualitative and quantitative methods are in the procedures used and in the emphasis and objectives of the study. Data collected qualitatively may be coded in such a way that statistical techniques may be used in analysis (Thomas, 2004).

Qualitative research is an umbrella term that covers several styles of social science research and it draws on many disciplines, such as sociology, social anthropology, social psychology and the business field of study (Denscombe, 2003). Thomas (2004) defines qualitative methods as an array of interpretive techniques, which seek to describe, decode, translate and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world.

So whilst the qualitative approaches have a number of advantages, they also have some important limitations. One limitation is that there is considerable room for ambiguity, since the research reflects the perceptions, beliefs and attitudes of individuals and as such it is highly subjective (Davis & Smith, 2005). This makes the research data difficult to interpret because it may have many different interpretations. It is difficult to rank order and attribute value to responses, since each response is as valid as the next. However, this makes qualitative techniques well suited to constructs like quality, where there is a strong subjective element (Thomas, 2004).

Many qualitative methods are simply devices whereby the researcher, once close to an organisational member, can gain the type of insights into people and situations he/she requires. Other methods are useful as aids or tools to help the respondents think about their own world and consider, possibly for the first time, the way they construct their reality.

Both Ghauri & Gronhaug (2002) and Davis & Smith (2005) accept that a variety of research methods may be needed. Research data can arrive in a variety of formats, such as fieldwork notes, interview transcripts and texts. Whatever the format, everything needs to be organised before it can lend itself to a process of analysis.

The use of quantitative data in social research has its attractions. Essentially, it carries a scientific respectability, because it uses numbers and can present findings in the form of both graphs and tables. It also conveys a sense of solid, objective research (Ghauri & Gronhaug, 2002). Quantitative methods are easy to code and interpret. They can be replicated with different groups of subjects, they lend themselves to statistical analysis and they are less prone to criticisms about validity and reliability. However, used alone, quantitative methods run the risk of overlooking important variables as they tend to be driven by the statistics rather than the data (Greenfield, 2001).

Statistical tests of significance give researchers additional credibility, in terms of the interpretations they make and the confidence they have in their findings. The analysis of quantitative data provides a solid foundation for description and analysis. Interpretations and findings are based on measured quantities rather than impressions

and these are, at least in principle, quantities that can be checked by others for authenticity (Ghuri & Gronhaug, 2002).

Large volumes of quantitative data can be analysed relatively quickly, provided adequate preparation and planning has occurred in advance. Tables and graphs provide a succinct and effective way of organising quantitative data and communicating the findings to others. Widely available computer software aids the design of tables and graphs and removes most of the hard work from statistical analysis (Marshall & Rossman, 1999).

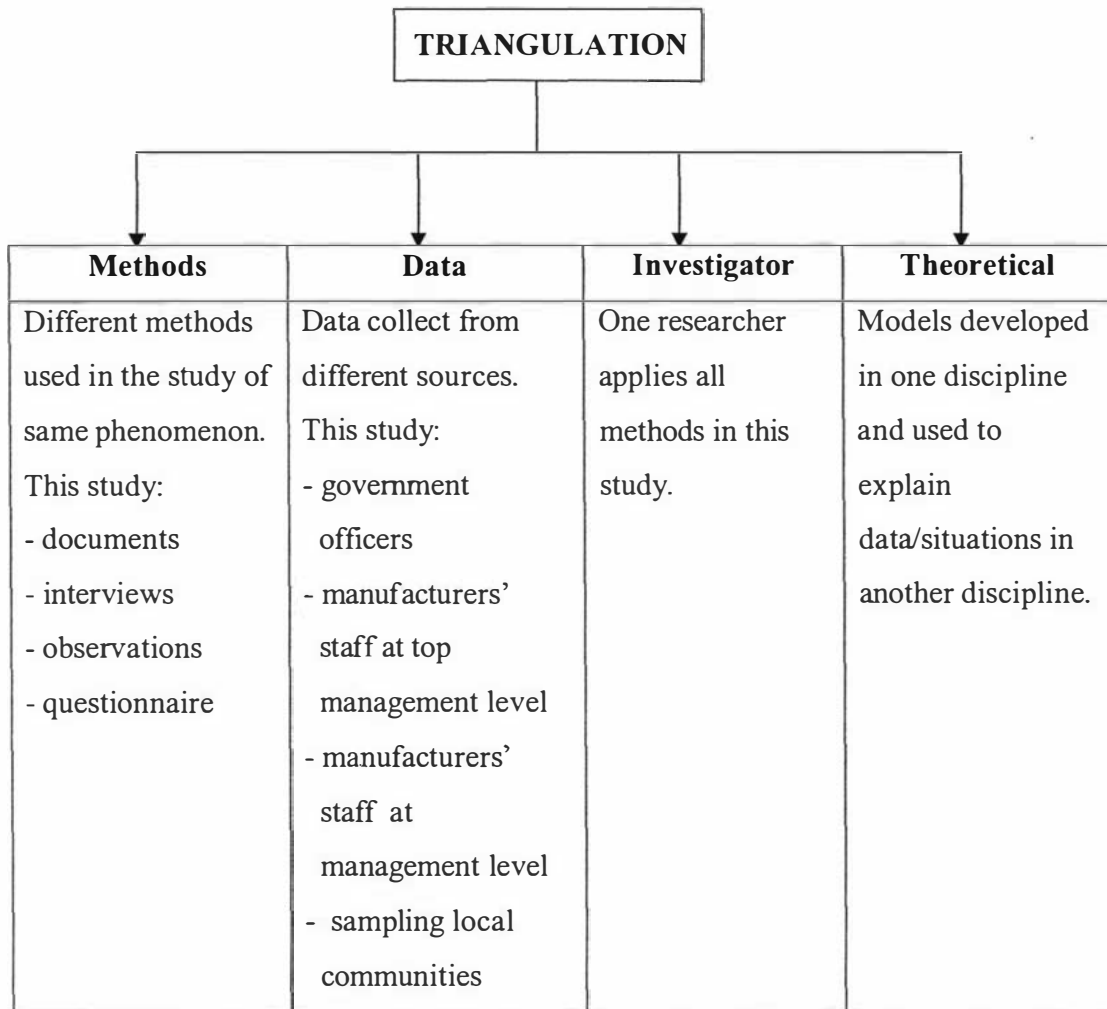
However, quantitative methods also have disadvantages. There is a danger of researchers becoming obsessed with the techniques of analysis, at the expense of the broader issues underlying the research. Particularly with the power of computers at researchers' fingertips, attention can sway away from the real purpose of the research, towards an overbearing concern with the technical aspects of analysis (Denscombe, 2003). Davis & Smith (2005) mention that large volumes of data can be a strength of quantitative analysis but, without care, they can start to overload the researcher. Researchers can get confused with too much complexity within the study. Decisions made during the analysis of quantitative data can have far-reaching effects on the types of findings that emerge. It is a fact that the analysis of quantitative data, in some respects, is no more neutral or objective than the analysis of qualitative data.

An interrelationship of both qualitative and quantitative data is very powerful in research, because it provides a deeper understanding of the issues being analysed and greater validity. The concepts of validity and reliability are discussed in 4.2.2.

4.2.1 Triangulation

Data triangulation is the method whereby data is collected from many sources. It may also include data collection over different time frames, such as in longitudinal studies. This technique of using different methods in the study of the same phenomenon is often referred to as triangulation, specifically methods triangulation (Gross & Yellen, 2004). This study used methodological and data triangulation. Figure 4.1 presents the method of triangulation and how it is relevant to this study.

Figure 4.1: Methods of Triangulation



The technique of triangulation is now widely applied in many disciplines including business and management research (Gross & Yellen, 2004). Methods triangulation enables the researcher to take advantage of the strengths of both qualitative and quantitative research to gain a wider perspective on the quality of environmental management. For example in this study, the interviews illuminated the construct of quality in terms of the beliefs, attitudes and values of the participants, a relatively small sample whose views were not necessarily representative of the population under study. The administration of questionnaire allowed data to be collected about the prevalence of these views and more valid conclusions to be drawn about the meaning of quality for the larger population. So the use of multiple methods increased the validity of the study.

Methodological triangulation is also a useful way to gather large amounts of data. There is a limit to the amount of qualitative data that a researcher can handle as it takes a great deal of time to code and interpret it. As a consequence, it is difficult to study large populations in this way. However, using quantitative methods which generate data that are easily coded and analysed facilitates the collection of large quantities of data. So there are often sound pragmatic reasons for using multiple methods.

As mentioned earlier in Chapter Two, EMAS requires systematic interaction between manufacturers, the government, and the local community. Therefore, the data of this study are collected from four different sources in relation to an understanding of the major dimensions of the environmental management quality of large manufacturing industry in Thailand – government officers; manufacturers' top management level staff; manufacturers' management level staff; and local community members. For a concept such as quality, which is strongly subjective, assessing or measuring it depends on understanding what it means to many different people who may be affected by it. The more opinions of different groups of stakeholders that can be tapped, the more the concept will be illuminated. This will enhance construct validity which is in line with Gross & Yellen's (2004) suggestion that understanding a social phenomenon requires its examination from different perspectives and/or under a variety of conditions.

There are expected outcomes that might result from triangulation methods. The first of these is *convergence*, whereby data from different sources, methods or investigators will provide evidence to support a single proposition. The second outcome is *inconsistency*, when the evidence presents alternative propositions, which may contain inconsistencies and ambiguities, whilst the third outcome is where the data are actually contradictory. Thus triangulation highlights areas of both congruence and incongruence in a study (Davis & Smith, 2005). Beebe (2001) says the value of triangulation is that it is a technique which provides more and better evidence, from which researchers can construct meaningful propositions about the social world.

The four methods used in the research for data collection, are literature review; individual interviews; the questionnaire; and observations and will be discussed after validity and reliability.

4.2.2 Validity and Reliability

Davis & Smith (2005) mention that measurement is concerned with the assignment of numerals to objects or events, according to rules. Measurement devices are numerous and diverse, but we know that three components are necessary for measurement to take place: observable empirical events, the use of numbers to represent these events and a set of mapping rules. Ruane (2004) notes that reliability means the consistency with which a set of test scores measures 'whatever they do measure', whilst validity means the accuracy with which a set of test scores measure 'what they ought to measure'.

Validity and reliability have a definite positive connotation. Anything characterised as reliable and valid should be described in positive terms, as it is with any type of measuring procedure, experiment or test. Reliability is basically an empirical issue, focusing on the performance of empirical measures. Validity, in contrast, is usually more of a theoretically oriented issue, because it inevitably raises questions (Crana & Brewer, 2002). The difference between validity and reliability can be illustrated with the example of a rifle being fired at a target. If successive shots are closely clustered, the rifle is performing reliably. However, for the rifle to be performing validly, the shots must also be clustered within the bulls-eye (Davis & Smith, 2005).

Crana & Brewer (2002) define validity as the extent to which any measuring instrument measures what it is intended to measure. A measurement scale is valid if it does what it is supposed to do and measures what it is supposed to measure. If a scale is not valid, it is of little use to the researcher, because it is not measuring or doing what it is supposed to be doing.

Validity is usually categorised as two major forms with which researchers must be concerned: internal and external validity (Zikmund, 2003). Internal validity refers to the degree of confidence that the results are true, given the study situation, whilst

external validity refers to the degree to which the study's results can be generalised across populations, settings and other similar conditions (Thomas, 2004). Ruane (2004) mentioned that external validity applies to experimental situations where one can have an experiment with pre-test and post-test but "those findings, however, can not be generalized to the organization world, where a pre-test is seldom administered to employees to be followed up by a post-test. Thus the effects of the treatment will not be the same in the field, which reduces the generalisability". This study is only concerned with internal validity because this research studies only large manufacturing companies in Thailand and it would be unwise to generalise its findings in other sized manufacturers, or other countries.

There are three basic types of internal validity: content, criterion and construct validity. Content validity is the extent to which adequate coverage has been provided for the topic under study (Clipson-Beyles, 2000). Fundamentally, content validity depends on the extent to which an empirical measurement reflects a specific domain of content. Related to this is the concept of face validity, where Ruane (2004) notes that there is no doubt it reflects a positivist position and this also highlights the dangers of relying on a single indicator of validity. These researchers could also be interpreted as adding support to the notion of using both qualitative and quantitative techniques. Panels, consisting of appropriate people, may be used to assess questions or test items. Often content validity is determined by groups of people, already involved in the research, agreeing on the elements that constitute adequate coverage of the topic and defining relevant dimensions and measures. Any instrument developed must then reflect these elements and dimensions.

Davis & Smith (2005) have given a definition of construct validity. Construct validity is, "the degree to which the measurement scale represents and acts like the concept being measured" (p.186). Attitude scales frequently fall into this category. In attempting to determine construct validity, a set of propositions based on theory is associated with the results derived from using a measurement tool. If these correlate in a predicted way then some construct validity can be inferred (Ruane, 2004). Denscombe (2003) notes that construct validity includes both convergent and discriminate validity. Convergent validity is the degree of association between two different measurement scales, that purport to measure essentially the same concept.

Conversely, discriminant validity is the degree to which the measurement scale may be differentiated from other scales purporting to measure different concepts.

Criterion or criterion-related validity is the degree to which the scale under study is able to predict a variable, and that is designated a criterion (Davis & Smith, 2005). It may be used to predict an outcome and it is known as predictive validity. An opinion poll that correctly forecasts an election result has predictive validity. The other form of criterion validity is concurrent validity which uses a criterion to estimate the existence of a behaviour or condition. As the name implies, the measures of the criterion and the behaviour or condition must be taken at the same time. Criterion validity is always empirically based and therefore provides a more rigorous approach to validity. However, it is important that the criterion measures, themselves, are valid and they should be judged in terms of qualities such as relevance, freedom bias, reliability and availability (Denscombe, 2003).

Thus content validity depends primarily on rational analysis and judgement, while criterion and construct validity are derived mainly from empirical and statistical evidence. These validities are summarised in Table 4.1: Basic Types of Validity in Measurement.

Table 4.1: Basic Types of Validity in Measurement

Type of Validity	Definitions
1. Internal validity.	The degree of confidence that the results are true, given the study situation.
A. Content validity	The extent to which an empirical measurement reflects a specific domain of content.
B. Criterion validity	The degree to which the scale under study is able to predict a variable that is designated a criterion.
C. Construct validity	The degree to which the measurement scale represents and acts like the concept being measured.
2. External validity	The degree to which the measurement scale represents and acts like the concept being measured.

From the preceding discussion, it is clear that content and construct validity, but not criterion validity, are relevant to this study. Content validity is particularly relevant to the first stage of the study, when qualitative methods are used, derived from documents, individual interviews, questionnaires, and observations. It was anticipated that participants in the individual interviews, together with the data obtained from observations and the results of questionnaires would provide the basic elements and thus define the relevant dimensions of the quality for an environmental management system.

The individual interviews questionnaire, and observations are also an important step in construct validity. The ideas and concepts generated by them would test the major construct of the quality for an environmental management system identified and discussed in the literature and it would also help highlight the topic. The study then has used a mixture of qualitative and quantitative methods from which both content and construct validity were derived.

The major concern in validity is the appropriateness of the interpretations being made from the data, but in reliability the major concern is with the consistency of the results. "Reliability is concerned with estimates of the degree to which a measurement is free of random or unstable error" (Cooper & Emory, 1995, p.153). Reliable instruments are robust, work well over different times and in different conditions and allow the user to have confidence in the results. As with validity, reliability does not refer to the instrument itself, but to the results obtained with that instrument. However, unlike validity, reliability is primarily statistical. It always estimates a particular type of consistency and should not be treated as a general characteristic. The appropriate type of consistency will be dictated by the use to be made of the results (Davis & Smith's (2005).

Stability refers to the ability of an instrument or assessment technique to secure consistent results with the same person, given repeated measurements over time. This is referred to as the test-retest method. If the measure is stable over time and administered under similar conditions, similar results should be obtained. A coefficient of stability, r , is calculated and the closer this is to 1.00, which is a perfect positive relationship, the more stable the results and 0 is perfectly unreliable (Ghauri

& Gronhaug, 2002). This method has limitations, however. For example, subjects may remember how they answered questions the first time, they may become “test wise” or sensitised to the topic, or with an attitude survey, they may be subject to influences that alter their opinions between test administrations.

Linn and Gronlund (1995) suggest that these problems can be largely overcome by using test-retest in combination with equivalent forms which will yield measures of both stability and equivalence. Normally equivalent or parallel forms, which are alternative versions of the same instrument designed to be as equivalent as possible, are administered straight after one another to the same group of subjects. This known as item equivalence. However, this may lead to subject fatigue which can bias results so they suggest a delayed time interval between the two administrations to combat this problem. Ghauri & Gronhaug, 2002) sound a note of caution by pointing out that it is still rare to find forms that are fully equivalent and interchangeable.

Equivalence is also concerned with variations at a point in time among observers. In this case the scoring by different observers of the same event is correlated to give an interrater reliability index of how consistent their ratings are (Cooper & Emory, 1995). Estimates of equivalence are also expressed as correlation coefficient r .

A reliability measure is not suitable for use at this stage of this research, because the research was carried out on large size manufacturing companies in Thailand and it would be unwise to generalise its findings towards small and medium manufacturers, or manufacturers in other countries. Small and medium manufacturers have different characteristics from large manufacturers and they may well have different conceptions of quality, as well as different needs, particularly in terms of the quality of an EMS. Manufacturers from other countries may also have conceptions, cultures and needs which are different from manufacturing companies in Thailand.

The four methods use in the survey for data collection, that is published documentation, individual interviews, observations, and questionnaire will now be discussed.

4.2.3 Published Documentation Review

There are alternative types of documents for research such as books, journals, web site pages, records, newspapers, memos, reports and government publications and official statistics. These all constitute some form of document, which has a value for research. However, researchers have to consider the validity of all data sources (Denscombe, 2003).

For academic research, books, journals, government publications and official statistics should be the first places to instigate the research. Hek, Judd & Moule (2003) mention that the most important sources of research literature are the academic and professional journals. Some journals contain original research articles, some contain summaries or reviews of research, and many journals publish a mixture including case studies and discussion papers. With the rise of evidence-based practice, there are some really important journals that specialise in providing a commentary about the relevance of practice.

Cooper & Emory (1995) explain that books are very useful for their coverage of a subject in some specific reference on some point. Examples include the estimated the population of Thailand and Core Environmental Indicators of Thailand. Also, some edited books contain recent research on a particular topic, and these can be fairly up-to-date resources. In principle, books and journals contain the accumulated wisdom on which the research project should be built and also the latest cutting-edge ideas, which can shape the direction of the research (Davis & Smith, 2005).

Government publications, official statistics and commercial publications generally have their material referred by experts in the field, prior to the work being published, and therefore the researcher has some assurance about the quality of the author's ideas. However, researchers should consider the quality and validity of all sources before use. Some of these documents might provide a really in-depth account of primary research, or an overview of research findings on a particular topic (e.g. environmental standards, company policy, company budget),

Documents obtained from the Internet are one of the more recent modern ways to obtain any information. It is faster and easier than in previous times but Internet documents need to be subjected to the researcher's own quality audit, in line with those recommended in relation to books and journals, but with even more vigour and rigour (Davis & Smith, 2005; and Denscombe, 2003). Most of the information from the internet that is used in this research is from government and international organisations (e.g. the United Nations, ISO, ASEAN websites).

The industrial society has created a wealth of documentation in relation to administration, policy, management, finance and commerce. These provide a source of research data in whatever field they operate. The purpose of most documentation is to enhance accountability. Company records gather a large amount of useful data for social and business research. Records, whether publicly available or on restricted access, purport to depict things that have happened in a full and accurate manner. However, there is ample evidence that such records tend to be partial – in both senses of the word (May, 2001).

The researcher needs to be cautious about accepting company records at face value. Publicly available records reflect upon matters, in a way that is publicly acceptable at a given time and in a given social sphere. They tend to offer a version of reality massaged to meet public expectations.

Government publications and official statistics would seem to be an attractive proposition for researchers in any fields, particularly in social and business research. Most of the principle sources of social and business information are collected in government publication and official statistics. There are also other types of documentary data that can be used for doing research, such as newspapers, magazines, letters, diaries, etc.

4.2.4 Individual Interviews

Although individual interviewing is often claimed to be the best method of gathering research information, it is time consuming to properly undertake interviews and they are sometimes used when other techniques might be more appropriate, depending on

the nature of scale of research (Easterby-Smith, Thorpe, & Lowe, 2002; Denscombe, 2003).

The purpose of in-depth interviewing is not to get answers to questions, nor to test hypotheses or to 'evaluate', as the term is normally used. At the root of in-depth interviewing is an interest in understanding the experiences of other people and the meaning they make of that experience (Patton, 2002).

Denscombe (2003) notes that whether it is large or small-scale research, the nature of the research data collection depends on the total amount of research material available. There are inevitably restrictions on the use of both time and budget and for the researcher it can mean that choices need to be made.

Beins (2004) believes in the importance of all three components of an interview: informants, interviewers and information. The setting in which the interview takes place has a dynamic of its own, together with the variations contributed by the three constituent parts, which influence the reliability and validity of the information. It is easy in a face-to-face interaction to pursue new ideas or leads and skip over unwanted material. Clipson-Boyles (2000) point out that ideas can also be explored in depth, which is important when dealing with complex research topics, such as quality and the individual interviewee can be also encouraged to share as much information as possible. A researcher can approach the experience of people, in contemporary organisations, through examining personal and institutional documents, through questionnaires and surveys and also through a review of existing literature.

4.2.5 Observations

Beins (2004) defines "observational studies" as empirical investigation, in which the objective is to elucidate cause and affect relationships. It is often not feasible to use controlled experimentation, in the sense of being able to impose the procedures or treatments, whose effects it is desired to discover, or to assign subjects at random to different procedures.

Features of this definition deserve emphasis. Observational study may resemble an experiment. A research study without a treatment is neither an experiment nor an observational study (Denscombe, 2003). Observation offers the researcher a distinct way of collecting data. Observation does not rely on what people say they do, or what they say they think but it draws on the direct evidence of the eyes witnessing the events (Beins, 2004).

Denscombe (2003) explains that there are two kinds of observation research used in the social sciences: systematic observation and participant observation. Systematic observation has its origins in social psychology – in particular the study of interaction in settings such as school classrooms. It is normally linked with the production of quantitative data and uses statistical analysis. Participant observation is mainly associated with sociology and anthropology. The researchers infiltrate situations in order to understand the culture as it happens. Participant observation usually produces qualitative data.

4.2.6 The Questionnaire

The term “questionnaire” has been used in several ways. Willis (2005) defines the term questionnaire as a set of questions, including perhaps some open-ended ones, from more rigidly constructed scales or tests. A questionnaire is not some sort of official form, nor is it only a set of questions, which have been casually jotted down without much thought.

Questionnaires rely on written information supplied directly by people in response to questions asked by the researcher. The information from questionnaires tends to fall into two categories: facts and opinions. Questionnaires are usually administered face-to-face with the respondent and can be valuable for social and business research. They are widely used, especially to survey the opinions of the public (Biemer, 2003).

A questionnaire should not be long and complex (Frazer & Lawley, 2001). More pages, with a clear and user-friendly layout, are better than fewer pages with a cramped and forbidding layout. Word processing programmes have made it easy to create an attractive appearance. Brace (2004) points that there is no exact rule about

the number of questions that can be included in a questionnaire. It depends on factors such as the topic under investigation, the complexity of the questions, the nature of the respondents who have been targeted and the time it takes to complete the questionnaire.

Once a survey has been planned, the first step in developing the questionnaire is to construct questionnaire items that will produce the data required by the researcher. There are several types of questionnaires, such as yes/no questions, multiple-choice questions, checklists, rankings, Likert rating scales, etc. All techniques of this type have both advantages and disadvantages (Davis & Smith, 2005). Questionnaire data provides the analyses with an aura of scientific respectability. The analyses then appears to be based on objective laws, rather than the subjective values of the researcher. Additionally, the analysis of quantitative data provides a solid foundation for description and analysis. Interpretations and findings are based on measured quantities, rather than on impressions and these are, at least in principle, quantities that can be checked by others for authenticity (Denscombe, 2003). Finally, questionnaire surveys give respondents time to consider their responses.

4.2.7 Ethical Issues

Any research study carried out at Massey University, using human subjects, has to be approved by the Massey University Human Ethics Committee (see Ethics Committee letter in Appendix Two). Of prime concern are issues of confidentiality and the individual's right to privacy. Personal information about the research population and the need for informed consent from all participants remains the most important factor. A number of methods were used in this study, both to protect and to fully inform the participants from whom data were collected. This project has been evaluated, judged and approved to be low risk by the researcher and his supervisors, under delegated authority from the Massey University Human Ethics Committee.

4.3 THE RESEARCH STUDY IN THAILAND

In Thailand, increasing population and also rapid industrial development has caused a great deal of pollution in many areas (Chantadisai, 2004). Together with this goes recognition of the importance of meeting the needs and requirements of various stakeholder groups. According to the requirement of EMAS, it requires systematic interaction between manufacturers, the government, and the local community (see details in Chapter Two). The main purpose of the study is to understand the major dimensions of the environmental management quality, by sampling the perceptions of the four groups that are concerned with this problem, and these are:

- (1) Thailand government officers in six government departments and three ministries concerned about environmental policy;
 - a. Ministry of National Resources and Environment (MONRE)
 - Pollution Control Department (PCD)
 - Office of the Natural Resources and Environmental Policy and Planning (ONEP)
 - Department of Environmental Quality Promotion (DEQP)
 - b. Ministry of Industry (MOI)
 - Industrial Estate Authority of Thailand (IEAT)
 - Department of Industrial Work (DIW)
 - c. Ministry of Public Health (MOPH)
 - Occupation Health Division, Department of Public Health
- (2) Top management in manufacturing companies
- (3) Manufacturing staff at management level
- (4) The local communities

As mentioned earlier in Chapter Two, all of these groups are interrelated and impact on the other factors. For example, government's responsibility is to provide both manufacturing industries' staff and community members with sufficient information relating to environmental legislation, education, and develop environmental legislation; manufacturing industries have responsibilities to comply with environmental legislation, and produce good production and environmental management processes to improve environmental quality in their companies; and

community members have an important responsibility to help the government to monitor manufacturing industries' activities that may discharge pollutants to community and report the government. Both manufacturing industries and the community should also participate with the government in preparation of environmental standards and legislation.

It is thought that, whilst each of these groups would have the same common perceptions of quality, they would also have other concerns that were different. Furthermore, the emphasis that each group placed on the various dimensions of quality would also be different. Sampling and analysing the views of these four groups could contribute to finding a common understanding of the meaning of quality and other issues.

As stated in Chapter One, this thesis investigated the major dimensions of the quality of the Environmental Management System (EMS) in large size manufacturers, that are located in Amata Nakorn Industrial Town and outside of industrial towns in Chonburi Province, Thailand. In particular, the research examined whether different stakeholders had the same or different perceptions about these dimensions.

It is important to know that most of manufacturing companies in Amata Nakorn Industrial Town are large manufacturing companies. There are only a few medium size companies and no small companies, and if large companies have a poor EMS, they may have more effect on the environment than medium size companies. Therefore, the researcher has to focus on the EMSs that are used in large manufacturing companies only, by sampling the perceptions of four groups of stakeholders in order:

- To evaluate EMS systems used by large size manufacturing companies in Amata Nakorn Industrial Town and compare them with EMS systems used by manufacturers outside Amata Nakorn Industrial Town.
- To analyse the major factors that may affect the quality of environmental management practices in Thai large manufacturing companies.

- To assess manufacturers' staff responses of inside and outside industrial town, in regard to environmental management requirements.
- To assess community responses to environmental pollution problems cause by large manufacturing industries.

This study also answers three main questions:

- What are the Environmental Management Systems (EMSs) used in Thailand?
- Is there a difference between EMSs selected by industries in industrial towns and industries located generally in other areas of Chonburi Province?
- Which EMS is most effective for all types of large size manufacturers (the registered capital being 200 million or above Thailand Baht)?

Data was collected using a questionnaire, individual interviews, observations and published documentation review. I may take advantage from triangulation, combining the strengths of both qualitative and quantitative research methods, in order to gain a wider perspective on the phenomena being studied. For example, in this research, individual interviews highlighted the construct of the environmental management systems' (EMS) quality, in term of the attitudes, opinions, beliefs and values of the subjects which were a relatively small sample, whose views were not necessarily representative of the whole population under study. The questionnaire enabled data to be collected about the prevalence of these views and more valid conclusions to be drawn about the meaning of quality for the larger population. Therefore, using multiple methods increases the validity of the study. Figure 4.2 shows the research study processes.

Due to the limitations of time and budget, it is unlikely that I would be able collect information from the entire target population. Therefore, I collected information by using a cluster sampling technique to select a sample from the target population of both local communities and manufacturing companies.

There are three sampling techniques: cluster; quota; and convenience sampling techniques, which are use in this research. Firstly, cluster sampling is a sampling

technique where the entire population is divided into groups or clusters and a random sample of these clusters is selected. This technique is also used when a random sample produces a list of subjects so widely scattered that surveying them would prove to be far too expensive. Cluster sampling can also be referred to as multi-stage sampling, as the researcher selects the sample by following through a number of stages (Malhotra & Birks, 2003).

Secondly, quota sampling, the purpose of which is to ensure that several sub-groups in a research population are represented on pertinent sample characteristics, to the exact extent that the investigator desires. Stratified research sampling, a probability sampling procedure, also has this objective and it should not be confused with quota sampling (Zikmund, 2003).

Thirdly, convenience sampling is the method where researchers or field workers have the freedom to choose whoever they encounter. This technique has no controls to ensure precision, but it may still be a useful procedure. Often the researchers will take such a sample to test ideas and attitudes of the research objectives.

This study only sampled five manufacturing companies in Chonburi Province. Ideally a larger sample of eight to ten companies would have been preferred but given the limitations of access, time and financial budgets the sample was restricted to five. Two of the manufacturing companies are located in Amata Nakorn Industrial Town and three manufacturing companies are located outside of the Town. In addition, the local community was divided into four communities. One community in the industrial town area and three communities around each of the three sample manufacturers that are located outside of the Town.

There are a large number of manufacturers both in and outside of the Town. Manufacturing companies were broken down so as to focus on only large size companies (there are only 59 large manufacturers in Chonburi Province – see Table 4.2). A cluster sampling technique was then used to cluster five manufacturers into two categories: two manufacturers in the Town and three manufacturers outside of the Town. A list of manufacturers' names were put into the computer and then the computer was used to produce a sample of five sample manufacturers.

The local communities' members are sampled using the five representative groups below (by cluster sampling technique), and then quota and convenience sampling techniques were used to survey one person from each of the five representative groups (five people from each community).

- Community leaders (e.g. district chief officer, university lecturers)
- Environmental groups (NGOs)
- Religious communities
- Women's group
- Others sectors of industry (e.g. agriculture)

There are reasons that five groups were selected to represent the local community. For example, all community members usually discuss their local problems with both community leaders and religious leaders (e.g. monks). Environmental groups (NGOs) are organisations who are directly concerned with environmental problems in the local community. Women's groups are concerned with environmental pollution problems because their children could be affected. Environmental pollution problems may also affect other sectors of industry (agriculture), who should also be consulted.

The number of large manufacturing companies, used in this survey study was, therefore, limited by the following factors:

1. The cost of fieldwork in Thailand, including travel to and from New Zealand and within Thailand
2. Period of time able to be spent in Thailand
3. The potential completion of the questionnaire by respondents through interviews, because most top management and management level staff are busy people.

4.3.1 Published Documentation Review for the Study

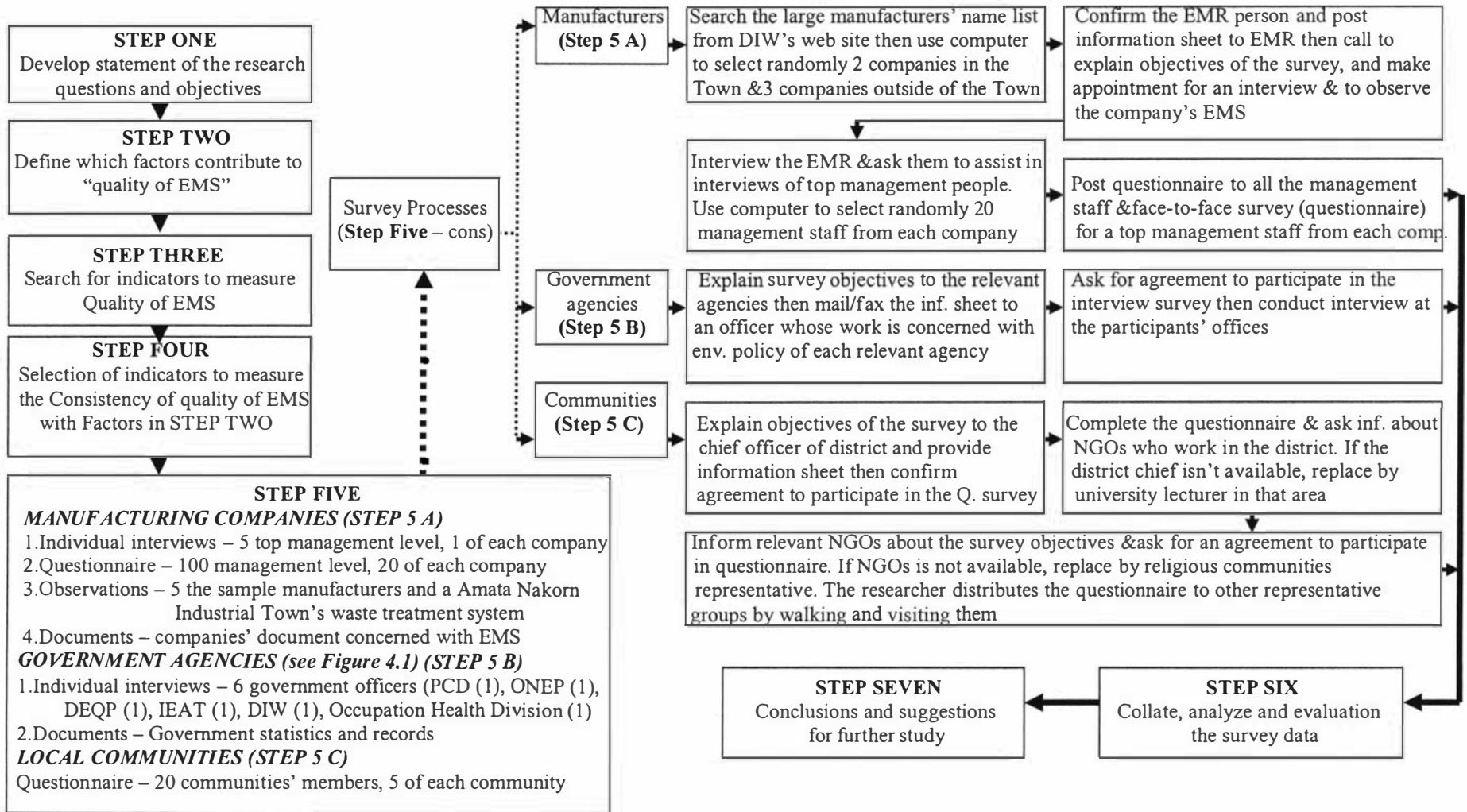
Denscombe (2003) points that in the social sciences, library-based research, archive research and others are all types of research in which the data comes from documents.

This comparative research used many types of literature, such as academic journals academic books, government publications, official statistics, the manufacturers' records and the Amata Nakorn Industrial Town report.

Many available academic and professional journals and books are case studies, reviews of research, discussion papers concerned with EMS and industrial environmental management in Thailand and worldwide. Therefore, both academic and professional journals and books were used as the main literature of this study because there are mostly of relevance evident-base practice and specialize in provide a commentary in this area of study.

However, there is still other literature that was used in this study. For example, the relevant documents from government departments and companies, concerned with quality of environmental management systems was used in this study, such as the Pollution Control Department, The Industrial Estate Authority of Thailand, Amata Nakorn Industrial Town Office and the sample manufacturing companies, were contacted and permission was requested to search their data. A letter of thanks was sent to all contact persons. The published documentation review data is reported in Chapters Three and Six.

Figure 4.2: The Research Study Process



4.3.2 Individual Interviews for the Study

The strength of an interview technique clearly lies in the ability to observe interaction on a topic (Thomas, 2004). The interviews for this study were conducted with government officers and the companies' top management level staff, during which the construct of quality in EMS was explored.

In semi-structured interviews (see Appendix Three), the researcher still has a clear list of issues to be addressed and questions to be answered. However, in a semi-structured interview, the interviewer is prepared to be flexible, in terms of the order in which the topics are considered and perhaps, more significantly, to let the interviewee develop ideas and speak more widely on the issues raised by the researcher. The questions are open-ended and there is more emphasis on the interviewee elaborating on points of interest. The same questions were used to interview both government officers and the manufacturers' top management level staff.

Individual, face-to-face interviews, might only provide the researcher with access to individuals who will answer the questions. These highly structured interviews are based on a carefully prepared set of questions and they are refined until the researcher is convinced of their validity.

4.3.2.1 Thailand's Government Officers in the Ministries concerned about Environmental Policy

By reviewing the Thai government document on the environmental policy, there are only six government agencies from three ministries whose work is concerned with environmental policy. Government officers in these six government agencies, who have direct influence on matters of quality for environmental management policy, were defined as government officers in The Ministry of Natural Resources and Environment (MONRE), The Ministry of Industry (MOI) and The Ministry of Public Health (MOPH).

Individual interviews were held with one government officer from each of the six government agencies concerned about environmental policy. These officers were

selected because their job profiles, compared to others, emphasised more their duties for environmental policy. All interviews were conducted during work hours. Uninterrupted time was requested and granted, with each interview tape recorded and transcribed ready for data analysis.

A letter and information sheet was sent to each government officer sampled, in each of the relevant government agencies (see Figure 3.1). These explained the purpose of the research and an interview was requested (see Appendix Four). The information, provided by me, met the requirements for informed consent, gave an assurance of confidentiality and explained that the interview tape and/or transcript would be available on request. This was followed up several days later with a phone call and a time was arranged for the interview. A letter of thanks was sent after each interview was completed.

4.3.2.2 Top Management Level Staff in the Sample Manufacturers

In this research, individual interviews were held with one of the top management level staff within the five sample manufacturers (total of five staff). These five, although they had different job titles, their main responsibility was that of environmental management representative (EMR). Similar to the sample government officers, a letter and information sheet was sent to each sample top management staff, to explain the purpose of the research and to request an interview (see Figure 4.1 and Appendix Four). In addition, this was followed up with a phone call and letter of thanks after the interview was completed.

In this study, large manufacturers are classified as those with a registered capital at 200 millions Thailand Baht or above (1 New Zealand dollar = 20 Thailand Baht). The number of manufacturers in Muang District, Chonburi Province, Thailand is shown in Table 4.2.

Table 4.2: The Number of Manufacturers in Muang District, Chonburi Province

	Number of Manufacturers
Total manufacturers in Muang District	806
1. Manufacturers in Amata Nakorn Industrial Town	
- Small and medium manufacturers	70
- Large manufacturers	47
2. Manufacturers outside of the Town	
- Small and medium manufacturers	677
- Large manufacturers	12
Total number of large manufacturers	59

Source: Adapted from the list of manufacturers in Chonburi Province 2000; Ministry of Industry, Thailand, 2001

From data in table 4.2, the decision was made to sample one top management staff person from each of two large size manufacturers in Amata Nakorn Industrial Town and one top management staff person from each of three different manufacturers outside of the Town, with the requirement that each was also an EMR person in these companies. It was important to explore the same questions whilst interviewing all the participants.

4.3.3 Observations for the Study

Thomas (2004) believes that observation is a time and cost efficient method for exploring a topic. According to Ghauri & Gronhang (2002), one of the advantages of the observation technique is the opportunity to observe a large amount of interaction on a topic, within a limited period of time.

Observations were made on how environmental management systems (EMS) are implemented across all the five sample manufacturers; also the operation of the central waste treatment system in Amata Nakorn Industrial Town was observed. In addition, any differences were noted between companies in the implementation of EMSs. For example, during the observation the companies were asked to show to me the records of the EMS audit and the records of environmental complaints; all records of environmental pollution problems in the production line (noise, smell, dust pollution in production line); and evidence of the existence of a continuous improvement process (how does the company solve environmental pollution problems?). These observations helped me to reduce bias from the questionnaire and interview data.

The letter and information sheet, providing details about the observation on the environmental management system (EMS), were sent to each of the environmental management representatives (EMR) / production managers of the participating companies and included those in Amata Nakorn Industrial Town. The information provided met requirements for informed consent and explained that the researcher may take photos during some of the EMS processes. This was followed up with a phone call several days later and a time was arranged for the observation. A letter of thanks was also sent after the observations were completed.

4.3.4 Questionnaire for the Study

The research used a questionnaire (see research questionnaire in Appendix Three) to collect response data from both the manufacturers' staff and the local communities, about the environmental management systems that are used by large manufacturers in Chonburi Province, Thailand. The responses of both the manufacturers' staff, in the two sample manufacturers in Amata Nakorn Industrial Town, and the three sample manufacturers outside of the Town were surveyed.

The purpose of the questionnaire survey was to evaluate: the environmental management system used by large industry in Thailand, the differences between EMS used by industry in Amata Nakorn Industrial Town, and industries located outside of

the Town. A map of the sample manufacturers both in and outside of the Town is shown in Appendix One).

The questionnaire includes 39 questions in three major sections. The first section provides background information about respondents. It contains details about the ages, gender, education, and work experience. The aim for collecting this information is to provide a background to the reader of the sample respondents and to reflect that background to the general Thai population. The next section provides information to identify manufacturers' staff opinions about how environmental management systems (EMS) are used in their companies. Questions in this section deal with the frequency of the audit cycle and the use of the environmental audit results. The final section refers to the views of community representatives about environmental responsibility of the industries (see the questionnaire in Appendix Three).

The questionnaire was distributed to the sample manufactures, both in Amata Nakorn Industrial Town and outside of the Town. The manufacturers' staff population included one top management level staff and 20 management level staff from each sample manufacturer. After finishing the interview with the company's Environmental Management Representative (EMR), the EMR was asked to assist to obtain a company staff name list, then a computer was used to select randomly one top management and 20 management level staff of each from the sample companies. The top management level staff, involved in the questionnaire part of this research, are defined as department managers or persons in higher positions, whose work is concerned with the environmental management system. There are approximately 10-15 top management level staff and 80-200 management level staff at each of the sample companies, whose work was concerned with the EMS. To ensure that there was a high response rate the questionnaires were not send to these managers but I made an appointment with them and went though the questionnaire with them filling in their responses.

This research used mailed questionnaires to gather data from management level staff, which in this research are defined as supervisors or senior officers in the production, personnel, facility and administration departments of the sample companies. The questionnaire's covering letter (see Appendix Five) assured anonymity, in that no

individuals could be identified from their responses. The questionnaire was translated into the Thai language by the researcher, because most of Thailand's residents speak and read in this language. The responses were then translated back into English by the researcher, for the purpose of this research. Being a native Thai speaker, the researcher had intimate knowledge of the aims of the research. The researcher is confident that the quality of the translations and retranslations are of a high standard.

Before the questionnaire was distributed to all respondents, a pilot was pre-tested with Mr. Pinyo Ounsuvan, Department Manager, Facility Department, who is the Environmental Management Representative (E.M.R.) of Toshiba Semiconductor (Thailand) Co. LTD and Mr. Thanapat Sornkul, Managing Director of Amata Facility Services Co. LTD. Mr. Pinyo and Mr. Thanapat were chosen because of their long experience managing industries in industrial towns and both have an interest in improving the application of environmental management systems (EMS) by industries. Davis & Smith (2005) consider a survey pre-test is important to gauge the readability of the survey and to ensure that the questions are understandable and can be answered consistently.

The survey results are grouped according to the four major parts of the environmental management system (EMS) (see Chapter Two). In addition, at the end of the questionnaire for manufacturing staff, there are seven more items, which asked respondents to rate the effectiveness of seven different groups in communication in Items 23 to 29.

A face-to-face survey was used for the respondents in the four local communities in the vicinity of the target manufacturers. A quota sampling technique was used to determine the sample size. Individual respondents were selected by word of mouth using community leaders' involvement.

There are eight items in the community survey which require a response on a five point Likert scale (questions 30 to 37) and two questions (questions 38 and 39) are multiple choice. The survey response from the community attracted quite a large number of the population. The population of Muang District, by age and employment,

is shown in Table 4.3. The population of Muang District, by municipal and non-municipal area, is shown in Table 4.4.

Table 4.3: The Population of Muang District, by Age and Employment, in the Year 2000

		Population (%)
1.	Population by Age Group	
	- 0 – 14 years	20.7
	- 15 – 64 years	71.4
	- 65 years or above	7.9
2.	Employment Characteristics of Population	
	- Population in the Industrial Sector	76.2
	- Population in the Agricultural Sector	23.8

Source: Adapted from Population and Census Report; National Statistical Office, 2002

Table 4.4: The Population of Muang District, by Municipal and Non-municipal Area

		Population (%)
1.	Living Area	
	- Municipal area	183,317
	- Non-municipal area	62,081
2.	Population in Working Age Group	
	a. Industrial sector	
	- Municipal area	99,737
	- Non-municipal area	33,776
	b. Agricultural sector	
	- Municipal area	31,151
	- Non-municipal area	10,550

Source: Adapted from Population and Census Report; National Statistical Office, 2002

The questionnaire was distributed (by hand) to the sample population in the working age group (15 – 64 years) in the agricultural sector and in the five community representative groups (see Figure 4.3). The total population in the agricultural sector, in the working age group, is around 30,000 people.

In this study, the local community is divided into four communities, the local community in the vicinity of the target manufacturers (as mentioned on page 128), and five individuals representing different stakeholders (one person from each community representative group), who were selected from each of the four communities (a total of 20 persons) using the sampling approach described earlier in the Chapter. The researcher distributed a total of 10 questionnaires to survey the opinions of these communities.

The statistical analysis is the examination of the level of statistical difference between the responses of the two groups on all questions. The Mann-Whitney U Test is used for this purpose. This test was chosen because it is a powerful non-parametric test and the sample size is small and, therefore, a fair measure for the data. It avoids the limiting assumptions of the parametric t Test, which requires data to be drawn from normally distributed populations, and is appropriate to use with two independent samples if the data are at least ordinal. Zikmund (2003) claims that the Mann-Whitney U Test is the most useful alternative to the powerful parametric t Test where nonparametric data are being examined. The statistic U Test will tell us whether the separation of the two sets of ranks is sufficient to warrant the rejection of null.

The Mann-Whitney U Test uses ranks rather than means, and overcomes the assumption that the number on a Likert scale represents equal intervals or values. It was postulated that there is no significant difference in perception of environmental management system quality between both the manufacturing staff in and outside of the Town and the communities in and outside of the Town (see Chapter Four, Methodology).

In order to test this hypothesis, the Mann-Whitney U Test is applied to the following groups:

1. The sample manufacturing staff in the Town and outside of the Town
2. The community in the Town area and the other three communities around the sample manufacturers outside of the Town area

The survey results are grouped according to the four major parts of the environmental management system (EMS) (see Chapter Two). There are a total of 71 items on the four major parts of the EMS. Items 10 and 11 are relevant to Part A: performance agreement for the environmental program. There are 18 items on this part. Items 12 to 14 are presented in Part B: plan for transformation implementation. Items 15, 16, 18, and 19 are relevant to Part C: standards and process. Items 17, 20, 21, and 22 are presented in Part D: the continuous improvement process. In addition, Item 23 to 29, at the end of the questionnaire for manufacturing staff, there are seven more items, which asked respondents to rate the effectiveness of seven different groups in communication. Finally in the communities survey, there are eight items which require a response on a five point Likert scale (questions 30 to 37) and two questions (questions 38 and 39) are multiple choice.

4.4 CONCLUSION

This chapter has described the various methods used in this study, including documents, individual interviews, observations and questionnaires. By using the strategies of methodological and data triangulation, this study has explored the development of quality in environmental management systems.

In Chapter Five, the results of the primary data, collected from the questionnaires are presented. Chapter Six analyses and reports on the qualitative data collected from the individual interviews and observations during the field trips and it also includes documents from several sources.

CHAPTER 5: ANALYSIS OF THE QUESTIONNAIRE DATA

5.1 INTRODUCTION

This chapter reports the findings of the questionnaire data collection. The questionnaire mainly aims to assess the responses of the large manufacturers' staff in Amata Nakorn Industrial Town and compare these with manufacturers' staff from outside of the industrial town, in regard to environmental management (the research Objective Three), and the response of the selected members of the communities in the sample manufacturers' areas to the environmental pollution problems from manufacturing industries (the research Objective Four). In addition, some results from this chapter will be used to evaluate EMSs that are used by the large manufacturers in and outside of the Town, and analyse the major factors that may affect the quality of EMS in large manufacturers in Thailand.

This and the next two chapters report, interpret and discuss the findings in respect of the objectives and the previous research in the area. The structure of this chapter follows two parts: the first is where statistical results between different categories of the respondents are described. The second is where all respondents are gathered into the categories, and then the results in the four major parts of the EMS (see Chapter Two), are described.

In Chapter Six, the results of the interviews, observations, and document review will be analysed to confirm the questionnaire results. Chapter Seven aims to evaluate the EMSs that are used by large manufacturing companies in and outside of the Town, and analyse the major factors that may affect the quality in large manufacturers in Thailand. It is in Chapter Seven that the detail of the findings as they relate to previously public research, will be discussed.

5.2 SAMPLE DESCRIPTION

In this part of the questionnaire I am providing demographic information about the sample and compare it, where appropriate, with the general population of Thailand. In this way the reader will have a good picture of the demographic characteristics of my sample.

5.2.1 Manufacturers' Staff

5.2.1.1 Gender

Table 5.1: Top Management and Management Level Staffs Respondents by Gender

Gender	Top Management in Town	Top Management out of the Town	Management in Town	Management out of the Town	Percentage (%)
Male	2	3	5	7	51.5
Female	-	-	8	8	48.5

In this research 51.5% of respondents were male and 48.5% were female (see Table 5.1). Top management levels both in Amata Nakorn Industrial Town and outside of the Town were male.

However, with respect to the management level in both study areas, there were 28 respondents at management levels of which 12 were male (42.9%), and 16 were female (57.1%). This gender make-up differs from that of the companies' personnel departments as supplied to the researcher by the companies themselves, with the make-up being 65% male and 35% female. Although the gender profile of the survey respondent sample differs from the companies' personnel department profile, it is not of significant importance for this study.

5.2.1.2 Age

Table 5.2: Staff Respondents by Age

Age	Top Management in Town	Top Management out of the Town	Management in Town	Management out of the Town	Percentage (%)
Under20	-	-	-	-	0
20 – 29	-	-	7	2	27.3
30 – 39	-	2	5	8	45.5
40 – 49	2	1	1	4	24.2
50 – 59	-	-	-	1	3
60&over	-	-	-	-	0

The respondents did not have staff from either the youngest age group (under 20 years) or the oldest (60 years and over), and there was strong representation from the 20 – 39 years age group (i.e. 73%). Only one respondent was aged 50 - 59 years. The age profile of the survey respondent sample is a good match with the profile of the population of top management level and management level in the sample manufacturers (data from Personnel Department of the five sampling manufacturers).

5.2.1.3 Respondents domicile

Table 5.3: Respondents Domicile

Province	Top Management in Town	Top Management out of the Town	Management in Town	Management out of the Town	Percentage (%)
Chonburi	2	3	10	13	87.5
Others	-	-	2	2	12.5

It was found that 87.5% of the respondents live in Chonburi Province and only 12.5% in another province near Chonburi. One respondent did not respond to this question.

The proportion of respondents living in Chonburi province matched that of the employees as a whole.

5.2.1.4 Staff experience

Table 5.4: Staff Experience at Top Management Level and Management Level

Years	Top Management in Town	Top Management out of the Town	Management in Town	Management out of the Town	Percentage (%)
Less 2	-	1	5	2	24.2
2 – 5	1	1	5	7	42.4
6 – 10	-	1	3	5	27.3
Over 10	1	-	-	1	6.1

Survey responses have been received for all of the work experience categories listed. Although approximately 60% of staff respondents had been working in the position of top management level and management level for five or fewer year experience, this does not necessarily indicate inexperience. Many staff have good educational backgrounds and work experience before promotion to top management level or management level. Information of their educational background and work experience has been obtained during individual interviews (see Chapter Six, Analysis of the Qualitative Data)

5.2.1.5 Environmental management system categories

Table 5.5: The Environmental Management System Categories

Systems	Manufacturers in Amata Nakorn Industrial Town	Manufacturers Outside of the Town
TQM/TEQM	-	2
ISO14000	2	-
Others	-	1

Survey responses were received from both the two sample manufacturers in Amata Nakorn Industrial Town that used the ISO 14000 system. Two of the three sample manufacturers outside the town use TQM/TEQM environmental management systems. Only one sample manufacturer did not use any environmental management system. However, this manufacturer had to comply with the government's environmental laws and regulations.

It is interesting to note that the TQM/TQEM system was chosen by companies with links to Japan, while companies with links to the US and EU chose the ISO 14001. The company that was involved in exporting has chosen a system that ensured that would fulfill the environmental legislation of Thailand.

5.2.2 Members of Communities

5.2.2.1 Gender

Table 5.6: Communities Member Respondents by Gender

Gender	Community in Amata Nakorn Industrial Town Area	Communities outside of Amata Nakorn Industrial Town Area	Percentage (%)
Male	2	7	45
Female	3	8	55

The researcher surveyed four communities. Five people were selected from each community to be present five categories of community activity (see Chapter Four: Research Methodology). There were 9 male respondents (45%), and 11 female respondents (55%). The gender profile of the Chonburi province population and housing census in the year 2000 was 50% male, 50% female.

5.2.2.2 Age

Table 5.7: Communities Member Respondents by Age

Age	Community in Amata Nakorn Industrial Town Area	Communities outside of Amata Nakorn Industrial Town Area	Percentage (%)
Under20	-	2	10
20 – 29	2	5	35
30 – 39	-	4	20
40 – 49	-	1	5
50 – 59	3	2	25
60&over	-	1	5

The survey responses were received for all of the age categories listed, and there is strong representation from the 20 – 39 age group i.e. 55%. Eighty percent of the

respondents are within the age range of 20 – 59 years, and only two are younger than 20 year. Only one is over 60 years of age. The age profile of the Chonburi province population and housing census in the year 2000 shows 89% of the population is within the age range of (20 – 59 years old). This survey response is a good match with the information of population and housing census.

It is interesting to note that the manufacturer staff sample was representative of the total manufacturer staff in the five sample manufacturers in 2005 in terms of gender and age distribution, and province of residence. The community member sample is also representative of the communities in Chonburi Province in terms of both gender balance and age distribution.

5.3 DESCRIPTIVE STATISTICS RESULTS

In order to test this hypothesis, the Mann-Whitney U Test is applied to the following groups:

1. The sample manufacturing staff in the Town and outside of the Town;
2. The community in the Town area and the other three communities around the sample manufacturers outside of the Town area.

5.3.1 Group One: The Sample Manufacturers' Staff in the Town and Outside of the Town

The hypothesis of this group is:

H_0 = There is no significant difference in perception of EMS quality between the sample manufacturers' staff in the Town and outside of the Town.

H_1 = There is a significant difference in perception of EMS quality between the sample manufacturers' staff in the Town and outside of the Town.

The results of this group aim to assess the response of the manufacturers' staff in and outside of the industrial town, in regard to environmental management (the research Objective Three). There are 71 items in this group (see Appendix 11). Only three items of this group are significant at a five percent level ($p < 0.05$) and only one item is significant at a one percent level ($p < 0.01$). These results are summarised in Table 5.8: Significant Differences Between Manufacturing Staff in the Town and Outside of the Town.

Table 5.8: Significant Differences between the Sample Manufacturers Staff in the Town and Outside of the Town

Item	Sig. Level
15. How often does your company audit environmental management system	*
19c. Discharge of the pollutants to ground	**
20. Does environmental audit information result in changes to manufacturing process	*

Note: * significant at the $p < 0.05$ level
 ** significant at the $p < 0.01$ level

As shown by the results in Table 5.8, there are only few items of Part C (item 15 and item 19c) and Part D (item 20) which revealed that the EMSs used by the two groups show significant differences in regard to environmental management in 'standards and processes' (Part C) and 'continuous improvement process' (Part D). But the manufacturers' staff in and outside of the Town show no significant differences in Part A, performance agreement, and Part B, plan for transformation implementation. The implications of these finding are discussed in Chapter Seven.

5.3.1.1 Part A: Performance Agreement for the Environmental Program

This part of the survey contains 18 items (see Table 5.9), which relate to how the sample manufacturers have performance agreement with the environmental program.

Items 10a to 10h look at the characteristics of customers in terms of environmental management, and items 11a to 11j ask about the commitment of the management team for environmental management.

Table 5.9: List of Items, Part A: Performance Agreement for the Environmental Programme

Q10. Which of the following groups you believe are your customers?

- Q10a. Consumers of your manufactured products
- Q10b. Government regulators at a provincial level
- Q10c. Government legislators at a national level
- Q10d. Politicians
- Q10e. People in Chonburi community
- Q10f. National environmental lobby non-government organisations
- Q10g. Your company employees
- Q10h. Others

Q11. Which actions your management team is committed to?

- Q11a. Definition of EMS policy
- Q11b. Clear vision for future EMS
- Q11c. Time allocated to learn about EMS across manufacturer
- Q11d. Top management defines the policy
- Q11e. Continual improvement and prevention of pollution
- Q11f. Comply with relevant legal requirements
- Q11g. Setting and reviewing objectives and targets
- Q11h. Monitoring of strategies
- Q11i. Set communication line in Manufacturer
- Q11j. Communicated EMS to public

The results of this part do not show any significant differences in responses between the staff from both groups. Therefore, it is accepted that the sample manufacturers' staff in the Town have no significantly different responses in terms of 'performance agreement for the environmental programme' with the sample manufacturers' staff outside of the Town, in respect of environmental management. This is further discussed in Chapter Seven.

Table 5.10: Results of Part A: Performance Agreement for the Environmental Programme (Group One)

Items	Frequency	Percent
10a. Agreement with consumers of your manufactured products	14 / 17	93.3 / 94.4
10b. Agreement with government regulators at a provincial level	7 / 3	46.7 / 16.7
10c. Agreement with government legislators at a national level	6 / 1	40.0 / 5.6
10d. Agreement with politicians	0 / 0	0.0 / 0.0
10e. Agreement with people in Chonburi community	9 / 10	60.0 / 55.6
10f. Agreement with national environmental lobby non-government org.	3 / 2	20.0 / 11.1
10g. Agreement with your company employees	9 / 8	60.0 / 44.4
10h. Agreement with others (sub contactors)	1 / 0	6.7 / 0.0
11a. Definition of EMS policy	9 / 7	60.0 / 38.9
11b. Clear vision for future EMS	14 / 13	93.3 / 72.2
11c. Time allocated to learn about EMS across manufacturer	7 / 10	46.7 / 55.6
11d. Top management defines the policy	13 / 17	86.7 / 94.4
11e. Continual improvement and prevention of pollution	7 / 5	46.7 / 27.8
11f. Comply with relevant legal requirements	9 / 12	60.0 / 66.7
11g. Setting and reviewing objectives and targets	14 / 16	93.3 / 88.9
11h. Monitoring of strategies	9 / 5	60.0 / 27.8
11i. Set communication line in Manufacturer	6 / 4	40.0 / 22.2
11j. Communicated EMS to public	4 / 6	26.7 / 33.3

- Note:** a) Manufacturers' staff in the Town frequencies and percentages are shown in regular font (e.g. 14 and 93.3 in item 10a.)
- b) Manufacturers' staff outside of the Town frequencies and percentages are shown in bold italics (e.g. 17 and 94.4 in item 10a.)

The results of the questionnaire Part A is present in Table 5.10. The results of this part show that the manufacturers' staff from both in and outside of the Town do not clearly understand both the characteristics of customers in terms of environmental management and the commitments of the management team. For example, there is no respondent who believed that politicians are also the companies' customer, and only few respondents believed that setting up a communication line in the company, and communicating the companies' EMS to the public, are a commitment of the management team. These results are different from the interview results where all of the companies' participants mentioned that the companies provide budgets for training their employees about EMS, It may be argued that the programmes the companies have provided for their employees do not cover all important topics. As mentioned earlier in Chapter Two, environmental education and awareness about environmental protection are one of the important factors of an EMS process. The Thai government may help the manufacturers to develop a list of the topics that manufacturers need to use to train their employees about the EMS, or the government may provide training programmes to train for manufacturers and the community.

5.3.1.2 Part B: Plan for Transformation Implementation

This part is made up of 15 items, which concern the plan for transformation implementation (see Table 5.11). Items 12a to 12d ask respondents about employees' requirements to do their jobs; items 13a to 13d look for feedback from customers, and items 14a to 14g ask the respondents about decision making tools that management teams use in making decision about environmental management.

Table 5.11: List of Items, Part B: Plan for Transformation Implementation

Q12. Are employees required to consider the following matters as part of their job?

Q12a. Manufacturing systems and procedures relevant to quality of the product

Q12b. Training programs about product quality

Q12c. Training programs about environmental quality

Q12d. Seeking innovative alternatives to outdated process and policies

Q13. Do you have feedback from your customer?

Q13a. No

Q13b. Product quality

Q13c. Production voice

Q13d. Waste water

Q14. Which decision making tools does your management team use in making decisions about environmental management?

Q14a. P-D-C-A cycle

Q14b. Cause and effect diagram

Q14c. Control chart

Q14d. Flow chart

Q14e. Histogram

Q14f. Benchmarking

Q14g. Brainstorming and team work

There are no significant differences between manufacturers' staff in the Town and outside of the Town in respect of all these items. It means that the sample manufacturers' staff in both groups have no significant differences in responses in terms of 'plan for transformation implementation', in respect of environmental management. Table 5.12 presents results of Part B.

Table 5.12: Results of Part B: Plan for Transformation Implementation (Group One)

Items	Frequency	Percent
12a. Manufacturing systems and procedures relevant to quality of the product	11 / 16	73.3 / 88.9
12b. Training programs about product quality	8 / 10	53.3 / 55.6
12c. Training programs about environmental quality	9 / 12	60.0 / 66.7
12d. Seeking innovative alternatives to outdated process and policies	10 / 10	66.7 / 55.6
13a. No feedback from customer	7 / 6	46.7 / 33.3
13b. Product quality	7 / 6	46.7 / 33.3
13c. Production voice	5 / 3	33.3 / 16.7
13d. Waste water	0 / 2	0.0 / 11.1
14a. P-D-C-A cycle	11 / 11	73.3 / 61.1
14b. Cause and effect diagram	3 / 3	20.0 / 16.7
14c. Control chart	2 / 3	13.3 / 16.7
14d. Flow chart	11 / 12	47.8 / 52.2
14e. Histogram	6 / 6	40.0 / 33.3
14f. Benchmarking	0 / 0	0.0 / 0.0
14g. Brainstorming and team work	11 / 10	73.3 / 55.6

Note: a) Manufacturers' staff in the Town frequencies and percentages are shown in regular font (e.g. 11 and 73.3 in item 12a.)

b) Manufacturers' staff outside of the Town frequencies and percentages are shown in bold italics (e.g. 16 and 88.9 in item 12a.)

The results show that most of the staff know the requirements to do their jobs, and the companies use many management tools together with a P-D-C-A cycle in making decisions about environmental management. However, many of the Town respondents (46.7%) said their companies do not have feedback from customers (Item 13a). It is in accordance with the interview results that the companies' respondent mentioned that their companies have had no customer complaints about environmental problems since the companies have adopted ISO 14001. On the other

hand, there are some of the respondents from the outside Town companies (33.3%) who mentioned that their companies do not have feedback from customers. It may be because they are working in departments that are not concerned with the customer feedback. Therefore, it may be concluded that the companies from both in and outside of the Town have a good plan for implement their EMSs.

5.3.1.3 Part C: Standards and Processes

This part, standards and processes, has only 10 items (see Table 5.13) relating to production process and quality standard. Items 15 and 16a look for an environmental management system audit, items 16b and 16c ask respondents about the reason they could not give copy of environmental audit, and item 18 is an emergency plan and results of an equipment breakdown. Finally, item 19 looks for effects that would occur as a result of equipment breakdown.

Table 5.13: List of Items, Part C: Standards and Processes

<p>Q15. How often does your company audit environmental management system?</p> <p>Q16. Can you give me a copy of an environmental audit?</p> <p>Q16a. Yes</p> <p>Q16b. Do not have information about an environmental audit</p> <p>Q16c. Do not have authority to give information about an environmental audit</p> <p>Q18. How many time a year does your manufacturer use an emergency plan as a result of equipment breakdown?</p> <p>Q19. Which of the following affects would occur as a result of equipment breakdown?</p> <p>Q19a. Discharge of the pollutants to air</p> <p>Q19b. Discharge of the pollutants to water</p> <p>Q19c. Discharge of the pollutants to ground</p> <p>Q19d. Injury to employee</p> <p>Q19e. Nothing</p>
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Although there are only 10 items in this part, there are two items (15 and 19c) where the differences are significant between the two groups of staff in the Town and outside of the Town (see Table 5.8). In the answer to question 15, “how often does

your company audit environmental management system?’, 55.6% of staff outside of the Town and only six percent of staff (one person) in the Town say that their manufacturers have “never” audited their operations using an environmental management system (EMS). Most of the staff in the Town say their manufacturers were audited one or two times a year, while most of staff from outside of the Town agree “never”. According to the results of the interviews and documents review, Thai manufacturers in industrial towns (who use ISO 14001) are required for an external audit, and they may be randomly audited by the industrial town operation office and the IEAT. While, the manufacturers’ outside of the industrial town (who use TQM/TQEM) are monitoring the system to thoroughly check any process (but do not require an external audit), and the companies outside of industrial towns may be randomly audited only by the DIW. As for these results, manufacturers’ staff in the Town might have more participation in environmental audit activities than staff from outside of the Town. Item 19c involves a highly significant difference between manufacturing staff in the Town and outside of the Town. Here 66.7% of staff in the Town and 11.1% of staff outside of the Town say the result of equipment breakdown inevitably lead to a discharge of the pollutants to the ground. It may be as a result of the nature of its industry (e.g. producing some hazardous waste). The remaining eight items in this part do not show significant difference between the groups. However, many of the respondents in the Town companies (40%), and most of the respondents from outside of the Town companies (77.8%) mention that they do not have information about an environmental audit (Item 16b). As mentioned in Chapter Two, the ISO 14001 company is require to develop a good documentation system and use the record of an environmental audit with other records to make decisions in improving the quality of an EMS. Therefore, all of the questionnaire respondents (top management and management level staff) from the Town companies (ISO 14001) should have information about an environmental audit. The top management staff of these companies need to review a documentation system of their companies and then solve this problem. Whereas the outside industrial towns companies (TQM/TQEM) do not require all departments to keep an environmental audit system. Each department must keep its own records and then come to share information at the meeting. Table 5.14 presents the results of Part C.

Table 5.14: Results of Part C: Standards and Processes (Group One)

Items	Frequency	Percent
15. How often does your company audit environmental management system?		
5 times or more	1 / 1	6.7 / 5.6
3-4 times	0 / 0	0.0 / 0.0
1-2 times	13 / 7	86.7 / 38.9
Never	1 / 10	6.7 / 55.6
16a. Yes, I can give you a copy of an environmental audit	7 / 4	46.7 / 22.2
16b. Do not have information about an environmental audit	6 / 14	40.0 / 77.8
16c. Do not have authority to give information about an environmental audit	1 / 1	6.7 / 5.6
18. How many time a year does your manufacturer use an emergency plan as a result of equipment breakdown?		
5 times or over	0 / 0	0.0 / 0.0
3-4 times	0 / 0	0.0 / 0.0
1-2 times	7 / 3	46.7 / 16.7
Never	8 / 15	53.3 / 83.3
19a. Discharge of the pollutants to air	10 / 11	66.7 / 61.1
19b. Discharge of the pollutants to water	7 / 7	46.7 / 38.9
19c. Discharge of the pollutants to ground	10 / 2	66.7 / 11.1
19d. Injury to employee	4 / 10	26.7 / 55.6
19e. Nothing	1 / 4	6.7 / 22.2

Note: a) Manufacturers' staff in the Town frequencies and percentages are shown in regular font (e.g. 7 and 46.7 in item 16a.)

b) Manufacturers' staff outside of the Town frequencies and percentages are shown in bold italics (e.g. 4 and 22.2 in item 16a.)

This part may conclude that the EMS systems that are used by manufacturers from both groups have some significant difference in the standards and processes part (e.g.

audit system and documentation system). The EMS system that is used by manufacturers in the Town (ISO 14001) requires an external audit and is more often audited than the EMS systems that are used by manufacturers from outside of the Town (TQM/TQEM, and the Thai EMS). With these results, the manufacturers' staff in the Town have more responses (participation) to environmental audit activities, and more paper work than manufacturers' staff from outside of the Town.

5.3.1.4 Part D: Continuous Improvement Process

Of the 21 items in this part (see Table 5.15), there is only one item (item 20) that shows a significant difference at five percent level ($p < 0.05$) between staff in the Town and outside of the Town (see Table 5.8). Item 20 (does environmental audit information result in changes to manufacturing process) has significant differences at the one percent level ($p < 0.01$).

Table 5.15: List of Items, Part D: Continuous Improvement Process

<p>Q17. What percentage of annual production costs are spent on employees training about environmental management?</p> <p>Q20. Does environmental audit information result in changes to manufacturing process?</p> <p>Q21. How does management use record of incidents in management decision making?</p> <p>Q21a. To planning environmental plan</p> <p>Q21b. To set an environmental budget</p> <p>Q21c. To solve environmental problems</p> <p>Q21d. To develop production process</p> <p>Q21e. To making decision about raw materials</p> <p>Q21f. To evaluate environmental plan</p> <p>Q22. List three actions used by your company to prevent accidents or environmental incidents?</p> <p>Q22a. Using raw materials had less effect to environment</p> <p>Q22b. Reducing materials using</p> <p>Q22c. Developing a good inspector system</p>

- Q22d. Training about environmental management system
- Q22e. Setting up the respondent in any job
- Q22f. Saving electric power
- Q22g. Using reused process
- Q22h. Contact with company specializing in hazardous waste disposal
- Q22i. Setting up a good maintenance system
- Q22j. Setting up a good record system
- Q22k. Collecting all waste in specific/safe area
- Q22l. Waste treatment system
- Q22m. Good production plan

In response to whether there is a change in the manufacturing process as a result of environmental audit information (Item 20) 73.3% of staff in the Town and only 27.8% of staff outside of the Town agree (see Table 5.16). As shown by the result of item 20 staff in the Town have reviewed the results of an environmental audit and have used this information in improving their work, more than staff outside of the Town. Although we can not generalise from the results there is no doubt that the result of this question (Item 20) may be caused by different audit systems between the companies in and outside of the Town. The TQM/TQEM system is monitoring the entire system to thoroughly check any process, and many of their staff do not know about the company environmental audit (Item 15). Whereas the ISO 14001 system requires an external audit, so all the company staff may be randomly audited by the external auditors. In addition, the Items 21 and 22 are the open questions. The results of these two items show that the respondents from both groups have an elementary knowledge of EMS such as: how to use the record of incidents to manage decision making? Further, how might the company prevent an environmental accident? The remaining 20 items do not show significant differences between the groups.

Table 5.16: Results of Part D: Continuous Improvement Process (Group One)

Items	Frequency	Percent
Q17. What percentage of annual production costs are spent on employees training about environmental management?		
40% or more	0 / 0	0.0 / 0.0
30-39%	1 / 1	6.7 / 5.6
20-29%	0 / 0	0.0 / 0.0
10-19%	6 / 5	40.0 / 27.8
Less than 10%	8 / 12	53.3 / 66.7
Q20. Does environmental audit information result in changes to manufacturing process?	11 / 5	73.3 / 27.8
Q21a. To planning environmental plan	12 / 11	80.0 / 61.1
Q21b. To set an environmental budget	9 / 10	60.0 / 55.6
Q21c. To solve environmental problems	9 / 10	60.0 / 55.6
Q21d. To develop production process	7 / 10	46.7 / 55.6
Q21e. To making decision about raw materials	4 / 7	26.7 / 38.9
Q21f. To evaluate environmental plan	3 / 5	20.0 / 27.8
Q22a. Using raw materials had less effect to environment	5 / 6	33.3 / 33.3
Q22b. Reducing materials using	8 / 6	53.3 / 33.3
Q22c. Developing a good inspector system	4 / 10	26.7 / 55.6
Q22d. Training about environmental management system	4 / 11	26.7 / 61.1
Q22e. Setting up the respondent in any job	5 / 2	33.3 / 11.1
Q22f. Saving electric power	4 / 0	26.7 / 0.0
Q22g. Using reused process	1 / 2	6.7 / 11.1
Q22h. Contact with company specializing in hazardous waste disposal	2 / 2	13.3 / 11.1
Q22i. Setting up a good maintenance system	3 / 2	20.0 / 11.1
Q22j. Setting up a good record system	2 / 1	13.3 / 5.6
Q22k. Collecting all waste in specific/safe area	2 / 2	13.3 / 11.1
Q22l. Waste treatment system	2 / 3	13.3 / 16.7
Q22m. Good production plan	2 / 7	13.3 / 38.9

- Note:** a) Manufacturers' staff in the Town frequencies and percentages are shown in regular font (e.g. 11 and 73.3 in item 20)
- b) Manufacturers' staff outside of the Town frequencies and percentages are shown in bold italics (e.g. 5 and 27.8 in item 20)

This part may conclude that the EMS systems that are used by manufacturers from both groups have a few significant differences in the continuous improvement process. An EMS system that is used by the companies in the Town (ISO 14001), used the environmental audit information resulting in changes to their manufacturing process more than the EMS systems that are used by the companies from outside of the Town (TQM/TQEM and the Thai EMS). Also it causes manufacturers' staff in the Town to have more responses in reviewing the environmental audit information result and making changes to their manufacturing process than manufacturers' staff from outside of the Town (the research Objective Three).

In conclusion, there are only a few significant differences between the EMS that are selected by manufacturers in industrial town and outside of the Town. The EMS that are used by manufacturers from both groups have no significant difference in the "performance agreement for the environmental programme" and "plan for transformation implementation". But there are a few significant differences in "standards and processes" and "continuous improvement process" (the research Objective Three). For example, manufacturers in the Town have the EMS often audited than the companies from outside of the Town. The manufacturers in industrial towns (who use ISO 14001) are required to have an external audit, and they may be randomly audited by the industrial town operation office and the IEAT. While, the manufacturers' outside of industrial towns (who use TQM/TQEM) are monitoring the system to thoroughly check any process (but do not require an external audit), and the companies may be randomly audited only by the DIW. Moreover, the companies in the Town have used environmental audit information more to improve the manufacturing process, than have outside the town companies. As these results show, the manufacturers' staff in the Town have more responses (participation) concerning environmental audit activities than manufacturers' staff from outside of the Town, and the staff from the Town companies reviewed the environmental audit information

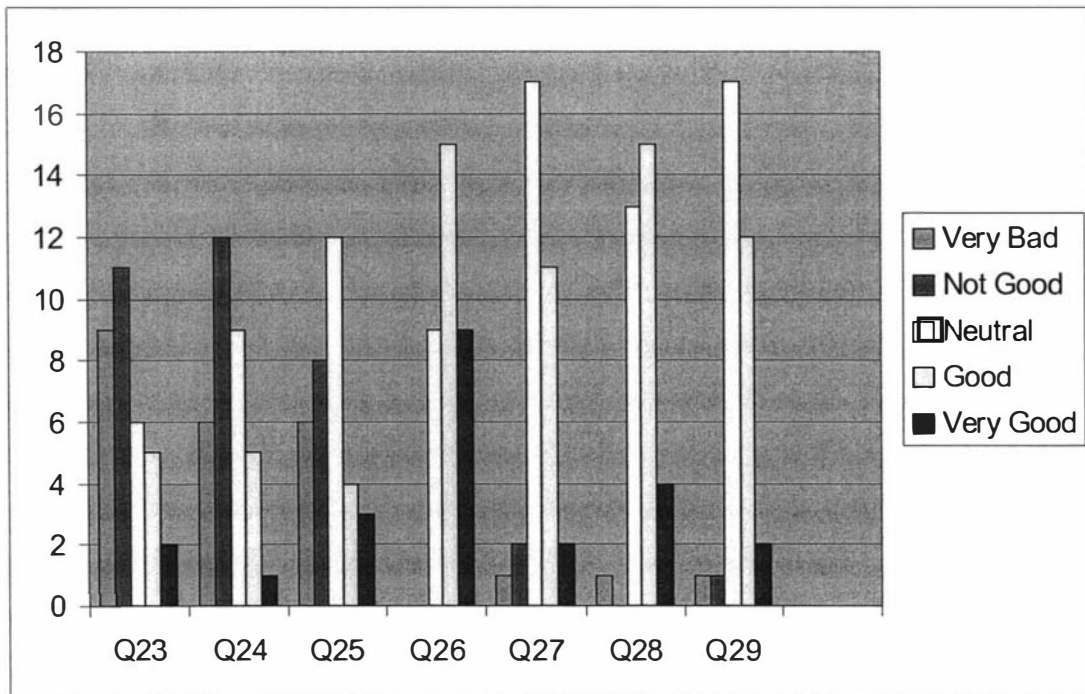
result and make changes to their manufacturing processes more than manufacturers' staff from outside of the Town.

The questionnaire results also show that large manufacturers' staff from in and outside of the Town have a problem with the training programmes that they have provided for their employees. It seems like the training programmes do not cover some important topics such as the characteristics of customers in terms of EM, and the commitment of the management team. This problem may be solved by the government by providing a list of the topics that manufacturers need to use to train their employees, or the government may develop the programmes to train all manufacturers' staff and the local community. However, the results show that the companies from both sides have a good plan to implement their EMSs. They use many management tools together with a P-D-C-A cycle (as explained in the Literature Review, Chapter Two) in making decisions about EM, and the respondents know the requirements to do their jobs.

Moreover, the ISO 14001 is required to develop a good documentation system and use a record of an environmental audit with other records to make decisions to improve the quality of an EMS. But the Item 16b result shows that many of the respondents in the Town companies (who use ISO 14001) said they do not have a record of an environmental audit. This result shows that there is a problem with the documentation system in these companies. The top management of the companies need to review a documentation system and resolve the situation.

In addition, at the end of the questionnaire for manufacturers' staff, there are seven more items, which asked respondents to rate the effectiveness of seven different groups in communication in item 23 to 29. Figure 5.1 and Appendix 10 are a summary of items 23 to 29. The last item (item 39) asks if respondents want to receive a summary of the survey results or not.

Figure 5.1: The Effectiveness of Seven Different Groups in Communication



There are only seven items, which asked the manufacturing staff from both in and outside of the Town to rate their manufacturers’ communication on the seven different groups using a five point Likert scale (item 23 to 29).

Interestingly, respondents’ answers from both in and outside of the Town show a high congruence in all communication categories. The respondents from both in and outside of the town agree that communication between employees in the same department is the most effective, while the next most effective communication occurs between employees at the same working level. On the other hand, the respondents from both groups say that national government departments and provincial government departments were the least effective groups terms of communication.

As mentioned in the Chapter Two, effective communication is an essential foundation of an EMS. Communicating relevant information about the EMS means sharing the power for implementing, maintaining, and improving the EMS. Conversely, when communications are inadequate and information is missing, an EMS is weakened. Therefore, this part of the questionnaire aims to evaluate the effectiveness of communication systems of the manufacturers from both in and outside of the

industrial town. As the survey results show, there are no significant differences in the communication systems between large manufacturers from both sides.

It may be assumed that the sample manufacturers' staff from both sides have no problem with the internal communication between the various levels and functions of the organisation. However, the manufacturers' staff may have problems in documenting and responding with the government (external communication). The government at both national and provincial levels should improve the methods of communication to communicate with industries. For example, the government may gather all of the responsibilities and budgets about educating and communicating the environmental information with the government agencies, industries, and community in the DEQP, and then assign the DEQP to develop new methods of communication with the industries and the community. Appendix Ten, which is a summary of Item 23 to Item 29 provides these results.

5.3.2 Group Two: The Community in the Town Area and the Other Three Communities around the Sample Manufacturers Outside of the Town Area

Members of the sample communities in the four areas, one community in the Town area and three communities outside of the Town area, have answered only 10 questions in section three of the questionnaire from items 30 to 39. Items 30 to 37 use a five point Likert scale, while two items (item 38 and 39) are multiple choice.

The hypothesis of this group is:

- H_0 = There is no significant difference in perception of environmental quality between the sample community members in the Town and outside of the Town area.
- H_1 = There is a significant difference in perception of environmental quality between the sample community members in the Town and outside of the Town area.

The results of the Group Two aim to assess the response of the community to the environmental pollution problems from manufacturing industries (the research Objective Four). There are only 14 items in this group. Three items are significant at a five percent level ($p < 0.05$). These results are summarised in Table 5.27. There are significant differences between community in the Town area and the other three communities in the sample manufacturers outside of the Town area.

Table 5.17: Significant Differences between the Community in the Town area and the Other Three Communities in the Sample Manufacturers Outside of the Town Area

Item	Sig. Level
33. Important government scientific information is available in communities to assist decision making	*
35. Communities take part in the preparation of environmental standards at a national level	*
36. Communities take part in the preparation of environmental standards at a provincial level	*

Note: * significant at the $p < 0.05$ level

** significant at the $p < 0.01$ level

From the results of Questions 30, and 31, most of the communities' members from both in and outside of industrial town areas are interested in environmental problems, and believe that an EMS is important for manufacturers (Questions 30 and 31). As these results show, the manufacturers should use the EMSs to establish a good relationship with the local community and built the company image. The company may also expand their market.

However, there are some significant differences in responses to the environmental pollution problems from manufacturing industries between the communities'

members in and outside of the Town areas (see Table 5.27). Although most of the communities' members from both sides are interested in environmental problems (Question 30), only the respondents in the Town agreed that communities should take part in the preparation of environmental standards at both national and provincial levels (Questions 35 and 36), whereas only 20% of respondents outside of the Town agreed with this statement. Less interest from the communities' members from outside the Town areas may be because the government does not provide them with enough environmental information, but for most of respondents in the Town the environmental information is available in their community (Question 33) (see Appendix 12). These results are in accordance with the interview results that the government has problems with communicating with both industries and the local community.

Moreover, Question 38 asked the communities' respondents about industrial environmental pollution problems affecting their communities. The result shows that the communities' members monitor the manufacturers that are located in their community and know the problems. It is very useful if the government develops a good communication channel with the local community and asks the local community to help the government to monitor environmental problems.

5.4 CONCLUSION

The results of the questionnaire survey answer three research questions. The answers of the questions are below:

- There were only two types of EMS systems currently used by large size manufacturing companies in Thailand – ISO 14001 and TQM / TQEM. Most large manufacturing companies in the industrial town use ISO 14001 as their EMS, whereas many of the large manufacturing companies outside of the industrial town use TQM / TQEM, and few of them do not have an EMS, they just complied with the Thai environmental legislation.

- There are only a few significant differences in EMS quality between the three EMS systems that are selected by industries in the industrial town and outside of the Town. Manufacturers' staff in and outside of the Town have no significant difference in responses in terms of 'performance agreement for the environmental programme' and 'plan for transformation implementation'. However, there are a few significant differences in 'standards and processes' and 'continuous improvement process'. For example, manufacturers in the industrial town have their EMS more often audited than the companies from outside of the Town, and the companies in the industrial town have used environmental audit information more to improve the manufacturing process, than have outside the town companies. In addition, there are some significant differences in responses to the environmental pollution problems from manufacturing industries between the communities' members in and outside of the Town areas. The community members in the Town commented more about the preparation of environmental standards at both national and provincial levels than the communities' members outside of the Town. Less interest from the communities' members from outside the Town areas may be because the government does not provide them with enough environmental information, but for most of the respondents in the Town, the environmental information is available in their community.
- The questionnaire results cannot confirm which EMS system is the most effective to use in all large size manufacturing companies. So, we have to gather the results from other survey methods (documentation review, individual interviews, and observations) to answer this question.

In addition, the questionnaire results show that the manufacturers' staff from both in and outside of industrial town do not clearly understand about the characteristics of customers in terms of EM and the commitment of the management team. It may be assumed that the programmes that the companies have provided for their employees do not cover all important topics. The government should help the manufacturers by providing a list of important topics about which the manufacturers need to train their staff, or the government may develop the training programmes for both manufacturers

and community. In addition, the questionnaire results show that the manufacturers from both groups have no problem with the internal communication between the various levels and functions of the organisation. But the companies from both sides may have problems in documenting and responding with the government (external communication). The Thai government needs to improve the methods of communication to communicate with industries. For example, the government may gather all of the responsibilities and budgets about educating and communicating the environmental information with the government agencies, industries, and the community in the DEQP, and then assigned the DEQP to develop new methods of communication with the industries and the community.

There are a few significant differences between the responses of the manufacturers' staff in and outside of the Town concerning the audit of EMS. For example, the manufacturers' staff in the Town know about the audit of EMS in their companies, while just over a half (55.6%) of the manufacturers' staff outside the Town mentioned that their companies never audit an EMS (Item 15). It may be because the manufacturers outside of the Town (who use TQM/TQEM) are monitoring the system to thoroughly check any process but do not require an external audit. Therefore manufacturers' staff in industrial town may have more participation in environmental audit activities than staff from outside of the town. As the result of Item 15, most of the staff from outside of industrial town said environmental audit information does not result in changes to manufacturing process, whereas most of the staff from the Town companies mentioned their companies use environmental audit information in changes to manufacturing process.

The results of the community survey show that the communities' members from both in and outside of industrial town areas are interested environmental problems and believe that an EMS is important for manufacturers. Therefore, manufacturers should use use the EMSs to establish a good relationship with the local community and build the company image. Moreover, the survey result also shows that the communities' members monitor the manufacturers that are located in their community and know the problems. It is very useful if the government develops a good communication channel with the local community and asks the local community to help the government to monitor environmental problems.

In the next chapter, Chapter Six, the researcher reports the analysis of documents, individual interviews, and observations data.

CHAPTER 6: ANALYSIS OF THE INDIVIDUAL INTERVIEWS, OBSERVATIONS, AND DOCUMENT REVIEWS DATA

6.1 INTRODUCTION

This chapter reports, interprets and discusses the findings of the qualitative data collection from the individual interviews, observations and literature reviews. The findings of this chapter are used to compare with the questionnaire results in Chapter Five. The structure of this chapter follows three parts. The first is where the interview results that were conducted with top management level staff in the sample manufacturers and the government officers, who work in the government agencies concerned about environmental policy in Thailand, are reported.

The second is where I describe the evidence that I found during the field observations. These field observations were conducted with all sample manufacturers and central treatment systems in Amata Nakorn Industrial Town. This involved observations, which required making detailed analysis of EMS. The results were grouped according to the four major parts of the environmental management system (EMS).

The third includes an analysis of documented reports, from both government agencies that are concerned with environmental problems and policy in Thailand, manufacturers' records, and previous research. The aim of this part of the research was to assess the response of both large manufacturers' staff in and outside of the industrial town in regard to environmental management, and the local community to the environmental pollution problems from manufacturing industry.

6.2 RESULTS

The qualitative result of the study reports and analysis is in three sections: individual interviews, observations and document analysis.

6.2.1 Individual Interviews

Generally, there was a high level of interest in the research from prospective participants who were contacted, particularly top management level staff in Amata Nakorn Industrial Town and there was no one approached who declined to participate. Of the first two sample manufacturers in the Town, top management level staff were pleased to have the opportunity to participate through individual interviews and to give me explanations, as well as to allow me to observe the EMS in their companies. However, these two participants did not allow me to take photographs on the companies' premises. In this research, Respondent A was used as the participant from Denso (Thailand) Company and Respondent B as the participant from another company in Amata Nakorn Industrial Town (see Table 6.1).

On the other hand, refusal rates from the sample manufacturers outside of the Town were high (nine out of twelve refused). Anecdotal evidence suggests that this may be because many manufacturers in industrial towns are used to dealing the external visitors, while companies outside of the town have only limited experiences with external visitors. Top management level staff, from the nine sample manufacturers outside of the Town, were unable or unwilling to participate in this research. I persevered until three top management level staff, from manufacturers outside of the Town, were willing to participate. However, two sample manufacturers would also not allow me to take photos inside their company's premises. Only one company allowed photos, of some areas in the company, to be taken. Two companies, from the three sample companies outside of the town, use the TQM / TQEM system as their EMS and the third company does not have an EMS. Respondents C and D were selected as the participants from companies outside of the town, that use TQM / TQEM and Respondent E was selected as the participant from a remaining company from outside of the town, that does not have an EMS (see Table 6.1).

Individual interviews with government officers in six agencies, from the three ministries concerned with environmental policy, were also difficult to obtain. Many officers are unable or unwilling to participate in the individual interviews because they believed that they are too busy or that they have no authority to discuss environmental policy with a person from outside the government. However, after trying to contact many government officials, I finally had an opportunity to interview six government officers, from all three ministries concerned with environmental policy. The six officers contacted were very pleased to have an opportunity to discuss the situation with someone, who is interested in Thailand's environmental planning and policy. This study uses Respondent F as the participant from the Pollution Control Department, Respondent G as the participant from the Department of Environmental Quality Promotion, Respondent H as the participant from the Office of the Natural Resources and Environmental Policy and Planning, Respondent I as the participant from the Industrial Estate Authority of Thailand, Respondent J as the participant from the Department of Industrial Work and Respondent K as the participant from the Bureau of Environmental Health (see Table 6.1).

Table 6.1: Research Interview Participants

Participants	Organization Name
Respondent A	Denso (Thailand) Company Limited (in industrial town)
Respondent B	Thai Iwaki Glass Company Limited (in industrial town)
Respondent C	UMC Metal Company Limited, a company from outside of Amata Nakorn Industrial Town that uses TQM / TQEM system
Respondent D	Another remaining company from outside of Amata Nakorn Industrial Town that uses TQM / TQEM system
Respondent E	Confidential name, a company from outside of Amata Nakorn Industrial Town that did not have EMS
Respondent F	Pollution Control Department, Ministry of Natural Resources and Environment
Respondent G	Department of Environmental Quality Promotion, Ministry of Natural Resources and Environment
Respondent H	Office of the Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment

Respondent I	Industrial Estate Authority of Thailand, Ministry of Industry
Respondent J	Department of Industrial Work, Ministry of Industry
Respondent K	Bureau of Environmental Health, Division of Planning and Evaluation, Ministry of Public Health

A great deal of very useful and positive information came from top management level staff, both inside and outside of Amata Nakorn Industrial Town and the government officers. Participants from the individual interviews raised a variety of issues with agreement on some of the questions, but less agreement on other questions. This variety is helpful to the study, in that responses enabled a broader range of topics to be explored.

6.2.1.1 Performance Agreement for the Environmental Programme

Research in this area (Prakash, 1999) indicates that an EMS requires a coordinated effort from all stakeholders. All participants from both industry and government were in strong agreement that the government, manufacturers and communities have a joint responsibility to protect the environment. Together, they can achieve improvements to environmental quality in a number of ways. Many of these activities require the sharing of responsibility. The government has an important role in legislating environmental laws and regulations. However, industries and communities should have an opportunity to take part in the formulation of environmental laws and regulations. This result shows that the manufacturers' top management accepted that they have a co-responsibility with other stakeholders in regard to EM confirming earlier research by Prakash (1999).

The government not only has the responsibility for legislative solutions, but it also needs to provide industries with enough information about environmental laws, regulations and education. Surprisingly, the participant from the Division of Planning and Evaluation, Bureau of Environmental Health, does not disseminate important government scientific information about the environment to communities. In contrast other participants from the MONRE and the IEAT, said their offices provided industries and communities with information about the environment, including important scientific information, by passing it onto provincial level departments.

However, the government does not give sufficient financial resources to provide enough environmental education to industries and communities, as the following statements confirm:

Respondent F

I believe that my department provides important information about environmental quality to industries and communities both directly and by passing information to provincial level, but I think the provincial level may not be efficacious in passing it on to the community. My department provides little education to communities; it is not my departmental responsibility.

Respondent G

My department passes important information about environmental quality to provincial level and orders them to publicise to industries and communities. However, I accept that we do not provide enough education to communities. You have to understand that government does not give enough financial resources to my department.

Respondent H

We provide both education and information about environmental laws, policy and plan to communities, but it may not be enough to be effective.

Respondent I

Our organisation provide environmental laws and other information to the community by passing it to provincial level and we also provide some training courses and education for manufacturers who are located in industrial towns.

In addition, the participant from the Office of Natural Resources and Environmental Policy and Planning mentioned that the ministry provided the State of Environment Report every year. Moreover, the government has a responsibility to inspect environmental standards in both manufacturers and communities, to help them improve environmental quality.

Top management level staff, from both inside and outside of the Town, agreed that an EMS is important for manufacturers to achieve environmental standards and to help save production costs. Respondents who were government officers also agreed with this statement. Only Respondent E, from a manufacturer outside of the Town who does not use EMS, disagreed and commented:

Respondent E

My company has good production and management planning and also it has achieved the national environmental law and regulation standards.

Most respondents believed that an EMS not only assists manufacturers to achieve environmental standards, but the adoption of an EMS helps manufacturers to save on production costs and it increase productivity, as seen in the comments below:

Respondent A

Denso (Thailand) seriously pays attention to environmental problems and their environmental management system. We provide many training programmes about environmental management to our employees every year. ISO 14001 system advantages the company in saving production costs, such as a decrease in raw material cost, energy costs and pollution treatment cost.

Respondent B

An EMS made the company manage the environment better and easier. Moreover, it helps the company to save time in control of the environmental quality and increased productivity.

Respondent C

TQM not only helps our company to manage the environment but also to gain advantages in improving our product quality, and decreasing production costs.

Respondent D

Our company has used TQM for a long time. It really is useful and it is a powerful system in helping our company improve product quality, also it helps

the company to manage the environment, such as decreasing raw material use, and assisting with reducing energy cost.

Participants from both manufacturers and government strongly agree that an informed community is the most important success factor, to improve environmental quality. According to most respondents, when a community has a very strong concern about environmental quality, both the government and industries will show more concern. This is similar to the results reported by Skanavis and Sarri, 2002.

However, it is not easy to make the community concerned about environmental quality, particularly in developing countries, such as Thailand. Researchers (e.g. Chantadisai, 2004; Hirsch & Lohmann, 1989) have reported that most people in developing countries are concerned more about economic advancement, than environmental pollution issues, as this has an immediate financial effect on them. Nonetheless, it should be noted that the community in Thailand has paid more attention to environmental problems in the last few years, than in the last 10 years (Chantadisai, 2004).

According to Chantadisai (2004), the participants, from both the Office of Natural Resources and Environment Policy and Planning and the IEAT, said that local communities are generally not committed enough to take part in the preparation of environmental standards. Additionally, local communities lack education about environmental management and they are not interested. The participant from the Division of Planning and Evaluation, Ministry of Public Health said he has no idea how local communities could take part in the preparation of environmental standards. This is illustrated below:

Respondent H

It is not easy to invite the local community to take part in the preparation of environmental standards because many of them are not interested in the environmental quality and they still do not have enough education about the environment.

Respondent I

The local community is most concerned about economic issues and less concerned about environment quality. They are not ready to take part in the preparation of environmental standards and EMS systems.

However, these results differ with the questionnaire results. The questionnaire survey with the local community shows that the local communities pay attention to environmental problems. Most of the local community members in the industrial town area and some of the local communities' members from outside the Town areas are interested in taking part in preparation of environmental standards. However, they claim that the Thai government does not provide enough environmental information for their communities. This problem might be because the National Economic and Social Development Plan (the national plan) does not provide a clear direction about roles, responsibilities and targets of each government agency. The national plan provides the government agencies' roles, responsibilities and targets in general. Also, there is an overlap of responsibilities between government departments, in both the same and different ministries, as indicated by the following sample of respondent statements:

Respondent F

The national plan does not mention anything in detail. It is too broad. Our department has a problem with an overlap of responsibilities between other departments in MONRE and different ministries, for example, we do not know which department has responsibility for the environment pollutants discharged from manufacturers, whether from my department or the Ministry of Industry?

Respondent G

In my opinion, the national plan does not provide detail about government agencies' roles, responsibilities, and targets. Moreover, the government organisation still has an overlap of responsibilities between government agencies that are concerned about environmental quality, for example, whether my department of the Ministry of Industry has responsibility to provide education to manufacturers?

Respondent H

Not clear at all. Also, the government has an overlap of responsibilities between government agencies, that are concerned about the environment, in both the same and different ministries, such as which department has responsibilities to control environmental management for the manufacturers.

Respondent I

I do not think so, the national plan is described in general. I agree that it still overlaps the responsibilities between government agencies that are concerned about the environment. However, my department tried to do many things to improve an environmental management quality of manufacturers in all industrial towns.

Respondent J

The national plan does not mention the government agencies' roles, responsibilities, and targets. It just mentions environmental goals in general. It still has overlaps of responsibilities between government agencies. My department also has this problem; however, our department usually works in a relationship with the MONRE to promote EMS for the manufacturers.

Respondent K

The national plan mentions many things in general, it does not have specific detail of government agencies. My department has overlap of responsibilities with other departments, such as which department has the responsibility to promote occupational health in manufacturers that suffer from environmental problems.

The findings above indicate that large manufacturers, whether they are inside or outside of the industrial town agree as to the usefulness of the EMS programme. In any case, all companies have a commitment to comply with the environmental legislation. In addition, the participants from both industry and government believed that there is a joint responsibility between the government, industries, and community to protect the environment. All of these parties have responsibilities for differing commitments. For example, the government has the responsibility for legislative

solutions, providing information and education about environmental legislation and environmental management to industries and community. Industries have a responsibility to manage and control production and the environmental system in their companies, and comply with the environmental legislation. Communities also have responsibility to help the government to monitor all manufacturing companies' activities and report back to the government when the manufacturing companies discharge pollutants into their community. The results of Part A converge with the requirement of the EMAS that requires an interaction between the government, manufacturers, and community (Barrow, 2005).

However, interview results show that the government may not be providing adequate information and education about environmental legislation and management to both industries and the local community (same as the questionnaire results). It may not be easy to invite the local community to take part in the preparation of environmental standards because most of the community members' concern is about economic matters. However, the government still has full responsibility to provide education to the community and appoint community leaders to form committees that are concerned about the preparation of environmental standards.

The review of the National Economic and Social Development Plan by myself and the interviewees opinion of the Plan suggest that part of the communication problem identified may be due to the situation that the Plan does not provide clear roles, responsibilities, and targets of each government agency. Also, there still is an overlap of responsibilities between government departments, in both the same and different ministries. This problem may affect the provision of information and education to industries and the community.

6.2.1.2 Plan for Transformation Implementation

Participants from manufacturers believed that their industry had good enough tools for the management of the environment. The participants from manufacturers in the Town say their manufacturers used ISO 14001 as an EMS. The ISO 14001 has many tools such as P-D-C-A cycle, cause and effect diagrams, control charts, flow charts

and teamwork, which are used in making decisions about environmental management. Also, ISO 14001 requires a good documentation system for inspecting any process.

A participant from Denso (Thailand) mentioned that his company had a good relationship with local communities. Both companies in the Town welcomed local communities to visit their companies and the company had staff to explain to visitors about ISO 14001, which is used in the company. In contrast, the company of respondent B has no staff dedicated to explain its environmental policies to visitors.

The participants from manufacturers, that used TQM as EMS, explained that the TQM / TEQM system requires a P-D-C-A cycle, as the main tool for processing anything. The P-D-C-A cycle has four major steps: Plan, Do, Check and Action (Dawson & Palmer, 1995). The participants said that their companies have environmental plans and run their processes following these plans. Also, their companies have monitoring systems to thoroughly check any process. If any problems arise, the company has procedures to deal with them, as described below:

Respondent C

TQM / TQEM system has many management tools such as P-D-C-A cycle, cause and effect diagrams, flow chart, histogram, brainstorming and team work to help management teams in making decisions about environmental management. TQM / TQEM is the system that requires all staff from the chief executive officer (CEO) to any operational staff to join in one single team.

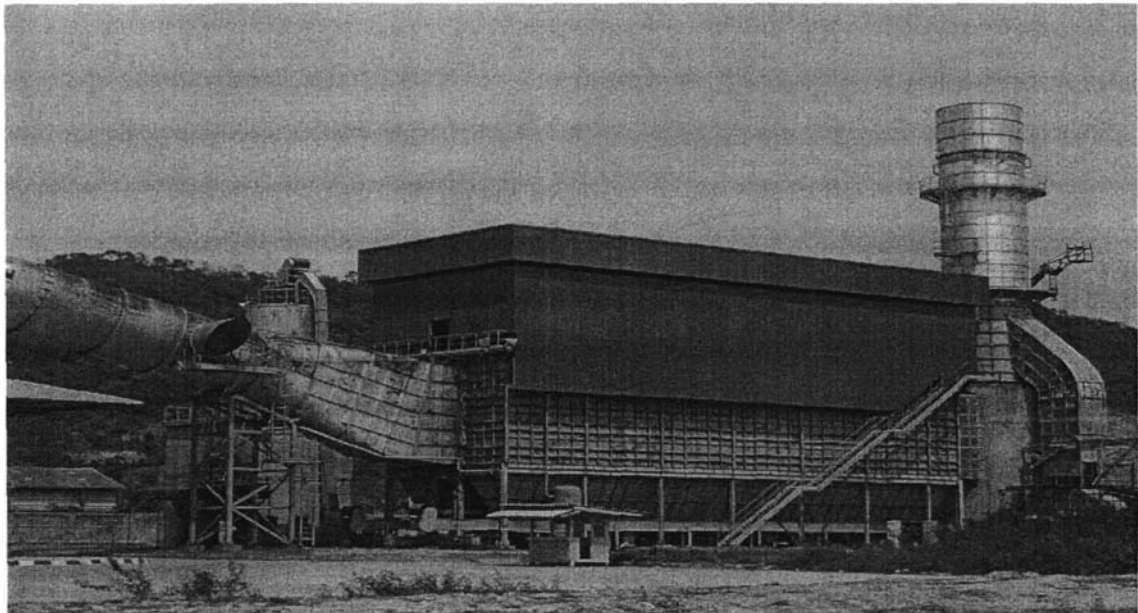
Respondent D

TQM / TQEM is such a powerful system for production and environmental management. P-D-C-A cycle is a main tool of TQM that requires a company to provide good planning, to monitor the system, and have a continuous improvement process.

Respondent C (a sample manufacturer from outside of the Town) mentioned that teamwork is the major key to success in environmental management. However, respondent C accepted that his company received complaints from the community about noise and dust pollution. His company tried to solve these pollution problems

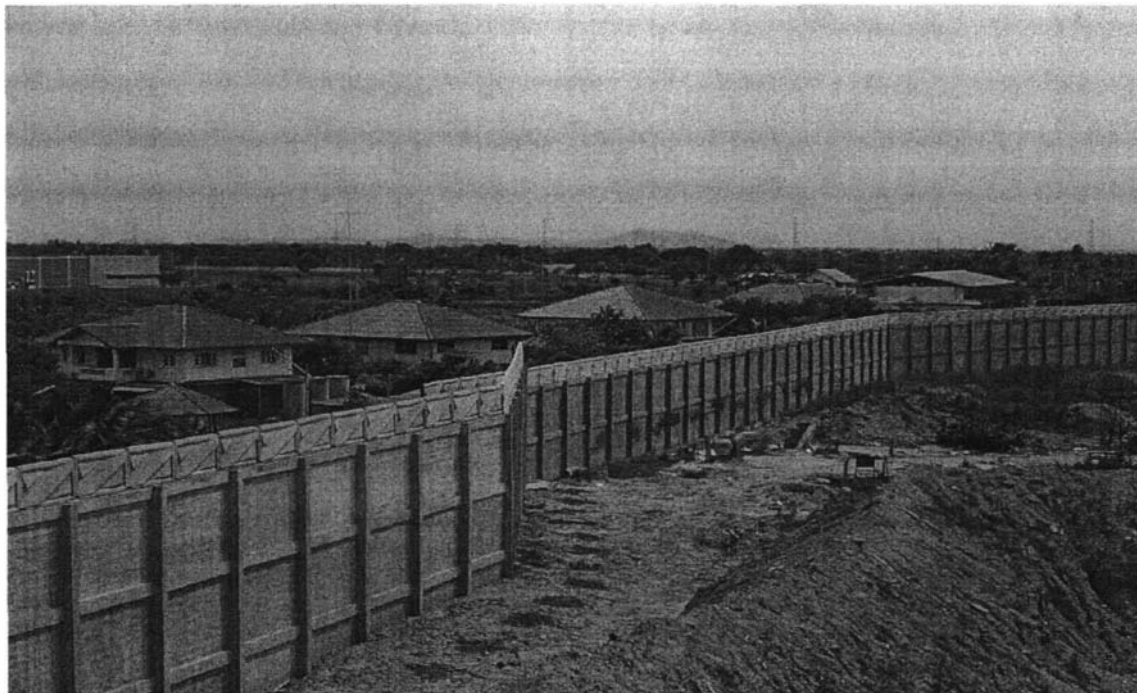
by building a big dust collector system and a very high wall to reduce the noise. The picture of the dust collector system at the company of respondent C, a sample manufacturer outside of the Town, is shown in Picture 6.1 and Picture 6.2 is the noise retaining wall, with concave noise diffusion surface, at the company of respondent C.

Picture 6.1: Dust Collector and Noise Retaining Wall with Concave Noise Diffusion Surface at the Company from Outside of the Town (Respondent C)



Note: Pictures 6.1 taken on 27 May 2005

Picture 6.2: Noise Retaining Wall with Concave Noise Diffusion Surface (under construction) at the Company from Outside of the Town (Respondent C)



Note: Pictures 6.2 taken on 27 May 2005

The participant from another manufacturer outside of the Town, that uses TQM/TEQM (Respondent D), said his company used to receive complaints from the community about water pollution. However, after the company improved its water treatment system last year, it has not received any more complaints.

Also, a respondent from the remaining company outside of the Town (Respondent E) said his company does not use any environmental management system. Since the company does not produce any environmental pollutants, it does comply with the environmental laws and regulations. This manufacturer, from outside of the Town solves any environmental problems totally without assistance.

The participants from the manufacturers in and outside of the Town agreed that they and the local community have co-responsibility for environmental management. In addition, the government has to provide education to communities and assign community leaders to form committees, that are concerned about the preparation of

environmental standards. All of the sample manufacturers in this survey would welcome such local community committees to visit their company.

The results of this part of the research that deal with the “plan for transformation implementation” indicate a congruence of the EMS applied by large manufacturers in the industrial town and outside of the Town in terms of the “plan for transformation implementation”. The interview results show that both the ISO and TQM/TQEM manufacturers use P-D-C-A cycle with other management tools (e.g. cause and effect diagram, flow chart, control chart) in making decisions about environmental management. This confirms findings by other researchers (Dale, 2003; Piper, Ryding and Henrison, 2003) and the results of the questionnaire that both ISO and TQM/TQEM used a base type of P-D-C-A cycle as the basic element.

Finally, although company E does not have EMS and does not use a P-D-C-A cycle in making decisions about the environmental management, it complies with the Thai environmental legislation and is not a significant producer of environmental pollutants. Additionally, the results of this research indicate that company E has a good production management system and provides training programmes about environmental management for their staff.

6.2.1.3 Standards and Processes

The participants from the Town identified ISO 14001 as the EMS for their manufacturing companies. ISO 14001 has a comprehensive manual to follow. However, ISO 14001 is not a perfect system. Participants informed the researcher that ISO systems control everything by a documentation system. Manufacturers have to spend more time and money to manage such documentation systems. This confirms similar findings by other researchers (Quazi, 1999; Levy and Newell, 2005). Although manufacturers obtained an ISO 14001 certificate, this does not necessarily mean that they do not discharge pollutants. It simply means that manufacturers have a system to control and reduce the discharge of pollutants. Although an ISO 14001 system is not a perfect system for management of an environment, the participants from the Town say ISO 14001 is the most recognisable system and has a lot of advantages for manufacturing companies.

On the other hand, all participants from manufacturers outside of the Town say their manufacturers do not use the ISO 14001 system. Two manufacturers outside of the Town use TQM as their EMS. Another manufacturer just complies with the requirements of the national environmental laws and regulations.

Participants from the two manufacturers, that use TQM as their EMS, commented that ISO 14001 is a good management system and internationally recognised. The ISO 14001 system is required for international trading companies, particularly when trading with the United States and Europe. However, TQM is considered to be a good enough system to manage environmental production and to meet the requirements of national environmental laws and regulations, and TQM/TQEM has monitoring system to thoroughly check any process. Manufacturers believe that ISO 14001 has too many documentation processes to complete and involves higher implementation costs.

The one remaining participant, from the manufacturers outside of the Town, mentioned that their manufacturer does not discharge a great deal of pollutants into the environment. This manufacturer manages everything and complies with relevant legal requirements. However, the participant knows that an EMS is a useful tool, as explained below:

Respondent E

The EMS may help manufacturers to save production costs. This company may apply for ISO 14001 certification in the future, when the company expands and exports products to other countries.

In addition, all manufacturers' respondents said that their companies have a safe policy to handle accidents and emergencies. If an accident happens, the first line supervisor or manager is asked to investigate the cause, in order to reduce the risk of the accident happening again. If the problem is beyond the expertise of the company then outside expertise, such as local government agencies, is sought. All participants from government agencies also mentioned the government have an emergency plans for environmental incidents, but they do not have any readily available information.

All participants from manufacturers say that Thailand's national environmental standards do not result in a safe environment across the country. However, they agree that the country should still have environmental standards, as evidenced by the following responses:

Respondent A

The government should carry out its own research and then set up its own standards. At present Thailand's national environmental standards are taken from those that exist in developed countries, such as the United States and the United Kingdom. I think these environmental standards do not result in a safe environment but the country has to have an environmental standard.

Respondent B

In my opinion, the national environmental standards do not result in a safe environment, but some international traders require international environmental management systems, and this is the major reason for encouraging manufacturers to improve environmental quality. However, the environmental laws and regulations might better encourage manufacturers to work in partnership with government.

Respondent C

I do not think the national environmental standards result in a safe environment even though it contains high standards. The government does not have a good monitoring system and enforcement, so standards do not give results. However, the country has to maintain a high standard.

Respondent D

No, the national environmental standards do not result in a safe environment. Community pressure is a factor that results in a safe environment. However, the government has to maintain environmental standards.

Respondent E

The environmental standard is not a main factor in a safe environment, but Thailand still has to have environmental standards. In my view, I think community pressure may result in a safe environment.

The participants from the government agencies said that environmental laws and regulations encouraged manufacturers to improve environmental quality and work in partnership with the government. In contrast, the participants from the manufacturers said that environmental laws and regulations do not, in effect, encourage manufacturers to improve environmental quality and work in partnership with government. For example, respondent C believed it was complaints from local communities which encourage manufacturers to improve environmental quality and to work in partnership with government (taken from the research interview results). Also, he mentioned that the government should, without fail, provide communities with enough education about environmental problems and EMS.

All participants from manufacturers accepted that manufacturing industry is one of the major sectors that discharges pollutants into the environment. However, most manufacturers have known about the effects of environmental problems and they try to reduce the discharge of pollutants. Participants from the Denso (Thailand) company believe that over 80% of manufacturers in industrial towns have a good environmental management system and most of them use the ISO 14001 system. Both the IEAT and the central environmental system for industrial towns inspected manufacturers in industrial towns, but manufacturers outside of industrial towns are inspected only by the MOI.

Participants from outside of the Town believe that manufacturers in industrial towns and outside of the Towns are not different. All manufacturers believe they have the best environmental management system for themselves and try to reduce the discharge of pollutants as illustrated below:

Respondent C

I believe that environmental management quality from manufacturers in industrial towns and outside of industrial towns are not different. It is

dependant on the manufacturer's executive decisions, whatever system they think is best for manufacturer.

Respondent D

Some manufacturers outside of the industrial towns may have better environmental management systems, than manufacturers in industrial towns. However, we may have been allocated budgets that are not sufficient to educate our employees and communities about our activities in those communities.

Participants from the government disagree with the view that, if manufacturers applied EMS in their industrial processes, the government could not reduce environmental regulations. They said that both government and manufacturers should keep to high standards of environmental laws and regulations. Accordingly, the participants from manufacturers, both in the Town and outside of the Town, that use TQM / TEQM, said government and manufacturers should not reduce environmental standards.

The results of this part of the research show that there are some differences of “environmental management processes” between the EMSs that are applied by large manufactures in industrial town and outside of the Town. For example, the ISO system controls everything by a documentation system. The companies that used ISO 14001 have to spend more time and money to manage their documents than the other two systems (TQM/TQEM and the Thai national laws and regulations) and require an external audit. On the other hand, the TQM/TQEM companies have a monitoring system to thoroughly check any process. Therefore, both TQM/TQEM and the Thai national laws and regulations systems are more flexible processes than ISO. The attraction of using the ISO was its international standing. The interview results also show that the EMS process can help manufacturers to save production costs by using a better operation system (e.g. less material and energy use, recycle and reuse generated waste). Both government agencies and manufacturers from in and outside of the Town have assigned budgets for training their employees about environmental management. In addition, the participant from the manufacturer that does not have

EMS mentions that his company may apply for ISO 14001 in the future, when the company expands.

The government officers interviewed believe that environmental legislation encouraged manufacturers to improve environmental quality and work in partnership with the government. In contrast, the manufacturers' staff explain that environmental legislation is used as a legislative requirement but does not encourage manufacturers to improve environmental quality and work in partnership with the government. The demand from customers and the local community, and the international trade requirement, have a greater impact in encouraging manufacturers to improve environmental quality.

6.2.1.4 Continuous Improvement Process

The participant from Denso (Thailand) believed that a continuous improvement process is a very important part of EMS. This creates an environmental management system as a cycle. The EMS is not a longitudinal project. It does not have a limited period of time. Manufacturing has to keep improving environmental quality. Keeping a record of environmental incidents is one of the EMS requirements that might help manufacturers improve the quality of EMS. Denso's management team uses records of environmental incidents, together with other tools, when making decisions about environmental management.

Respondent B noted that his company has records of both environmental incidents and accidents. The company uses both types of records in making decisions about environmental management and setting up training programmes about environmental management.

The participants from the two manufacturers outside of the Town, that use TQM /TEQM said all departments in their companies keep their own records. Also, companies have departmental managers meetings every month. The participants believed that all important incidents and accidents are reported at these meetings and the management team uses these records when making decisions to solve problems as seen in the responses below:

Respondent C

All departments in this company keep their own records, and all important data will be shared together in the monthly meeting. A record of environmental incidents is kept in the Quality Control Department. Also, my company has a record of customer complaints and uses this record to improve both products and environmental quality.

Respondent D

This company keeps a record of environmental incidents in the Production Planning Department. All important data about environmental management are passed to other departments in the monthly meetings.

A participant from a company outside of the Town, that does not have EMS, said his company does not have a record of environmental incidents, because the company does not discharge any pollutants into the environment.

The participant from the Department of Industrial Work, Ministry of Industry, mentioned that his department has a record of manufacturing environmental incidents but he accepts that this record does not apply to all manufacturers. The Office of Natural Resources and Environmental Policy and Planning participant noted that the Ministry was only established a few years ago, so many systems are not yet set up. He believed the Ministry still does not have a record of all manufacturing incidents. The participant from the Division of Planning and Evaluation, Ministry of Public Health, believed his Ministry does not keep a record of manufacturing incidents. The Ministry of Natural Resources and Environment and the Ministry of Industry should provide these records.

Respondent B said the government has to improve government officers' knowledge about environmental problems and environmental management systems. He stated that, when the government inspects the company, he thinks most of the inspectors from the government department do not have enough knowledge about environmental management. Also, the government is responsible for providing industries and communities with enough information about environmental laws, regulations and education. Interestingly, all of the respondents from the government departments said

their departments provide many training programmes and education about ISO 14001 and TQM / TQEM to their officers and that most of their officers have a responsibility to educate and inspect manufacturers' qualifications, relating to the management of the environment.

Other participants, from the manufacturers in and outside of the Town, said that the government has to give local communities enough information about environmental problems and how to protect themselves from environmental pollution problems. Additionally, the government should change environmental laws and regulations, that are mainly standards-based, as they do not assist manufacturers in developing industry systems.

The government respondents described many factors that result in good environmental outcomes for industry and many factors that reduce the effectiveness of environmental policy. They argued that these factors should be analysed to improve the quality of the laws and regulations concerning the environmental policy:

Respondent F

There are many factors which may result in good environmental outcomes for industry, such as manufacturers' employees and community knowledge, environmental laws and regulations, government actions, financial resources, equipment. Also, all of these factors may reduce the effectiveness of environmental policy.

Respondent G

In my opinion, environmental laws, regulations and standards are the most important factor; however, there are still other factors that are also important such as EMS, manufacturers' production processes, education. These factors may result in good or bad outcomes for industry.

Respondent H

There are many factors that result in both good and bad outcomes for industry, such as human knowledge, laws, EMS, government' monitoring system, community.

Respondent I

I think community knowledge is the most important factor. However, there are still other factors, for example, environmental standards, monitoring and enforcement system, NGOs.

Respondent J

There are many factors that result in good or bad outcomes for industry such as education, environmental laws and regulations, moral consciousness of manufacturers owner and community.

Respondent K

There are many factors that result in good and bad outcomes for industry, such as environmental laws and regulations, community, government, education.

The government participants also agreed that environmental laws and regulations should improve. Because Thailand's national environmental laws and regulations are based on those from the United States and the United Kingdom, some standards used do not translate easily to the situation in Thailand. In addition, a participant from the Office of Natural Resources and Environmental Policy and Planning stated that the MONRE did not have enough financial resources to provide education about environmental management to local communities and industries.

The results of the research in this section show that both the ISO and TQM/TQEM companies have records of environmental audit information and environmental incidents, and they use these records with other tools when making decisions about environmental management in their companies. The company outside of the Town that does not have EMS, does not have any records about the environment. The participant of this company claims that his company does not discharge any pollutants into the environment (no chemical use and no hazardous waste). Records of environmental audit information and environmental incidents are one of the important tools that companies should review to use in a continuous improvement process (Levy and Newell, 2005). Environmental records help the company to have a better understanding of their environmental management problems and then the company

can use these records together with other management tools (such as cause and effect diagrammes, flow charts, and control charts) to solve the problems (Piper, Ryding and Henricson, 2003). The results of this part clearly show the benefits of the EMS processes that help the company to have a better process to manage an environmental system.

The government and industry respondents also reported that there are many factors which may result in good environmental outcomes for industry, such as manufacturers' employees and community knowledge, environmental laws and regulations, government actions, monitoring and enforcement systems, financial resources, and equipment. Also, lack or weak performance of these factors may reduce the effectiveness of an EMS.

6.2.1.5 Summary of the Interview Results

The interview results show that the EMS applied by large manufacturers in the industrial town and outside of the Town are not different in terms of the commitment of the management team, the responsibilities about environmental management of manufacturers' staff, management tools that management teams use in making decisions about environmental management, emergency plans, and budgets for environmental training programmes.

However, there are a few significant differences between the EMSs applied by large manufacturing companies in and outside of the town concerning the audit of EMS, documentation system, and the records of environmental audit and incidents. For example, the ISO 14001 system monitors all the processes by checking the documentation system. The ISO companies' staff have to spend more time to develop and manage their documents and the company has to spend more budget on the documentation system than do the other two systems (TQM/TQEM, and the Thai environmental legislation). Moreover, the ISO requires an external audit. Implementation of TQM/TQEM is a production monitoring system that places strong emphasis on the stages of the production process. Therefore, both TQM/TQEM and the Thai environmental legislation systems are more flexible processes than ISO 14001.

The interview results also show that both the ISO and TQM/TQEM companies have good records of environmental audit information and environmental incidents, and they use these records with other tools when making decisions about environmental management in their companies. The company outside of the Town, that does not have an EMS, does not have any records about the environmental audit. Environmental records help a company to better understand their environmental management problems and then use these records together with other management tools (such as cause and effect diagrammes, flow charts, and control charts) to solve the problems. The results of this part of the research clearly show the benefits of the EMS processes that help a company to have a better process to manage an environmental system.

Additionally, the results show that government may have problems in not providing sufficient information and education about environmental legislation and management to both industries and the local community. The government should improve the communication channel to communicate with industries and the community, and the methods to educate industries and the community.

6.2.2 Comparison of Research Observations of Industry Accounts

By observing the implementation of EMS in manufacturing companies, I was able to observe processes used to collect dust emission, wastewater treatment, solid and hazard waste treatment and other systems. I also asked the companies' participants to show me the records of EMS audit and environmental complaints. In this section, these observations are recorded and compared with the results of company interviews in order to ascertain variations in practice, between manufacturers in and outside of the Town.

I observed two manufacturers in Amata Nakorn Industrial Town, the central treatment system of Amata Nakorn Industrial Town and finally the three manufacturers outside of the Town. I spent approximately two hours in each place. These observations looked at production lines, water treatment systems, air cleaning systems and solid waste treatment systems inside the manufacturers' environment.

All manufacturers, that participated in this study, provided staff for me to observe, who worked in the section concerned with environmental management and with the companies' EMS. However, four out of five manufacturers, that participated in these observations, did not allow me to take photos inside the company's premises. Only the UMC Metal Company allowed me to take photos inside its company's area of operations.

6.2.2.1 Performance Agreement for the Environmental Programme

Denso (Thailand) Company Limited

Denso was the first manufacturer that I observed. This company is located in the Amata Nakorn Industrial Town. It manufactures automobile electrical parts, such as alternators, starters, etc. for both the local and export trade. This company is beneficial to study since it has good systems and is often referred to by others as an exemplar. The company occupies quite a large area, totaling approximately 144,800 sq. m. Denso also has the ISO 14001 and ISO 9001 displayed at the company main entrance. An excellent view of the company is seen in Picture 6.3: Denso (Thailand) Co. LTD.

Picture 6.3: Denso (Thailand) Co., LTD.



Note: Picture from company profile 2002, Denso (Thailand) Co., LTD.

Denso has a good security system and visitors must make an appointment before visiting the company. However, Denso (Thailand) is pleased to welcome local

community visits. I made an appointment to observe the EMS. The company provided a staff member involved with the company's EMS to explain everything to me. In this observation, I had the opportunity to visit production lines, a water treatment plant and a water treatment laboratory.

The company participant said that Denso (Thailand) has a company philosophy and one of the company's management principles is environmental preservation and harmony with society. Inside the plant, it also has the company performance agreement for environmental programmes displayed on the wall.

Thai Iwaki Glass Company Limited

This is another manufacturer in the Town where I observed the company's EMS. The company manufactures best-quality borosilicate glass lenses, for automotive headlamps, to automotive headlamp manufacturers all over the world together with heat-resistant glass cookware. Thai Iwaki Glass is also very interesting. This company's area is large and its premises are clean. Thai Iwaki Glass has the ISO 14001 and ISO 9001 displayed at the company main entrance, and the company performance agreement for environmental programme together with the quality policy displayed in the front of it plant.

Picture 6.4: Thai Iwaki Glass Co., LTD.



Note: Picture taken on 22 April 2005



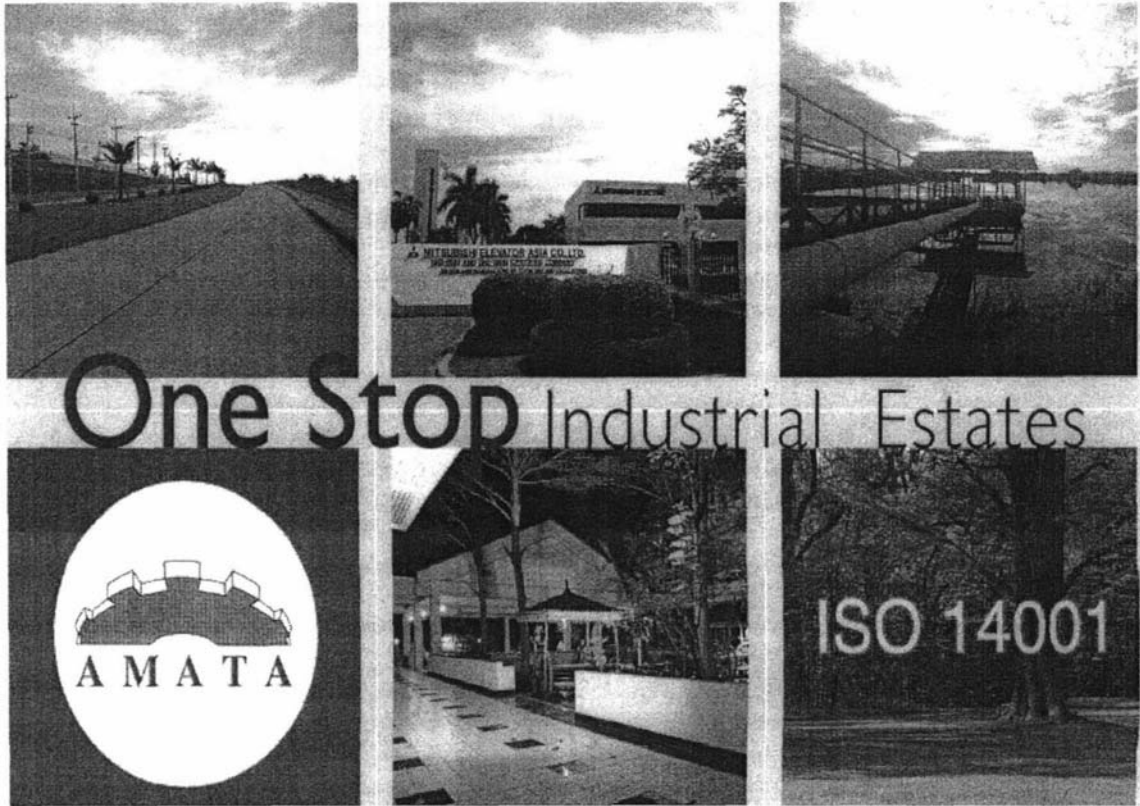
Note: Picture from company profile 2002, Thai Iwaki Glass Co., LTD.

Thai Iwaki Glass Co. LTD. is pleased to welcome members of the public to visit the company. I made an appointment to observe its EMS. Thai Iwaki Glass also provided a staff member involved with the company's EMS to provide explanations. In this observation, I had the opportunity to visit production lines and inspect the company. The company participant state that Thai Iwaki Glass has an agreement to maintain its EMS (ISO 14001) and reduce the amount of polluting substances emitting from its premises.

Amata Nakorn Industrial Town

In addition, I also observed the central treatment system of Amata Nakorn Industrial Town. Amata Nakorn Industrial Town was established in 1989. The town is located on Bangna-Trad Km.57 Road, Chonburi Province. I had a great opportunity to observe power plants, water resources, a waste water treatment system and a solid and hazardous waste management system, together with the managing director of the Town. The managing director says that the Town is pleased to welcome visits from local communities. Also, the participant stated that the Town has an agreement to take environmental management seriously. The Amata Nakorn Industrial Town picture is shown in Picture 6.5.

Picture 6.5: Amata Nakorn Industrial Town



Note: Picture from annual report 2001, Amata Nakorn Industrial Town

Amata Nakorn Industrial Town has an excellent infrastructure, including concrete roads and dedicated utilities to support reliable and efficient manufacturing. The town has co-generation power plants, abundant water resources, wastewater treatment system (see Picture 6.5 and 6.6) and a solid and hazardous waste management system (see Picture 6.7) to support manufacturers in the Town. Also, the Town has the ISO 14001 displayed at the main entrance and the environmental performance agreement for environmental programme displayed at the front of the office and published in the Town annual report.

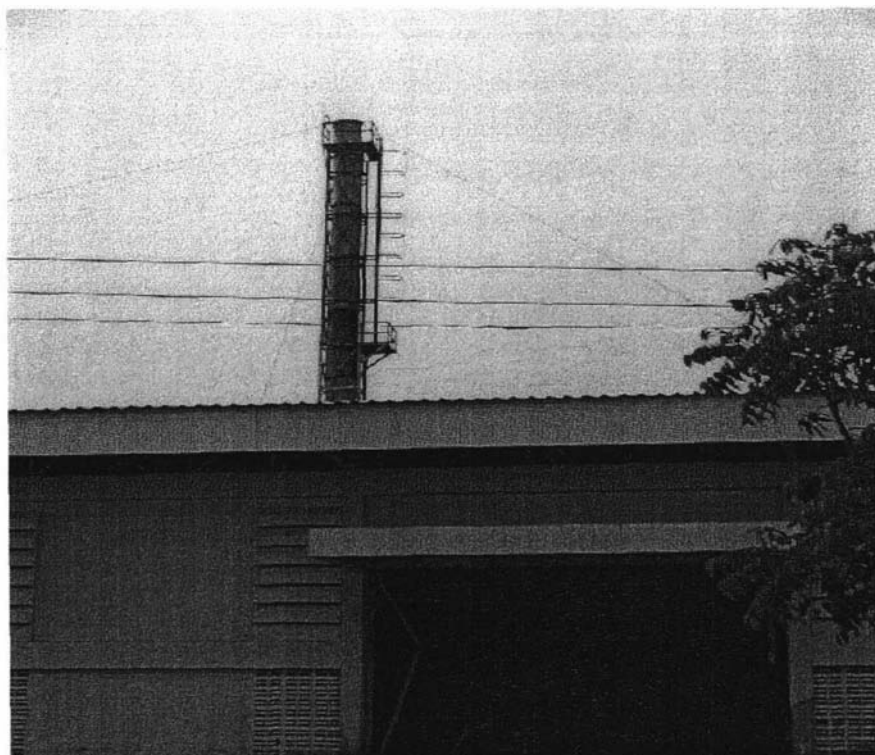
Picture 6.6: Amata Nakorn Industrial Town's Waste Water Treatment System



Note: Picture taken on 30 April 2005

Picture 6.7: Amata Nakorn Industrial Town's Solid and Hazardous Waste Management System



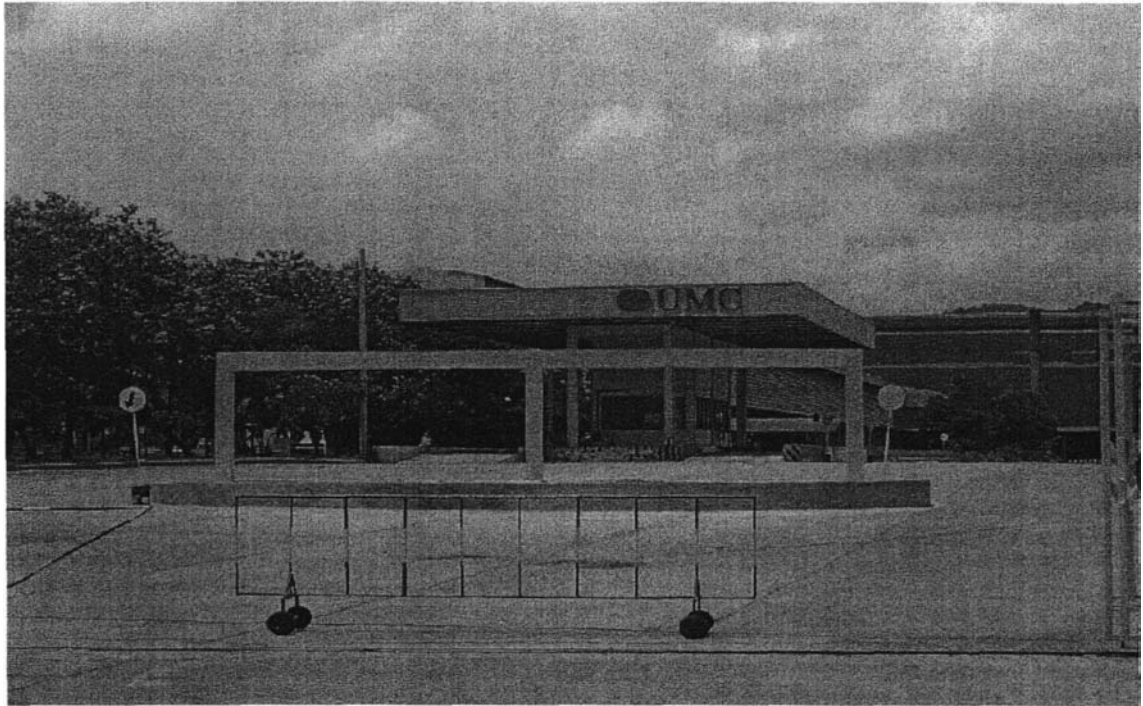


Note: Picture taken on 30 April 2005

UMC Metal Company Limited

Further observations were made at UMC Metal Co., LTD, one of three manufacturers outside of the Town. UMC Metal uses TQM / TEQM as their EMS. However, I found that most processes were similar. The participants from UMC Metal and the other company that used TQM/TQEM (respondent D) stated that the company has a performance agreement for environmental management. The management teams of these two companies pay attention to environmental management, since they understand that, if the company discharges pollutants into the environment and it is detected by the Ministry of Industry, they might be forced to close the company. These companies also have the TQM/TQEM process (P-D-C-A cycle) displayed on the walls inside their plants. The remaining company that does not have EMS looks tidy and has the 'keep the areas tidy at all time' sign in all their production sections.

Picture 6.8: UMC Metal Co., LTD.



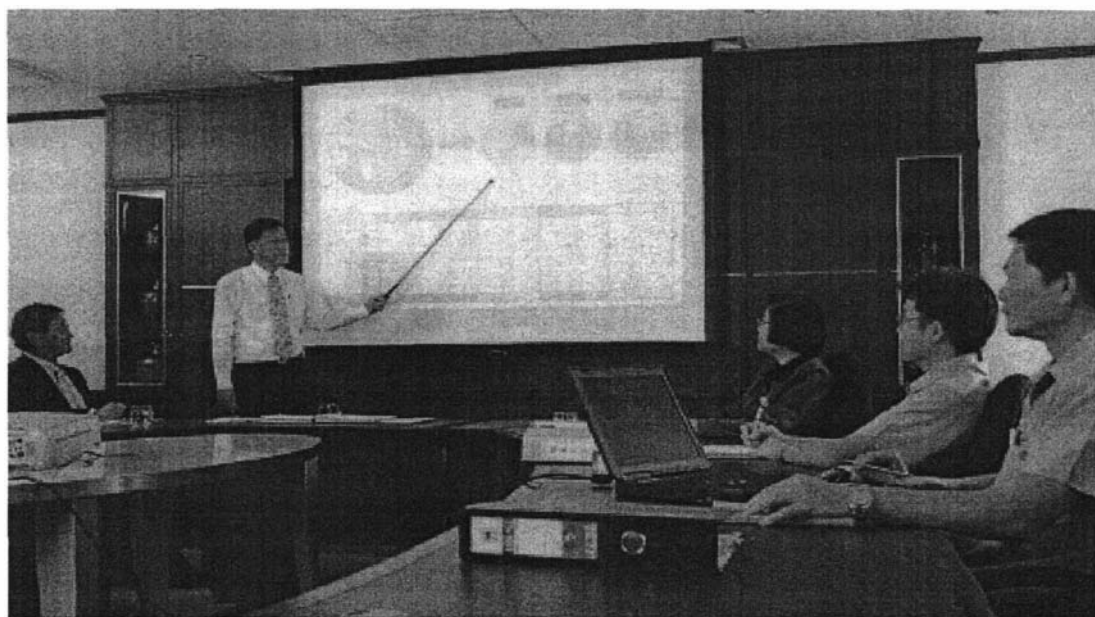
Note: Picture taken on 27 May 2005

The companies that use ISO 14001 and TQM/TQEM have no significant difference in the “performance agreement for the environmental programme”. The companies from both systems have a commitment to comply with the environmental legislation and improve the environmental quality. Only the company (company E) that does not have EMS differs from the other EMS companies. This company (company E) does not have a performance agreement for the environmental programme, and just complies with the Thai national environmental standard. I found that the company has a good management system and the nature of its production does not produce many pollutants (no chemical use and no hazardous waste). However, based on the experience of the companies that use EMS and the findings of other researchers (Chin, Chiu, and Tummala, 1999; Harrison, 1999; Klassen, 2000) if the company adopted an EMS, an EMS may help the company to save electric power and reduce material use (the company’s participant also mentioned these benefits of an EMS during the interview survey).

6.2.2.2 Plan for transformation implementation

Participants, from both Denso (Thailand) and Thai Iwaki Glass, mentioned that their companies have annual environmental plans. From observations of these manufacturers, I found that these two town manufacturers use several tools in making decisions about environmental management. The participants from both companies allowed me to see conference reports from the departments controlling EMS in both companies. I found that the reports have information about the companies' training programme about ISO 14001. The companies use cause and effect diagrams, a control chart, flow chart, histogram, brainstorming and others tools when making decisions about environmental management. Picture 6.9 presents a management team meeting, Denso (Thailand) Co., LTD., and Picture 6.10 shows the company's activities for its employees and local communities.

Picture 6.9: Management Team Meeting, Denso (Thailand) Co., LTD.



Note: Picture from company profile 2002, Denso (Thailand) Co., LTD.

Picture 6.10: Company's Activities for Employees and Communities, Denso (Thailand) Co., LTD.



Note: Picture from company profile 2002, Denso (Thailand) Co., LTD.

On the other hand, the participants from the sample manufacturers, that use TQM / TEQM believed their companies also gathered plans about environmental management for the company annual plans. These participants also mentioned that their companies use TQM / TEQM tools, such as P-D-C-A cycle, cause and effect diagrams and team work when making decisions about environmental management and setting up the budget, relating to environmental management and training programmes.

The participant from UMC Metal mentioned that UMC Metal keeps a record of customer's complaints and also uses these complaints as a tool when making decisions about environmental management. However, both UMC Metal and another company that uses TQM / TEQM did not allow the researcher to see their annual plan and environmental records.

While the remaining manufacturer outside of the Town does not have any plans for transformation implementation, the company participant stated that the company

production process does not result in any discharge of environmental pollutants. The Personnel Department just ensures the company is kept clean, and that appears to be sufficient. However, during conversation with a supervisor in the production line, the researcher found that this company used the control chart, flow chart, and histogram in the production processes.

The Managing Director of Amata Nakorn Industrial Town explained to me that Amata Nakorn Industrial Town has long, medium and short term plans, that are concerned with environmental management. Long term planning means a plan for five years or more, medium term planning means a plan for over one year, but less than five years and short term planning means a plan for one year or less. The Town uses many management tools when making-decisions about environmental management.

It was observed that the companies that use ISO and TQM/TQEM had similar “plan for transformation implementation”. Both ISO and TQM/TQEM companies use P-D-C-A cycle with other management tools (e.g. cause and effect diagrams, control charts, flow charts) in making decisions about environmental management. These companies also provide training programmes about environmental quality for their employees. Moreover, the participants from the companies in the Town allowed the researcher to see conference reports from the departments controlling EMS in both companies. I found that the reports have information about the companies training programme about ISO 14001. However, the training programmes shown to me did not contain such important topics as the “commitments of the management team to the EMS” and the “characteristics of customer in term of EM”. This lack of topics was also reflected in the finding from the questionnaire results.

6.2.2.3 Standards and Processes

The participant from Thai Iwaki Glass Co., Ltd. mentioned that he believes the ISO 14001 has an excellent process for managing the environment of manufacturers. According to the opinion of another participant manufacturer from the Town, the ISO 14001 contains many tools to help industries develop good processes regarding environmental management. The participants from the Town companies believe their

companies have better standards, than those found in Thailand's environmental laws and regulations.

From observations, I found that both Thai Iwaki Glass and Denso (Thailand) have an excellent process for managing the environment, and a good documentation system that was easy to access. For example, when I asked the participants to show me the record of environmental audit, they found the records in a few minutes. However, Thai Iwaki Glass still has a large amount of solid and hazardous waste from its production lines. The staff who accompanied me during my observations said that Thai Iwaki Glass employed the GENCO Company to manage their waste. The participant mentioned that GENCO is a joint venture company between the government and private sectors, who specialise in managing industrial hazardous waste.

There was an opportunity to observe the wastewater treatment plant and solid and hazardous waste treatment plants in the central treatment system of Amata Nakorn Industrial Town. I found that that the wastewater treatment plants are well managed. However, the solid and hazardous waste treatment plant does not have an appropriate management system and it is very old, dirty and produces a very unpleasant smell.

In addition, whilst observing the other three manufacturers outside of the Town, I found that the two manufacturers that use TQM / TEQM have a good system in both production and environmental processes. However, when I asked the participants from both companies, to see their company environmental audit records, I noted that the participants had to look through many folders for approximately 20 – 30 minutes, in order to find the documents. From the environmental audit records, I found that both companies comply with, or have better standards than, Thailand's environmental laws and regulations.

In contrast, the company E does not have any activities which affect the environment. However, this company also has very good production processes and the company's area looks clean, both inside and outside the plant.

Picture 6.11: Waste Water Treatment Plant, UMC Metal Co., LTD.



Note: Picture taken on 27 May 2005

6.2.2.4 Continuous Improvement Processes

During the researcher's observations of the Denso (Thailand) wastewater treatment system the company was cleaning sludge in wastewater treatment pools. The participant from Denso (Thailand) said the company has its own laboratory. When the water quality from wastewater treatment plants is not acceptable then the staff have to investigate the cause and solve the problem.

I observed that some production sections of the Denso (Thailand) plant are noisy without specialised testing equipment and the noise level appeared to exceed the standard, which is a 24-hour average level of not more than 80 decibels. However, the company provides sufficient ear protectors for all staff in those sections. The participant stated that Denso (Thailand) would solve this problem by putting covers on particularly noisy machinery, to substantially reduce noise emissions. Denso (Thailand) has an excellent documentation system and also a good continuous improvement process in place.

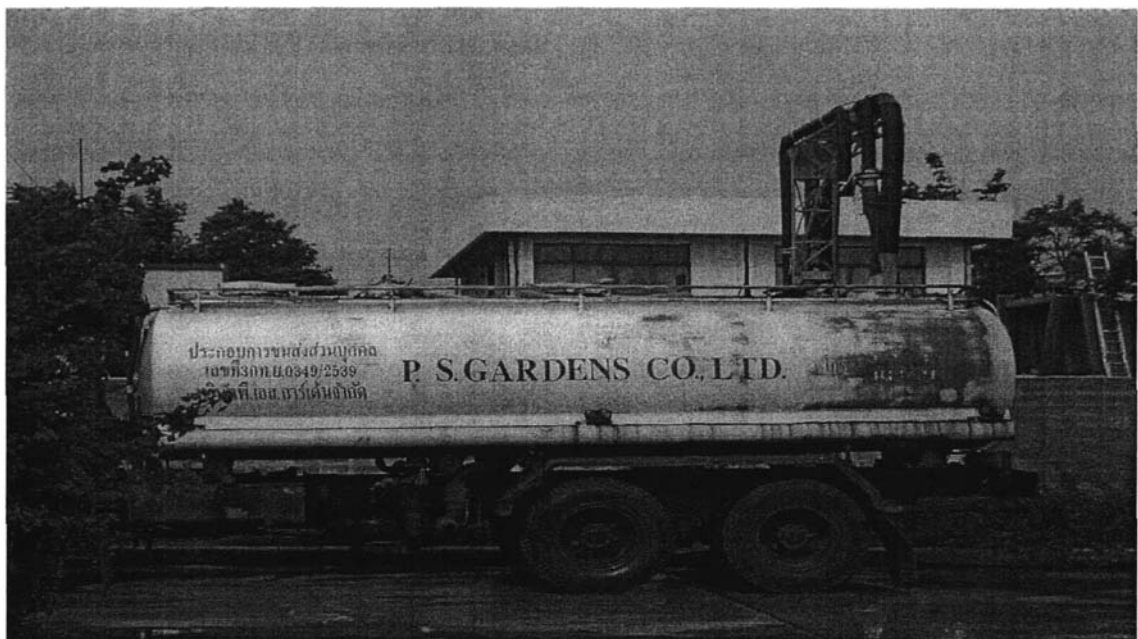
Whilst Thai Iwaki Glass has a problem with large amounts of solid and hazardous wastes from its production lines, the participant from Thai Iwaki Glass mentioned that the company is studying this problem and is trying to reduce the waste by changing

some raw materials and production processes. The participant believes this problem would be solved in the near future. This company also has an excellent documentation system and uses its records to improve its environmental processes.

UMC Metal, the manufacturer outside of the Town, is making improvements to its dust collector system and solving its noise pollution problem. I found that UMC Metal has made many improvements to its environmental management system. The participant from UMC Metal believed that the company is improving its documentation system. On the other hand, I did not find any continuous improvement process relating to environmental management in either the central treatment system of Amata Nakorn Industrial Town or the other remaining manufacturers, from outside of the Town.

However, during the observation at Amata Nakorn Industrial Town, I found that the Amata Nakorn Industrial Town uses water after it has been processed in the central treatment plants, to maintain its gardens (see Picture 6.12). The water is tested by laboratory before use. The participant from the Town mentioned that the Town used water after treatment, to maintain all gardens in the Town and some water in the Town was also passed into the public canal (see Picture 6.13)

Picture 6.12: Water after Treatment Process Was Used to Maintain Gardens



Note: Picture taken on 30 April 2005

Picture 6.13: Public Canal in Amata Nakorn Industrial Town



Note: Picture taken on 30 April 2005

In this part of the research I found that the companies in the industrial town use the environmental audit information to solve the environmental problems in their manufacturing process. For example, Denso solves the noise problems by putting covers on particularly noisy machinery, and Thai Iwaki Glass reduces solid and hazardous wastes by changing some raw materials and production processes. These responses to environmental problems may be because the ISO 14001 requires the company to develop a good documentation system. It is easier for the manufacturers' staff in the Town to review the record of environmental audit and use this information with other management tools (e.g. cause and effective diagrammes, flow charts, control charts) to solve the environmental problems.

In contrast, UMC Metal is only one of the three companies from outside of the Town that used the environmental audit information to solve the environmental problems. The other two companies from outside of the Town provided no evidence of using the environmental audit information to make changes to the manufacturing processes.

6.2.2.5 Summary of the Observations Results

From the observation results, it may be concluded that the ISO and TQM/TQEM companies staff did not differ in their responses about their companies EMSs in terms of the commitment for environmental quality, management tools that are used in making decisions about environmental management, the records of environmental audit, or in budgets for environmental training programmes. However, the ISO companies have a better documentation system than those using TQM/TQEM and the Thai environmental legislation. Indeed, the ISO companies can find document easier and faster than the companies using TQM/TQEM and the Thai environmental legislation. Also, it may be the result of that ISO companies using the records of environmental audit information to improve manufacturing processes in their companies.

In contrast, there are many differences between the companies that have EMS (ISO and TQM/TQEM) and the company E that does not have an EMS. The company E does not have a commitment to environmental quality and has no records of environmental audit. However, this company (company E) still has budgets for environmental training programmes for their employees and is using some management tools (control charts, flow charts, histograms) in the company production line. The company is aware that an EMS can help them to save production costs. Indeed, according to the information given during the interview the company may adopt an ISO 14001 when the company expands.

6.2.3 Reviewing Published Documentation

Although the potential benefits of industrial pollution control are clear in many developing countries, many environmental policy makers continue to worry about the economic costs. Industrial air and water pollution in Thailand have been major concerns for the past two decades, whilst industrial hazardous waste has only become a concern in the last few years (Chantadisai, 2004). The high levels of environmental damage are primarily due to the rapid growth of pollution-intensive industries, rather than the absence of environmental laws and regulations. Indeed, the government has set as its main priority a policy on pollution control and environmental protection,

under the Enhancement and Conservation of National Environmental Quality Act (the Environmental Act). The present Act has been used since 1992 (Pollution Control Department: 2, n.d.) and it emphasises only pollution control technologies. These were introduced about 35 years ago and were not particularly supported by the main stakeholders. As Klessen's (2000) research indicates this approach is not effective. Klessen (2000), as was discussed in Chapter Two, divides environmental technologies into three broad groups; pollution control, pollution prevention and EMS technologies. So by the turn of the century MONRE has announced many environmental management strategies that already applied both environmental prevention technologies and EMS technologies. For example, to promote collaboration among government agencies and private sector, to control and prevent air pollution; to promote investment and use benefits to promote activities and utilisation of facilities and equipments, that contribute to mitigating and preventing air pollution (Pollution Control Department: 2, n.d.). From these points, the government should apply both pollution prevention and EMS technologies to develop the new Environmental Act.

Many researchers mention that environmental legislation is an important factor requiring manufacturers to improve their EM and adopt an EMS (Aboulnaga, 1998; Chin, Chiu, Tummala, 1999; Watson and Emery, 2004). However, there are some researchers who argue that environmental legislation (standard) is necessary but may be insufficient if the government agencies lack sufficient sanctioning power and technical capacity to monitor and enforce existing regulations (O'Rourke, 2004; Rooij, 2006). This is confirmed by this study. The survey participants point out that the environmental standard in Thailand is not different to that set by many of the developed countries, but the monitoring and enforcement system by the government agencies is not effective.

The results from the document review and survey show there are still other factors that may affect the quality of an EMS. For example, environmental education and awareness, environmental laws and regulations, community demand, internal and external communication, production and environmental management processes. Huckle (1991) points out that education and awareness are critical to the success of the EMS. He and others researchers believe that when people have enough

environmental education and awareness they will work in partnership to protect the environment (Huckle, 1991; Peet, 1991; Sterling, 1992). However, in this study, the interview results of government officers did not show that the Thai government has a plan or strategy to provide environmental education and awareness to both industries and community. Yet a number of researchers offer detailed advice with respect to environmental education. For example, Huckle (1991) mentions that environmental education can be described within three categories:

- Education for environment awareness and interpretation aims to increase community understanding of their behaviour within the environment. It helps them to examine and share the beliefs, attitudes and values which contribute to non-sustainable ways of living with nature and to promote alternatives.
- Education for environmental management and control aims to provide the environmental manager of the future and young people who will be supportive of their work. Its curriculum supports the greening of society as is currently organised or structured and is built largely on empirical or technical knowledge of the environment and education.
- Education for sustainability aims to empower people so that they can become agents of social change and sustainable development. It enables them to reflect and act on the structures and mechanisms which shape the social use of nature in ways which prefigure a future democratic and sustainable society. Such education draws heavily on critical knowledge of the environment and education.

From these three categories of environmental education, it may be assumed that there are three level of education, which are education for community members, manufacturers' employees, and government officers or environmental organization (NGOs). It may also be assumed that these three groups have different responsibilities for the EM.

Additionally, Dyckhoff (2000) mention that effective communication is an essential foundation of an EMS. Communication relevant information about the EMS means sharing the power for implementation, maintaining, and improving the EMS. Informed and knowledgeable employees can be active participants in the EMS.

Conversely, when communications are inadequate and information is missing, an EMS is weakened. He also divides communication into two groups which are internal and external communication.

6.2.3.1 Air Pollution Problems

Presently, the government addresses air pollution problems, from industrial manufacturing, by establishing categories of industries which are subject to air pollution control and supplements and it regularly revises Industrial Emission Standards. In addition, public relations are undertaken to address the issue of air pollution reduction (Pollution Control Department: 5, n.d.). However, these measures cannot solve all problems, because of the lack of unity among many responsible agencies, resources and the lack of personnel with knowledge and experience to take measurements and to establish systems.

The Ministry of Natural Resources and Environment set of management strategic practices for air pollution prevention are:

- Separate industrial zones from local communities, by rigorously implementing master city plans.
- Continuously monitor, check, analyse and construct a database of the overall ambient air quality and emission of air pollutions from its sources.
- Formulate prevention measures and prepare emergency plans.
- Assign local government agencies to prepare master plans for continuous reduction of air pollution in local areas.
- Promote collaboration among government agencies, state enterprises and the private sector, to control and prevent air pollution and also support efficient and save energy utilisation.
- Establish buffer zones around industrial towns and industrial zones, in order to control and reduce air pollution conditions, arising from industrial activities.
- Control and reduce utilisation of substances that are a danger to the atmospheric ozone layer.

- Promote investment and use benefits to promote activities and utilisation of facilities and equipments, that contribute to mitigating and preventing air pollution.

(Pollution Control Department: 5, n.d.)

6.2.3.2 *Water Pollution Problems*

The national government's Pollution Control Department, reports that water quality in several types of water resources had deteriorated throughout the country, including surface water, ground water and sea water, particularly in the big cities and industrial areas, because of contamination of toxic substances from both local community and industrial activities (Pollution Control Department: 7, n.d.).

The present government promotes and encourages local governments, state enterprises and the private sector to invest in the construction of central wastewater collection and treatment systems, by increasing the fund for the Environmental Fund. In addition, the government prepares emergency action and accident prevention plans for mitigation relating to the damage caused by the spreading of pollutants in the environment, which then impact on the quality of water (Pollution Control Department: 6, n.d.).

Amata Nakorn Industrial Town is one of the public industrial Towns that provides a central wastewater treatment facility (Amata Nakorn Industrial Town, 1999). The calculation of the Town's wastewater treatment rate is based on the BOD levels of effluent discharge to the central wastewater treatment plant. (Amata Nakorn Industrial Town, 2002).

Moreover, many manufacturers inside Amata Nakorn Industrial Town still have their own wastewater treatment facilities. Denso (Thailand) is also located in the Town and it has its own wastewater treatment facility. Additionally, Denso (Thailand) is setting up the company vision called, "Denso EcoVision 2005". This is a long-term environmental policy that has formulated the following requirements, to reduce the environmental impact of company activities:

- Maintain environmental management system (ISO 14001)
- Green procurement
- Reduce waste
- Reduce environmental impact of the plant
- Prevent global warming
- Rationalisation of logistics

(Denso (Thailand) Co., LTD., 2002)

6.2.3.3 Hazardous Waste Pollution Problems

Frequently, many foreign industrial companies moving to Thailand do not seriously consider Thai environmental laws and regulations. The result of this oversight is the discharge into the environment of heavy metals, asbestos, Benzidine dyes and pesticides used in production processes. The impact of these discharges include air, water, hazardous waste and public health problems (Thailand Development Research Institute (TDRI), 1994).

The Environmental Quality Standards Division, Office of the National Environment Board, provides a definition of hazardous waste as follows:

Substances or materials which are not used or cannot be used, which contain or are contaminated with combustible substances, corrosive substances, highly active substances, explosives, toxic substances, soluble substances, radio-active substances, and/or disease producing organism which are produced by various industrial, community and agricultural activities.

(Thailand Development Research Institute (TDRI), 1994)

The government agency directly concerned with industrial hazardous waste is the Hazardous Waste Disposal Subdivision of the Office of Industrial Services and Waste Management in the Ministry of Industry. Unfortunately, in spite of Thailand's very fast economic growth, the Hazardous Waste Disposal Subdivision has not been allocated more manpower, to deal with escalating hazardous waste problems.

The Pollution Control Department reports on the hazardous waste situation in Thailand, to the effect that industrial hazardous waste pollution is a serious problem and it is expected to worsen in the future. Generally, hazardous waste is increasing rapidly from various activities throughout the country, from both industries and local communities. At present, the treatment of hazardous waste is not effective because the processes of control, import-export, separation, treatment to final disposal site and the illegal dumping of hazardous waste, from both manufacturers and local communities is not controlled (Pollution Control Department: 8, n.d.).

Sustainable development in industrial hazardous waste control, as an expectation of government, is a joint venture between the government and private sectors under the General Environmental Conservation Public Company Limited (GENCO) which was established in 1994. The Ministry of Industry and the Department of Industrial Works remains the principle stakeholder for the supervision, and protection of the environment from increases in industrial waste (General Environmental Conservation Public Company Limited, 2002).

6.2.3.4 Other Environmental Pollution Problems

Other industrial environmental pollution problems in the country include noise and odour pollution. Thailand's government attempts to control the level of noise in all areas of the country, with a 24-hour average level of not more than 80 decibels, by the formulation of a master and action plans for the prevention and eradication of noise pollution (The Royal Thai Government under His Majesty King Bhumibol Adulyadej, 1997). Although the government does not have regulation standards, relating to industrial odour pollution, most manufacturers have embarked on odour pollution control due to complaints about smells from local residents.

6.3 CONCLUSION

This chapter has reported on the individual interviews, observations and documentation data. The results here aim to answer the three research questions posed at the beginning of the thesis. Firstly, what are the Environmental Management

Systems (EMSs) used in Thailand. Secondly, whether there is a difference between EMSs selected by industries in industrial towns and industries located generally in other areas of Chonburi Province. Thirdly, which EMS is most effective for all types of large size manufacturers (the registered capital being 200 million or above Thailand Baht.

The survey results show that there are only two types of EMS systems currently used by large manufacturing companies in Chonburi Province, Thailand – ISO 14001 and TQM/TQEM. Most large companies in the industrial town use ISO 14001, and many of the large companies outside of the Town use TQM/TQEM. However, there are some large manufacturing companies who do not have EMS. These large companies just comply with the Thai national environmental legislation. Therefore, there is a distinct division between companies inside the Town and those from outside in respect of the EMS systems used.

The results from the research questionnaire and interviews show that there is no significant difference between the perception of the EMS quality between the companies that use ISO 14001 (inside of the Town) and TQM/TQEM (outside of the Town) in terms of (a) their commitment for environmental quality; (b) the responsibilities about environmental management of manufacturers' staff; (c) the tools used by management in making decision about environmental management; (d) the companies emergency plans; the records of environmental audit; and (e) budgets for environmental training programmes. However, as was discussed earlier in this chapter, there are some differences in documentation and audit systems between the EMS systems that are used by companies in the industrial town (ISO 14001) and outside of the Town (TQM/TQEM and the Thai national environmental legislation). The results of the survey also show that ISO companies have a better documentation system than those using TQM/TQEM, and the Thai national environmental legislation companies. However, the TQM/TQEM and the Thai national environmental legislation are more flexible than the ISO system, and the ISO companies have to spend more time and money on the documentation system and training programmes. In contrast, there are many differences between the companies that have EMS (ISO and TQM/TQEM) and company E which does not have an EMS. This company does not have a commitment for environmental quality and any record of environmental

audits. However, company E still has budgets for environmental training programmes for their employees and uses some management tools (control charts, flow charts, and histograms) in the company production line. It may be because the company knows that EMS can help it to save production costs. At present, this company has only the domestic market to consider, and this may be a reason for not having adopted an EMS. Indeed, as was mentioned during the interview the company is planning to expand overseas and they are thinking of adopting ISO 14001 at some further time.

Finally, the survey results show that the government officers believe that they have tried to do their best to improve environmental quality and to provide information and education about environmental legislation and management to both the industries and the community. However, due to the lack of financial and human resources, they accepted that the government does not provide enough information and education to both the industries and the local community, and the industrial pollution problems in Thailand still remain. On the other hand, large manufacturers' staff also believe that most of Thai large manufacturing companies from both inside and outside of industrial towns pay serious attention to environmental problems and their EMS. These companies provide many training programmes about EMS to their staff and have budgets to develop a good environmental management system. Moreover, the participants from both manufacturers and government strongly agree that an informed community is the most important success factor to improve environmental quality. According to respondents, when a community has a very strong concern about environmental quality, both the government and industries will show more concern.

In the next chapter, Chapter Seven, the implications and conclusions from the research are drawn. The Chapter also presents an EMS assessment framework for business.

CHAPTER 7: AN EMS ASSESSMENT FRAMEWORK FOR BUSINESS

7.1 INTRODUCTION

This concluding chapter focuses on the implications of the findings for good practice and improvement of the quality of EMSs applied to large manufacturing companies in Thailand. This research had four objectives which were:

- Evaluate EMS systems used by large manufacturing companies in Amata Nakorn Industrial Town and compare them with EMS systems used by manufacturers outside Amata Nakorn Industrial Town.
- Analyse the major factors that may affect the quality of environmental management practices in Thai large manufacturing companies
- Assess manufacturers' staff responses of inside and outside industrial town, in regard to environmental management requirements
- Assess community responses to environmental pollution problems caused by large manufacturing industries.

This study deals with large manufacturers, since they provide excellent examples for the application of EMSs by Thai manufacturing companies. Government policy in Thailand encourages manufacturers to locate in industrial towns (see detail of industrial policy in Chapter Two), therefore a comparison is made between manufacturers located in industrial Towns and those located outside the Town limits.

7.2 COMPARISON OF THE FINDINGS

Many environmental quality themes that emerged from the survey results are grouped into four major parts of EMS (see Chapter Two). These serve as the basis for the questionnaire design. There are some similarities and differences in attitudes about environmental quality in the EMSs used in large manufacturers from in and outside of

the industrial town in Thailand, and the response of the manufacturers' staff from both in and outside of the industrial town, and the local community. Bias can be introduced in the development of the questionnaire, the interviews, and during observation or surveys. So triangulation methods have been used to improve the validity of the data. The findings from different methods are compared, and then presented using the four major parts of the EMS as headings.

7.2.1 Part A: Performance Agreement for the Environmental Programme

According to the requirements of EMS, they require companies to provide training programmes about the EMS for their staff (Dale, 2003). Both the questionnaire and interviews results show that all the sample companies have provided such training programmes. However, the results of the questionnaire show that manufacturers' staff do not clearly understand the characteristics of the customers in terms of environmental management, and the commitment of the management team. For example, there are no respondents who believe that politicians are also a company's stakeholders, and most of the respondents do not believe that communicating EMS to the public, and setting up communication lines within the company, are a commitment of the company's management team. These results show that companies have problems with their training programmes. They need to improve the quality of training programmes for their employees to cover all of the important topics. The companies could ask the government to assist them to develop good training programmes.

The Thai Enhancement and Conservation of National Environmental Quality Act (1992) mentions that the government has responsibility to provide education and information about environmental matters to both industries and community. However, the questionnaire and interview results show that the government has problems in providing information and education about environmental legislation and management. The community survey results indicated that the government does not provide enough information about environmental management to the community outside of the Town and it could result in a better working relationship between the government and the community about environmental management. The government must improve the communication channels and the methods to educate the

community. For example, the government may gather all of the responsibilities and budgets about educating and communicating the environmental information in the DEQP, and then assign the DEQP to develop new methods of communication with the industries and the community.

7.2.2 Part B: Plan for Transformation Implementation

The results of all the survey methods show that both ISO and TQM/TQEM companies welcome the local community to visit the company, and they use P-D-C-A cycle with other management tools in making decisions about EMS. However, there may be some differences. Some systems may have an effect on the current manufacturing process optimised for product quality (e.g. from change of materials); cost (setting up cost, training cost, audit cost); and resistance to change by the existing workforce. For example, ISO 14001 requires the company to develop a good documentation system and have an external audit. These requirements may affect the company in increasing training costs for the ISO system, document system costs, and the company staff may be resistant to the change. EMAS requires an interaction between business, the government, and the community. These requirements may be a barrier for the company to implement the EMS. On the other hand, a participant of the remaining company said his company does not use any tools because they do not discharge any pollutants, but during the observation I found that the company uses some management tools (control chart, flow chart, and histogram) in their production line.

7.2.3 Part C: Standards and Processes

The survey results show that there are some differences, in the audit and documentation system of the EMSs that are used by large manufacturers in and outside of the Town. The interview results show that the ISO system monitors and controls everything by a documentation system, but TQM/TQEM has monitoring systems to thoroughly check any processes. Therefore, companies that want to adopt the ISO system have to spend more time and money to manage documentation systems. However, the observation results show that the ISO companies can find information easier and faster than the TQM/TQEM system.

It is interesting that more than half of the companies staff from outside of the Town (who use TQM/TQEM and the Thai EMS) said their company never audits an EMS (by questionnaire). The manufacturers in industrial towns (who use ISO 14001) in Thailand are required to have an external audit and they may be randomly audited by the industrial town operation office and the IEAT. In contrast, the manufacturers outside of the industrial town (who use TQM/TQEM and the Thai environmental legislation systems) may be randomly audited only by the DIW (and do not require an external audit). From these results, manufacturers' staff in the Town might have more participation in environmental audit activities than staff from outside of the Town. When the staff in the industrial town companies have more opportunities to participate in the auditing process, it results in the companies' staff in industrial towns using the environmental audit results to change the manufacturing process, more than those outside of the industrial town companies (see the questionnaire results in Chapter Five).

The interview results show that the government officers believe that the Thai environmental laws and regulations encouraged manufacturers to improvement environmental quality and work in partnership with the government. In contrast, the documents review and the interview of the manufacturers' staff point out that the Thai environmental laws and regulations do not encourage manufacturers to improve environmental quality. Many of the companies respondents said the environmental laws and regulations in Thailand are standard based and do not encourage companies to improve environmental quality. This finding confirms that the National Environmental Quality Act of Thailand is still using pollution control technologies (command and control system). Pollution control technologies are the old technologies and lack significant customer and public demand. The Thai government should apply pollution prevention and EMS technologies (required for interaction of the stakeholders) to develop the new Environmental Quality Act (see details of pollution control, pollution prevention, and EMS technologies in Chapter Two).

7.2.4 Part D: Continuous Improvement Process

The questionnaire results show that the ISO 14001 companies (inside the Town companies) use the record of environmental audit in changes to manufacturing process, but only a few staff of TQM/TQEM (outside the Town companies) said their companies use the record of environmental audit to improve the manufacturing process. According to the observation, I found that the companies in the Town use ISO environmental audit information to improve their manufacturing process. For example, Denso Company solved the noise problem by putting covers on particularly noisy machinery, and Thai Iwaki Glass reduce the solid and hazardous wastes from its production lines by changing some raw materials and production processes. On the other hand, UMC Metal is the only company from outside of the Town that I found used the record of environmental audit to improve the manufacturing process (build the dust collector and noise retaining wall). In contrast, the interview results show that the manufacturers' staff with both ISO and TQM/TQEM systems mentioned that their companies use the record of environmental audit to improve the manufacturing process. The remaining company that does not have an EMS does not show any continuous improvement process.

7.3 DIFFERENCES IN EMS CHOICES BETWEEN INDUSTRIAL LOCATED IN INDUSTRIAL TOWNS AND INDUSTRIES LOCATED GENERALLY IN OTHER AREAS OF CHONBURI PROVINCE

The results of this part aim to evaluate the EMSs that are used by large manufacturers in Amata Nakorn Industrial Town and compare these with manufacturers from outside the Town (the research Objective One). As mentioned earlier in the Chapter Two, I classified the differences between the EMSs used by the sampled manufacturing companies into four areas. These differences are: comparative environmental and social effectiveness; business implications; system issues; and environmental sustainability and management issues.

7.3.1 Environmental and Social Effectiveness

The survey results show some differences between companies, relating to company attitudes to environmental and social effectiveness, between the manufacturers in the Town (ISO 14001) and outside of the Town (TQM / TQEM and the Thailand EMS). These include: benefits and disadvantages, reasons for choosing EMSs and the driving force behind the implementation of EMSs (see Chapter Two for details). In Table 7.2, a summary of the findings from the interviews and questionnaires, concerning environmental and social effectiveness is shown. As can be seen from the table, results have been classified under four broad categories; benefits; disadvantages; reasons to choose the system; and the driving forces. These four parts are related to the environmental and social effectiveness of manufacturing companies.

Table 7.1: Summary of the Interview Results about Environmental and Social Effectiveness

	ISO 14001	TQM / TQEM	National legislation
Benefits	<ul style="list-style-type: none"> - Well recognised - Good company image - Good audit system - Well documented System - Reduced waste costs - Good training system 	<ul style="list-style-type: none"> - Good team work - Solve env. problems from core problems - Good customer satisfaction - Reduced waste costs - Encourage staff knowledge about EMS 	<ul style="list-style-type: none"> - High environmental quality standard - Cost savings
Disadvantages	<ul style="list-style-type: none"> - Many regular audits(internal, external, government) - High investment in documentation and auditing systems 	<ul style="list-style-type: none"> - Not required for formal audit system - Still have documentation system problems (difficult to search for documents) - The successful result of the system depends on the ability and responsibility of the company's staff. 	<ul style="list-style-type: none"> - Does not comply with EMS components - Is not accepted by other countries - Does not assist manufacturers to develop EMS

Reasons for choice	<ul style="list-style-type: none"> - Efficient and well understood system - Improved customer relations and company's image - Saving on production and env. treatment costs 	<ul style="list-style-type: none"> - Efficient system and mostly used by Japanese companies - Good customer satisfaction - Saving on production & env. treatment costs - More flexible 	<ul style="list-style-type: none"> - Required by the government - Supply for domestic market only
Driving Forces	<ul style="list-style-type: none"> - International trading requirement - Stakeholders' needs - Customers' needs - Benefits from local government 	<ul style="list-style-type: none"> - Customer satisfaction - Headquarters Office requirement (mostly from Japan) 	<ul style="list-style-type: none"> - Local government

The survey results show that all systems adopted by the sampled manufacturing companies have both advantages and disadvantages. When collated, the perceived environmental benefits of the systems show that ISO 14001, TQM / TQEM and Thailand's environmental legislation (Thai national EMS) accredited manufacturing companies with decreasing their waste.

The ISO 14001 is the most internationally recognised system. Nowadays, EMS certification is the market requirement, demanded by governments and consumers in developed countries. Most of these countries accept ISO 14001 certification from their suppliers. The ISO 14001 accredited companies express the benefits of the system as environmental protection and export trading on a defensible company image (see interview results in Chapter Six). Additionally, ISO 14001 is not only a benefit to manufacturers, who export their products to overseas markets, but it also benefits them by saving costs, such as a reduction in material and energy use and less waste treatment costs. Moreover, this research found that clean practices in this EMS system can help companies with saving the cost of legal actions, sanctions and the achievement of necessary civic responsibilities (see Chapter Two).

On the other hand, the interview results indicate that ISO 14001 also contain some disadvantages. It appears that implementation costs are higher, than those associated with implementing TQM / TQEM or Thailand's national environmental management system. For example, ISO 14001 requires that businesses improve their

documentation systems. By improving this, manufacturers have to provide documentation about all environmental management processes in each department throughout the company. This requirement results in higher documentation costs than TQM / TQEM systems, where all departments keep their own records and all important data will be shared in departmental meetings within the company (see interview results in Chapter Six). Despite this, the questionnaire results show that manufacturers' staff, in the companies that use ISO 14001, participated more and had a better understanding about EMS processes.

Another cost is the ISO 14001 requirement for manufacturers to have an external audit (a third party audit). Even though, all ISO 14001 accredited Thai manufacturing companies must have internal and government audits, they are still also required to have an external one.

Despite the fact that the International Organization for Standardization believes that ISO 14001 is a generic system, that can be applied to any size of organisation, the interview results of this study show that implementation may not be in the best interest of manufacturers who are not exporting to developed countries (see the interview results in Chapter Six).

The results of this study indicate that TQM / TQEM is a management philosophy and a set of accompanying quality improvement techniques, that may be adopted by Thailand's industries. By applying TQM / TQEM philosophy and techniques, businesses undertake continuous improvement across all operations, by seeking to discover the reasons for poor quality performance and customer satisfaction and then implementing methods to reduce and/or eliminate the causes of such poor quality. The definition of "customer satisfaction" includes environmental issues and treating the environment as a customer. When accompanied with a focus on satisfying customer needs, it offers Thailand's industries a promise of sustainable solutions with reduced environmental damage and improved productivity. By making use of employee familiarity with work problems, TQM / TQEM taps into the creative capabilities of employees in order to find solutions to such problems. TQM / TQEM focuses on people: it encourages the formation of teams and the empowerment of employees.

Additionally, the interview results from the manufacturers' spokespeople, who use TQM / TQEM give indication of these benefits.

However, TQM / TQEM still contains some weaknesses. The industry survey results indicate that manufacturing companies which use ISO 14001 have more frequent audits, than the manufacturing companies which use TQM / TQEM, and manufacturers using ISO 14001 use the environmental audit more frequently to improve their EMS (see the survey results in Chapter Five and Six). This system does not require manufacturing companies to have documentation and audit systems. Therefore, the success of environmental management depends on the ability and responsibility of company staff.

Thailand's national environmental legislation is the last system researched by this study. As a component of EMS, mentioned by Hillary (2000) in Chapter Two, Thailand's national environmental legislation does not require manufacturers to comply with all of the components of EMS and it does not assist manufacturers in developing their EMS. Another weakness, by relying on government regulation to set standards, is that companies often minimise their compliance, resulting in no additional commitment to the environment and society.

Thailand's environmental legislation contains high environmental standards, to protect the encircling quality of air, water and solid and hazardous wastes. The survey results indicate that some companies believe that Thailand's environmental regulation is sufficient for guiding environmental management practice, in situations where industries do not have complex production processes, or large budgets for environmental management.

According to the benefits of the ISO 14001 indicated above, the survey results show that manufacturing companies often adopt this system because it is: the best of what is available; the choice of certification is a collective decision within the company; it enables a greater choice in setting company targets; it improves accountability; and the system puts reporting processes in place. The widespread recognition of this system means these companies should receive the benefits of the system when trading internationally.

The reasons for choosing the TQM / TQEM system are not widely different from choosing ISO 14001. It is also an efficient EMS and it is recognised by many countries. This system is used by most Japanese companies operating in Thailand (see interview results in Chapter Six). It is an excellent system for taking care of their customers and it is based upon measuring customer satisfaction. Moreover, TQM / TQEM includes many management tools (e.g. cause and effect diagram, P-D-C-A cycle) to help the manufacturing industry to solve environmental problems, emanating from core causes, which can then help companies to save production and environmental treatment costs. In addition, it is more flexible than ISO 14001.

The interview results indicate that manufacturing companies often adopt Thailand's national environmental legislation as a minimum requirement, because all manufacturing companies have to comply with all legal provisions. Additionally, the interview results also show that only complying with the legislation (without an EMS) may be enough for manufacturers that have a good management system and only supply the domestic market.

Companies adopt EMS in response to many pressures, including internal pressures such as company stakeholder forces and employees' demands and external pressures such as customer demands and local government or international trade requirements. All these driving pressures were identified by the sample manufacturer companies who have to adopted ISO 14001 or TQM / TQEM.

If the adoption of EMS is to be effective in achieving community environmental objectives, it is important for the community to recognise that the ultimate reality of a voluntary system is that the system will, over time, be only as good and as sustainable as the underlying business reasons behind its implementation. These reasons are likely to be the private benefits to the manufacturing company that can justify the decision to its stakeholders.

Methods for promoting sustainability may depend on any one of the internal or external-driving forces, although the survey participants have not identified to which specific force they would accredit this factor. Business philosophy itself is recognised as a stakeholder force, since it is arguably the stakeholders who ultimately determine

the direction of the company. Arguably, the use of the EMS as a potential marketing tool is becoming an increasingly important competitive requirement in Thailand, with the advent of international consumers becoming more concerned with environmental issues.

The ISO 14001 certified companies state that additional driving forces include: the influence of other companies from both domestic and international trade; EMS enables accountability; EMS provides increased quality; and an EMS may influence future non-tariff barriers. Therefore, environmental performance will become a powerful tool for bargaining, during international trade negotiations.

Further driving forces recognised by TQM / TQEM accredited companies include increased efficiency (competitive force), formalisation of existing practices (competitive force) and official recognition by the industry (stakeholder force). Through formalising existing practices, the company is identifying the need for an EMS and the importance that it may play in the future, concerning relationships with suppliers, customers, employees and local government's legislation.

However, there still are some manufacturing companies, particularly outside the industrial Town, that do not adopt any EMS. The results do not mean that the pressure to adopt EMS will force them to do so. One of the sample manufacturing companies in this study has not adopted an EMS. The spokesperson for this company stated that the company already complies with the national environmental legislation. This company produces products to supply the domestic market only and the company does not want to invest in the adoption of an EMS. Also, the company believed an EMS contains higher costs, than just complying with the national environmental legislation.

As for the results of this part, it may be concluded that there are some differences in the area of environmental and social effectiveness, benefits; disadvantages; reasons for choice of the system; and the driving forces, between the EMSs that are used by large manufacturing companies in and outside of the industrial town. The companies must consider the benefits, disadvantages, costs and human resources for implementing an EMS. Companies have to compare between the benefits and

operation costs that may occur when they adopt an EMS. The findings indicate that if a company has enough financing and human resources, and if exports to the US or the EU, it is likely that it may adopt an ISO 14001. If companies have a Japanese management style or have a Japanese partner, and export to some countries in Asia, then they may adopt TQM/TQEM. In contrast, if companies have not enough financing and human resources and sell in domestic market only, they may simply comply with the Thai environmental laws and regulations (Thailand's EMS). However, other factors such as stakeholders force, employees' demand, etc, may force the company to adopt some system. For example, many of the large manufacturing companies in Thailand which attract investment from Japanese investor companies use a TQM/TQEM system as their EMS because of the strong preference for total quality management as an EMS in Japanese companies.

7.3.2 Implications for Business

By reviewing the literature and the interviews results, implementation of ISO 14001 appears to have been difficult, largely due to the time and paperwork involved in making the necessary changes. This is in contrast to the TQM / TQEM and Thailand's EMS implementation that involved, according to the respondents, only a formalisation of existing practices and therefore implementation is not difficult. There were no other difficulties expressed by the spokespeople for TQM / TQEM and Thailand's EMS. Other difficulties experienced by use of ISO 14001 included overcoming staff resistance, ensuring integration of the system into the company and the initial setting up of the system.

No major changes were made by the TQM / TQEM and Thailand's EMS accredited companies, whereas the ISO 14001 accredited companies found that many changes occurred within their manufacturing companies. In general, each EMS is believed to have improved the efficiency of business, by providing structure and information and aiding documentation and understanding of the environmental management process (see Chapter Two). Companies using ISO 14001 and TQM / TQEM believe their systems have helped efficiency, partly because their companies can now manage environmental problems easier and have therefore received a good reaction from the government and the local community. A company that has adopted Thailand's EMS

states that, as the system was in place from the initial development of the business, there has been no change to business functions.

Most of the companies implementing the various EMSs believe that the systems can all be easily personalised to their individual businesses. However, TQM / TQEM and Thailand's national EMS spokespeople identified ISO 14001 as being inflexible for small manufacturing companies, that supply their products to the domestic market only. Under the ISO 14001 system, manufacturing companies, according to the respondents, have high costs when setting up, and there are further auditing costs.

Thailand's manufacturing industries have accepted a position as global competitors and insist on building up Thailand's share of the world market, on the basis of supplying many products to niche markets. This strategy recognises the importance of niche marketing, that is, the implementation of an EMS is potentially a way to enter a niche market in order to stand out from the competition, via product differentiation and promotion of a "clean green" image for Thailand's manufacturing industries.

The marketing impact of each system has been varied. Whilst ISO 14001 accredited companies have noticed that their certification has had a marketing impact, TQM / TQEM and Thailand's national EMS accredited companies have not had similar marketing benefits from the implementation of their EMSs. The ISO 14001 companies believe that their respective EMSs made them more attractive in the market place, although none of the companies surveyed have implemented their systems solely as a marketing tool. The ISO 14001 accredited companies may reap an advantage from an internationally developed system that already enjoys business advantages.

It may be concluded that there are some differences concerned with the implementation of different EMSs for business. The companies need to study the scheme of each EMS, and then consider which system is best suited to the existing practices of the companies. Implementation of an ISO 14001 appears to be more difficult than others, largely due to the time and paperwork involved in making the necessary changes. Companies also have to be concerned about workforce-related aspects which resist change to EMS processes which may displace jobs or require

significant retraining and the likely cost of financial support during the set-up and continuous improvement processes. For these reasons, an ISO 14001 may not be best suited to some companies that do not have enough time, budgets, and other resources. These companies may consider other systems such as TQM/TQEM and the Thailand's EMS, that are more flexible to evolve. Companies should also consider a system that assists companies to improve product and EMS quality. Also, the requirement of the EMSs requires interaction of the stakeholders. Therefore, companies should consider the system that is of interest to all stakeholders (e.g. customer, employees, government, and shareholders).

7.3.3 Environmental Management System Issues

The orientation, goal or process is a very important element of an EMS. It determines the outcomes of a system and ultimately determines its sustainability. Thailand's national EMS company spokespeople believed that their system is standards orientated. This company can improve the quality of their EMS to meet Thailand's environmental standards, whilst on the other hand, most of the ISO 14001 and TQM / TQEM accredited companies believe that their EMSs made them a process-orientated business. When their companies want to change their environmental management processes they check it through the manufacturing process. This is consistent with the premise on which each EMS is based.

All company spokespeople believed that their systems are well integrated into the company and acknowledged by all staff. Whilst it is important for an EMS to have top management support, it is equally important that staff become involved and with strong participation (Zairi, 2002). This is a key success of the EMS application within a company. When implementing an EMS, an organisation needs to change or adapt the culture of EMS, in order to successfully integrate environmental issue awareness into their daily work practices. The TQM / TQEM spokespeople believed that, due to its team work approach, everyone in the company had a strong sense of being an environmental protection person.

The ISO 14001 and TQM / TQEM companies' surveyed believed they are closely achieving their EMS and consequently they have regard for Thailand's environment

legislation. In addition, they stated that the adoption of an EMS in itself provides clear and continuing evidence of commitment to improvements in environmental performance. Thailand's national EMS company spokesperson also believed his company had a good environmental performance.

It may be concluded that there is no difference between the EMSs that are used by the companies in and outside of the Town. Therefore, companies should consider the system that can help them to improve their operational effectiveness and public relations with close relationship with the government and community. In general, both government and community rely on manufacturers with an EMS and can be confident that they will deal quickly with environmental problems resulting from their production activities. Also, the Thai government and community accept many EMSs including ISO 14001, TQM/TQEM, and the Thailand's EMS. However, companies must consider the international trade requirement if companies export their products for sale in other countries.

7.3.4 Environmental Sustainability and Management Issues

Thailand's predominant piece of environmental legislation is the Enhancement and Conservation of National Environment Quality Act 1992 which emphasises sustainable 'management' as opposed to sustainable 'development'. All spokespeople believed their manufacturing companies are operating with sustainable management in mind. There is no clear division between the systems, as to whether the fundamental focus of the business has environmental, social or economic sustainability. This was reflected by all the industry spokespeople, who believed their businesses had a combination of economic, social and environmental elements.

Thailand's manufacturing industry sector identified three core environmental issues, that have the potential to threaten and undermine their industry sector – pollution to air and water and disposal of hazardous and solid wastes. All survey participants believed that these are serious environmental issues in Thailand, which are not being well managed, either collectively or by many of the manufacturing companies. This result is supported by many researchers and government studies (see detail of these research results in Chapter Two).

The issue of environmental legislation and its effect on Thailand's manufacturing industries is raised in the survey responses, with particular regard to whether or not Thailand's environmental legislation is appropriately related to manufacturing companies. The manufacturers' voluntary adoption of environmental management systems is promising but it will never completely eliminate the need for rigorous government oversight, because, when dealing with environmental affairs, the invisible hand of the market fails to align the interests of the individual or company with those of society at large. With the right balance of incentive-based and legislation-based controls, governments could promote the uptake of EMS and thus aid proactive sustainable management.

The purpose of the Enhancement and Conservation of National Environment Quality Act 1992 is to promote the sustainable management of natural and physical resources (see Chapter Four). Under the premise of this Act's basis of effects-based planning, a company can demonstrate a minimisation of effects, even though the activity itself is not sustainable.

The ISO 14001 TQM / TQEM and Thailand's national EMS companies which were surveyed, on the whole appear not to have major concerns with the environmental standards and legislation. The common response, regarding a tightening of Thailand's environmental legislation, is that there would be no effect on any of the businesses surveyed. Each business believes they are acting proactively in order to avoid any penalty if legislation concerning the environment was to become stricter.

Companies should enhance their competitive position through effective environmental conservation because the need for environmental protection and prevention has become more mandatory (Denton, 1994).

In summary, the survey results show that there are some differences between the EMSs that are used by large manufacturers in and outside of the Town in the areas of 'environmental and social effectiveness' and 'business implications'. But there are only a few differences in the areas of 'EMS system' and 'environmental sustainability and management' issues. For example, the EMS that is used by manufacturers in the Town (ISO 14001) is the most internationally recognised system. While the

companies outside of the Town use less recognised systems, the ISO accredited companies believed that the benefits of the system are environmental protection, and export trading on a defensible company image. However, implementation of ISO 14001 appears to have been difficult, largely due to the time, budgets, and paperwork involved in making the necessary changes. Therefore, companies have to compare the benefits, operation costs, financing and human resources of the company before selecting an EMS.

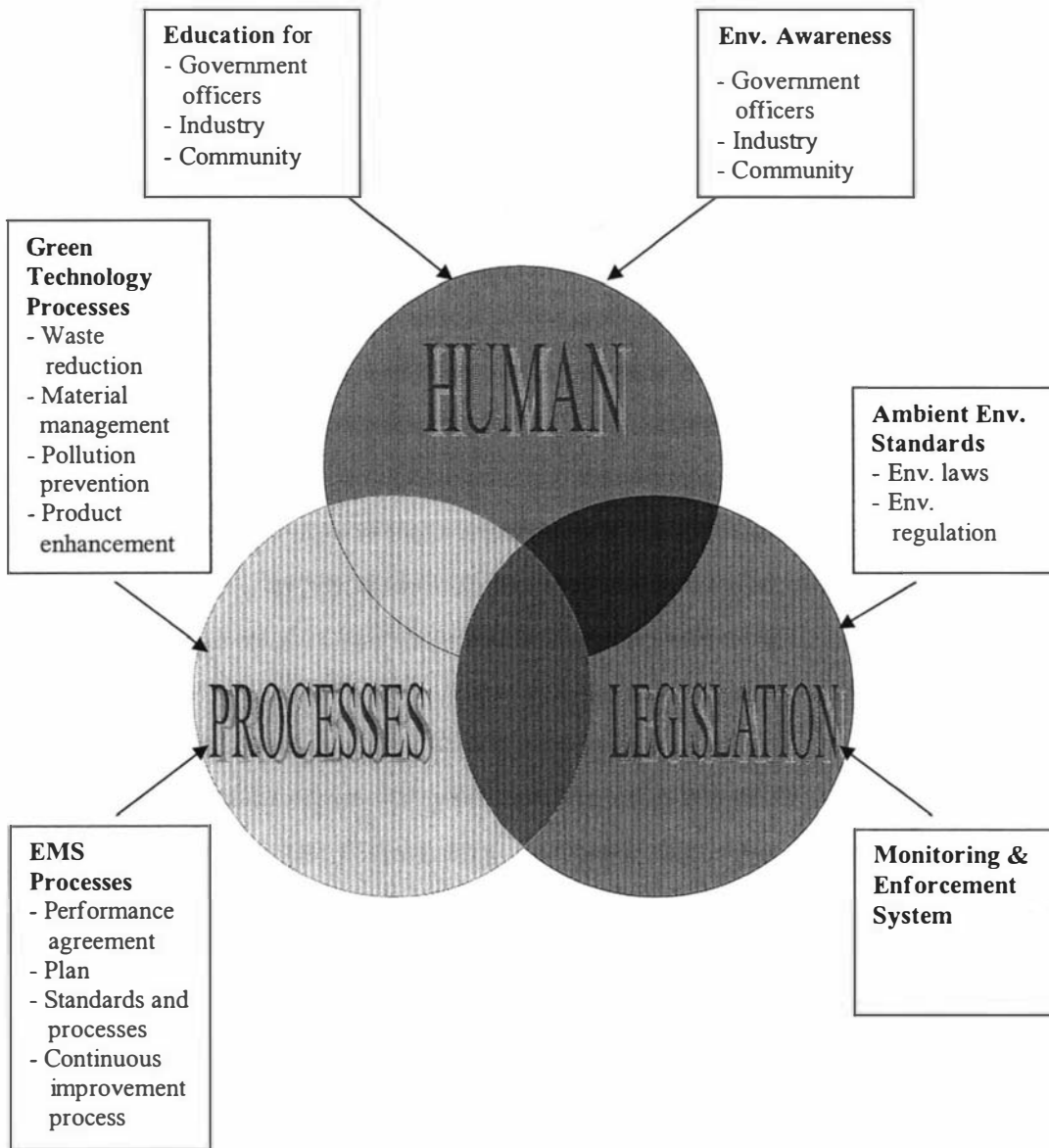
7.4 AN EMS ASSESSMENT FRAMEWORK FOR BUSINESS - SUCCESS

FACTORS FOR EMS IMPLEMENTATION

The results of this section aim to analyse the major factors that may affect the quality of the EMS in large manufacturers in Thailand. As I have mentioned in Chapter Two, the study of Chin, Chiu, and Tummala (1999) classified the success factors for an EMS implementation into four areas which are: management attitude; organisational change; external and social aspects; and technical aspects. This model looks confusing and has some overlaps in some sub-factors, and does not show the interaction and responsibilities between the government, industries, and the local community. Also, the management of the environmental performance diagram from Schaltegger and Wagner (2006) presents an EM framework for business (see Chapter Two). The management of an environmental performance diagram presents the relationship and interaction between industry performance (corporate environmental performance) and community demand (social environmental performance). The corporate environmental performance can be defined as production and EMS processes, and social environmental performance can be defined as education and awareness of stakeholders (e.g. community members, industries' staff, government officers). However, this diagram does not involve the government participation (environmental legislation). Therefore, I analysed the survey results (questionnaire, interviews, observation, and documentation review) of this study, and then developed new critical success factors for improving the quality of an EMS (an EMS assessment framework for business). The model from this research aims to present an easier model to understand for both industry and government to focus on the factors to which they should pay attention.

I have found that there are many factors that affect the quality of EMSs implemented by large manufacturers in Thailand. These may be classified into three main types, the effects of which influence the nature of the EMS chosen and then implementation which leads to achievement as a result. These three factors are: the human factor; manufacturing processes factor; and the environmental legislation factor. This model can be defined as the management and implement of the interaction between community, industries, and the government. Figure 7.1 presents the relationship between these three factors.

Figure 7.1: An Optimal EMS Assessment Framework for Business



There are three main factors that may lead to the successful implementation of an EMS. As mentioned earlier in the documentation review chapter, many researchers point out that environmental education and awareness (the human factor) are critical to the success of the EMS (Huckle, 1991; Peet, 1991; Sterling, 1992), and legislation is the most important external pressure perceived by manufacturing companies and adopted in their environmental practices (Henriques and Sandusky, 1999). The process factor is used to link these two factors to create a good environmental performance.

The human factor can be divided into two sub factors – education and awareness about environment. The manufacturing processes factor can be divided into two sub factors – production and the EMS process. Finally, the legislation factor is also divided into two sub factors – environmental standards and monitoring and enforcement systems. All of these factors and sub-factors are interrelated and impact on the other factors. For example, education in human factors also includes education about environmental standards in the legislation factors, or education about the EMS in the processes factors.

7.4.1 Human Factor Elements

The first factor is the human factor. All human beings are users of the environment, therefore this is one of the main factors and a person's values have a strong influence on the achievement of an EMS in manufacturing companies. Burchell (2002) mentions that environmental management is a human creation. This case study in Thailand demonstrates that the attitudes of government officials, company managers, company staff and local community leaders all influence the nature and success of EMS implementation in large manufacturing companies. This reinforces the view of Burchell (2002) and other experts who agree that most pollution problems originate from human activities, such as cleaning, agriculture industry and manufacturing industry (Montana & Charnov, 2000; Burchell, 2002; and Miller, 2004). People have full responsibility to prevent and solve environmental problems. Also, the elements of environmental management activities from ISO, EMAS, ICC and TQM / TQEM require organisations to provide education about their EMS. It means staff (the human factor) is one of the important factors that can affect the quality of an EMS (see the elements of EMS in Chapter Two). This is also supported by all the research interview participants (see interview results in Chapter Six).

Human factors can be divided into two sub-factors which are education and awareness about the environment. In reviewing the literature, Madsen and Ulhoi (2001), and other researchers, mentioned that education and awareness of the workforce has long been recognised as an essential ingredient in promoting and implementing environmental management practices in business organisations (Chin, Simon, and Tummala, 1999; Skanavis and Sarri, 2002; Zutshi and Sohal, 2005). In this study, the

respondents from both manufacturing companies and the local communities surrounding them, all agree that the government needs to provide education about EMS and basic scientific environmental quality to both industries and the community. Moreover, the manufacturers are also required to provide training programmes about EMS to their employees. According to the management of environmental performance diagram from Schaltegger and Wagner (2006) (see Figure 2.1), education and awareness (corporate social management) is one of the first steps to achieve the environmental management performance.

One of the main components of the human resource management function is training and development, since it focuses on improving the knowledge of staff. Miller (2004) notes that companies need to invest in staff training in order to provide better knowledge, before changing the company's environmental management processes. According to the study of Zutshi and Sohal (2005), the training not only increases the understanding and knowledge of the system, it also enhances the implementation process as employees will be better able to acknowledge and accept the changes taking place across the organization and the reasons behind the changes.

Many researchers emphasize the importance of education, employee empowerment and employee and community involvement, including Razaee and Elam (2000); Daily and Huang (2001); Pawar and Risetto (2001). It is essential that both the government and industries conduct training and induction programmes for both industries' employees and the community. These initiatives and programmes once again require involvement, commitment and resources from the government and top management staff in the industries. This training, as a minimum, should include the following topics:

- Impact of environmental problems and contributions that the industries and community can make to reduce environmental problems;
- Legal implications for the manufacturers and the local community for impacting on the environment;
- Importance of an EMS and the basic needs of the EMS;
- Responsibilities of the manufacturers' staff and community.

Awareness is also a very important human factor in protecting the environment, because even people who have a good knowledge about environmental protection, may not have an awareness of industrial issues, making it impossible to achieve effective environmental management. Zutshi and Sohal (2004) mention that top management must establish a set of environmental values – a corporate environmental culture and make these values evident to employees at all levels of the company, and the government has responsibility for awareness in the community. Communication plays a large role in establishing and maintaining employee and community awareness. Communicating successes and failures of an EMS to employees and the community throughout the organisation helps to further the understanding by them of the impact on the environment. The survey results show that the Thai government still has problems about the communication channels to provide environmental information to the communities outside of the Town area. Therefore, such communities are not interested in taking part in the preparation of environmental standards. On the other hand, the community in the Town area has enough environmental information and interest to take part in preparation of environmental standards.

It is not easy to improve the environmental awareness of people, particularly in countries that still face economic problems. Thailand's government aims to serve the needs of Thai people by encouraging economic development, whilst environmental concerns appear to be a lesser priority.

It is the government's main responsibility to provide both manufacturing companies' staff and community members with sufficient information relating to environmental laws, regulations and education about natural resources and environmental management. In addition, the government should also provide information and education for government staff and community. Manufacturing companies need to work in partnership with the government to provide education and information about environmental management, together with training programmes for their staff. In addition, NGOs and the local communities also have responsibility to adopt knowledge about the EMS and work in partnership with the government to develop an acceptable environment.

It is not only knowledge about environmental management that the government and manufacturing companies have to provide to all people, but they also have to develop an awareness about environmental protection. To establish an environmental consciousness, the government needs to provide sufficient education so that awareness and consciousness are established together. The government and manufacturers have to educate people about the importance of natural resources and the environment and the effects of pollution problems on people, in order to establish a community consciousness about environmental protection and the benefits of EMSs for manufacturers and local communities. When all people have an awareness of the need for environmental protection, it will become easier to solve environmental problems. This will occur when local community members have both knowledge and awareness about environment protection and then the local communities will work in partnership with the government to monitor all activities that could create pollutants. According to the study from O'Rourke (2004), who examined a community-driven regulation in the Vietnam context, Vietnam's government agencies lack sufficient sanctioning power and technical capacity to enforce existing regulations. Government inspections rarely happen unless the community has complained or the company has a history of violations. The threat to firms is thus community action, not government inspection or fines. Thailand and Vietnam face similar challenges. The governments of both countries usually act when the environmental problems are serious and there have been complaints by the local community. It is often too late to solve the problems or there is a need to spend more money for clean up. However, if the local community has both education and awareness about the EM, they help the government and report before the problem becomes serious. This way the government can prevent the occurrence of a serious environmental incident. The summary of human factor elements is shown in Table 7.3.

Table 7.2: Human Factor Elements

What is in the literature?

Researchers of environmental management agree that most pollution problems today result from human activities such as cleaning, agriculture and manufacturing industries. Therefore, people have a responsibility to solve such environmental problems (Montana & Charnov, 2000, Burchell, 2002, Miller, 2004).

What are the survey results from the interviews and questionnaires?

The results of this study show that all the respondents from government, the manufacturing companies and the local communities agree that all people have a responsibility to solve environmental problems. However, they also agree that many of Thailand's residents do not have sufficient education and awareness about environmental problems and management.

Who has the main responsibility?

It appears that the government has a general responsibility to provide education about environmental management to all its people. However, manufacturing companies also have a responsibility to help the government to educate their employees and they need to work in relationship with the government to develop a good environmental management system with their companies. The local community also has a responsibility to take advantage of all this knowledge and help the government to monitor all activities, that could discharge pollutants to the environment.

7.4.2 Manufacturing Processes Factor Elements

The manufacturing processes factor (production and EMS processes) is used as a tool to help industries to meet the demand of environmental protection of the stakeholders. Hillary (2000) notes that an EMS has four basic needs, one of which is process. Many researchers, in particular Prakash (1999), Emblemstvag & Bras (2001), Bennett, Bouma & Wolters (2002), have considered the definition of environmental management as a multi-process (see details of these theories in Chapter Two).

The process by which an organisation manages its social actions, no matter which approach it takes, has two main phases: the action phase and an evaluative phase.

Montana & Charnov (2000) note that the action phase consists of: problem identification; the definition of successful performance criteria for a solution to the problems; generation and evaluation of alternative courses of action; selection of alternatives; pilot plan implementation; full alternative implementation and programme evaluation. The evaluation phase is the organisation, government, and social audit. Manufacturers have to include these two phases together in their processes. Elements of environmental management activities from ISO, EMAS, ICC and TQM / TQEM also require organisations to implement both action and evaluative processes. One of the most recognised processes, that is adopted by many EMS systems is the P-D-C-A cycle process.

The processes factor can be divided into two sub-processes, which are production process and environmental management process. According to the management of environmental performance diagram from Schaltegger and Wagner (2006) (see Figure 2.1), the production and EMS processes (corporate environmental management) are the first steps to achieve the environmental management performance.

After decades of economic boom and environmental neglect, many manufacturers in Thailand began the first moves towards cleaning up their act in the mid 1990s (Crispin, 2001). Unfortunately, Thailand's economy collapsed in 1997 and many manufacturers became concerned with struggling to maintain their businesses. The cost of environmental management did not necessarily help in the survival of manufacturing companies, so this cost was inevitably their first budget cut. Many manufacturers had a pressing economic incentive to revert back to their cheaper, dirty old ways (Crispin, 2001).

Recently, those economic difficulties have disappeared and many manufacturers have again begun to improve their environmental management, because international trade rules require acceptable environmental practices, and Thailand's government wishes to develop the quality of life for Thai people. As a requirement by international trade rules, production processes have to be "clean and green" to access global markets. It is an opportune time for the government to encourage a "zero defects concept". The zero defects concept is based on the fact that mistakes are caused by two reasons: lack of knowledge and lack of awareness. Lack of knowledge and awareness can be

measured and corrected by training (Aboulnaga, 1998). To have success in the zero concept, manufacturers have to provide enough training programmes to their employees and apply some production technologies such as “green technology” to their companies’ production processes. Sarkis (2001) describes that manufacturing process developments from an environmental perspective can be linked to issues of reduction, reuse, recycling, and remanufacturing.

Green technology is a systems approach to production processes, which avoids environmental damage as a primary source. Green technology involves four major parts, which can improve the quality of the environment and also production activities, when implemented in the product design stage. These major parts are: waste reduction; materials management; pollution prevention; and product enhancement (Billatos & Basaly, 1997). From the results of the four major parts of green technology, manufacturers can get economic and beneficial results from lower production costs and also the strategic benefits of increased demand for more economic, higher quality products from an increasingly sophisticated and environmentally conscious public. Environmental benefits result from a reduction in waste and demand for resources, over the lifetime of the product.

Before manufacturers decide to adopt an EMS, it is important to communicate with all the stakeholders. Feedback from the top management through to bottom staff of the company is required to ensure that any gaps or improvements identified are promptly addressed. EMS requires adequate resources (e.g. budgets, equipment, technologies) and top management commitment, as well as adequate training programmes about an EMS to all employees (Chin, Chiu, and Tummala, 1999; Zutshi and Sohal, 2005).

There are many international environmental management systems such as ISO, EMAS, ICC, TQM / TQEM that are well recognised. Manufacturing industry should decide which system is most suitable for their situation. Many of the large size manufacturers in Thailand have implemented an international environmental management system. However, for many small and medium size manufacturers, who supply local markets, the adoption of an EMS seems to be an unnecessary expense.

The International Organization for Standardization mentions that EMS is a part of overall management processes, which includes organising, planning, staffing, coordinating, practices, procedures, motivating, implementing, reviewing and maintaining the environmental policy ((Piper, Ryding & Henrison, 2003). The EMS can be implemented in many different ways. However, its core elements should include: environmental policy; environmental programmes or action plans; organisation; integration into operations; a documentation system in order to collect analysis; monitoring system; preventive actions; audit system; management review; training; and external communications (Block & Marash, 2002). Both green production and environmental management processes result in economic benefits to the manufacturing industry (e.g. less material and energy use, low pollution treatment cost, meet the customer and government demands).

Manufacturing companies have an important responsibility, in both production and environmental management processes, to improve environmental quality in their organisations. However, the government also has a responsibility to provide and educate manufacturing companies about the EMS and help them to establish environmental management systems. In addition, NGOs and the local community need to help the government and the manufacturing companies to monitor any activities that may pollute the environment. The summary of manufacturing processes factor elements is in Table 7.4.

Table 7.3: Manufacturing Processes Factor Elements

<p><i>What is in the literature?</i></p> <p>Hillary (2000) notes that an EMS has four basic needs, of which process is one. Many experts say that environmental management is a multi-process (e.g. Prakash, 1999; Emblemavag & Bras, 2001; Bennett, Bouma & Wolters, 2002).</p>
<p><i>What are the survey results from the interviews and questionnaires?</i></p> <p>This study divides processes into two sub-processes, which are production processes and environmental management processes. Most of the manufacturing companies' respondents agreed that an environmental management process (EMS) is very important for manufacturing companies in order to manage their environment. This finding was echoed by all the government respondents. However, one respondent,</p>

from a manufacturing company outside of the Town, believed an EMS is not necessary if the manufacturing company has a good production process. His company does not use any EMS but his company does comply with the Thailand's environmental legislation.

Who has the main responsibility?

Manufacturing companies have the main responsibility to develop a good system of both production and environmental management processes. However, the government also has a responsibility to support education and work in partnership with the manufacturing companies.

7.4.3 Environmental Legislation Factor Elements

Environmental quality is a relative concept but it is generally related to human well-being in a broad dimension. Hence, the above reference to environment and resources is relevant, since environmental problems are generally related to human activities in resource exploitation which results in changes in the natural quality of the environment, that may be detrimental to the health of individuals or the well-being of the social environment of the local communities.

In the last three decades, Thailand's economic basis was based on agriculture. Thailand was not in a position to absorb the environmental crisis that arose out of rapid industrialisation as a development strategy. Environmental problems are very broad in dimension, covering many human activities. In Thailand, almost every aspect of these activities is covered by legislation. Environmental legislation also contains references related to environmental control. Many legal instruments, relating to the environment are against pollution. It has become increasingly obvious that this legislation is inadequate for the management of the environment in order to meet the pressure of modern technology in the country's rapid development. Some of the legislation does not have a clear definition of an enforcement agent, or it is inadequate because it contains no specific principles (Chantadisai, 2004).

From the interview results, the manufacturers' participants pointed out that environmental laws and regulations are some of the major factors which affect

achievement of the EMS by manufacturers in Thailand. According to the documentation review, results show that environmental laws and regulations are the most important pressures perceived by manufacturing companies for them to adopt environmental practices. The laws and regulations are used as an environmental standards guide for manufacturers to manage their own environmental cleaning processes (Henriques and Sadorsky, 1999; Watson and Emery, 2003). The World Bank also recognises the importance of environmental legal systems for EM. However, some scholars argue that the implementation of environmental legislation is difficult if it is without the interest of government officers, manufacturers' staff, and the community (Alford and Liebman, 2001; Van Rooij, 2004).

Most environmental legislation is "command and control". Government agencies may specify goals to be achieved and how this must be done. Polluting activities are managed, for example, by means of performance standards and technology based controls. The violation of regulations may lead to civil penalties or criminal prosecutions (Orts, 1995; Wolf and Stanley, 2003). Several criticisms have been made of command and control approaches to environmental protection. It is often argued that market-based instruments are economically more efficient than more traditional forms of regulation. They rely on enforcement agencies which may be reluctant to use the powers they possess (Watson, 2003; Wolf and Stanley, 2003; Varettoni and Boss, 2005).

According to the above statement, the environmental legislation is divided into two sub-factors which are standards and monitoring and enforcement systems.

The interview results indicate that manufacturing industries believe that Thailand's environmental standards are of a high quality, because most of them were adopted from developed countries, such as the United States and the United Kingdom. However, they also mentioned that some of these standards are not suitable for manufacturing industries in Thailand (see the interview results in Chapter Six).

On the other hand, the interview participants, from the manufacturers, accepted that the government should improve their monitoring and enforcement systems. Some of the interview participants, from the government, accepted that the monitoring and

enforcement responsibility is principally shared by: the National Environment Board; Pollution Control Department; Department of Industrial Work; and the Industrial Estates Authority of Thailand. These various institutions derive their authority from a variety of environmental laws, such as the Enhancement and Conservation of National Environmental Quality Act, Factory Act, Public Health Act. There is no integrated legal framework for environmental management and a coordinated set of regulations has not yet been developed. Another factor is inadequate manpower (see results in Chapter Six). The findings from this research are similar to those reported by Van Rooij (2004). He mentions Chinese environmental legislation problems also remain in the areas of monitoring and enforcement. The national legislation lacks local legitimacy: local actors do not share the environmental concerns of national regulation and have stopped regular enforcement. However, both governments can improve the quality of monitoring systems by providing education about EMSs to local communities and then use the community to monitor all industries and report back to the government. A partnership between the government and the local community is the best strategy to monitor the environment. Also, some EMS systems require an external audit that can help the government monitor manufacturing industries.

Most environmental laws and regulations in Thailand, such as The Enhancement and Conservation of National Environment Quality Act (1992), The Factory Act (1992) and The Public Health Act (1992) were passed over 10 years ago. As a result, penalties in these Acts, at the present time, may not be strong enough to provide effective enforcement of environmental standards. The government needs to establish a programme for a gradual revision of the environmental legislation and penalties.

The government has an important responsibility to develop good environmental legislation, monitor the environment, and penalise all polluters. Manufacturing industries, the local communities and NGOs also have a responsibility to: improve knowledge about EMS; take part in the preparation of environmental standards; and work in partnership with the government. Table 7.5 presents a summary of Legislation Factors.

Table 7.4: Legislation Factor Elements

What is in the literature?

Barrow (2005) mentions that environmental legislation plays a crucial part in monitoring and modelling, in order to understand the environment and it establishes trends, provides enforcement of the rules and assists in maintaining environmental quality. According to this theory, Tinsley (2001) notes that environmental laws and regulations are also part of EMS.

What are the survey results from the interviews and questionnaires?

All manufacturing companies and government respondents agreed that Thailand has high environmental standards. However, all the companies' respondents stated that Thailand's environmental legislation does not assist manufacturers to develop EMSs. Additionally, the respondents, from both manufacturing companies and the local community, agreed that the government does not have efficient monitoring and enforcement systems. However, the literature review results show that the government should attempt to provide more education about EMS to the local communities and develop a monitoring system with help from these community. Moreover, Thailand's government should review environmental legislation and bring it up to date.

Who has the main responsibility?

The government has the main responsibility to manage environmental legislation. Also, manufacturing companies and the local community have a responsibility to comply with the legislation and work in partnership with the government to protect the environment.

7.5 THE RESPONSE OF THE MANUFACTURERS' STAFF AND THE LOCAL COMMUNITY TO THE INDUSTRIAL ENVIRONMENTAL MANAGEMENT

As mentioned earlier in Chapter Two, an EMS is required for collaboration between companies, institutions and the public, with the aim of improving environmental quality. In term of an EMS, all of these groups are interrelated and impact on the other groups, but may have different responsibilities.

7.5.1 The Government Responsibilities

As mentioned in the Enhancement and Conservation of National Environment Quality Act, the Thai government has responsibilities to provide both manufacturing industries' staff and community members with sufficient information relating to environmental legislation, education about natural resources and environmental management, and to develop environmental legislation. According to the government officers interview results, all the government participants know all of these responsibilities, and they believed that environmental legislation encourages manufacturers to improve their EMSs, and work in partnership with the government. The government participants also believe that the government, at a national level, provides enough environmental legislation information to both industries and the community by passing all information to a provincial level. However, they accept that the government may not provide enough education about EM to industries and community.

This was argued by both industries and the community. The manufacturers questionnaire and interview results show that the Thai government had not succeeded in these responsibilities. Industries and the community mentioned that the government at both national and provincial levels does not provide enough information and education about EM. The results of the effectiveness of seven different groups in communication also show that the government has a communication problem with respect to communicating with industries and the community, and methods used to educate industries and the community. These problems may be the result of the National Economic and Social Development Plan which does not provide clear roles, responsibilities, and targets for each government agency. Therefore, there still is an overlap of responsibilities between government agencies. The government respondents also agree that this is the problem.

The communication problems may also result in environmental policy being severely disadvantaged in a highly bureaucratized, centralised system. It was found that decision-making processes are dominated by the central government, with government departments and legislative mandates largely pre-empting local decision-making authority on natural resource issues. This problem was confirmed by the

government interview results. All the government respondents said that their departments provide environmental information and education to both industries and the community by passing to the government agencies at provincial level. However, they are not sure how the provincial agencies provide this information and education to industries and the community. The provincial level would not have been able to be so participative in these matters because the relevant platform did not exist. The centralised system may also affect the local community outside of the industrial town area not having enough environmental information from the government. When the community has not enough information they may be less interested to take part in the preparation of environmental standards at both the national and provincial level.

The document review results show that most of the environmental legislation in Thailand was issued over 10 years ago. For example, the Enhancement and Conservation of National Environment Quality Act (1992), Thailand's only principal environmental law, still uses pollution control technologies. Pollution control technologies were introduced in the 1970s, and they lack significant customer and public demand; and some penalties may not affect large companies (e.g. fine up to 50,000 Thai Baht). From these points, the government should develop new environment legislation and apply new environmental technologies (e.g. environmental prevention and EMS technologies – see details in Chapter 2.4) within the new Environmental Act, and the government respondents also agree that the government should develop a new Environmental Quality Act.

7.5.2 Manufacturers Responsibilities

Manufacturing industries' staff at both top management and management level have legal and moral responsibilities to comply with environmental legislation, and produce good production and environmental management processes to improve environmental quality in their companies. For example, companies have to provide enough training programmes about EMS for their staff, controlled documentation of core elements, reference to related environmental documents, operational control, emergency preparedness for handling accidents, and tracking performance of the company in achieving its objectives and targets.

For the effective implementation of an EMS, the management attitude can be understood by examining the top management and management team commitment and support, appropriate environmental policy and regular management reviews. The establishment and implementation of an EMS is a long-term programme involving the participation of employees from all levels and all functions within a company. Therefore, it is essential to have total commitment and support from the top management to initiate the development and implementation of an effective EMS. Top management should commit to and give support for not only an effective system, but also for continuous improvement of environmental management, prevention of pollution, regulatory compliance and for adequate resource allocation (Mitsubishi, 1998).

As the questionnaire results reveal, the large manufacturers from both in and outside of the industrial town have only a few significantly different perceptions about the quality of their EMSs. However, the manufacturers in the Town have an audit more often than the manufacturers from outside of the Town, and use the environmental audit results when planning changes to their manufacturing process, more than the outside of the Town companies.

In contrast, the results from interviews, observations, and document review show that there are many differences between the companies that have EMS (ISO and TQM/TQEM) and a company that does not have EMS (Company E which only complies with the Thai national environmental legislation). For example, the ISO and TQM/TQEM companies respondents believe that they have the responsibilities to develop and implement an effective EMS in their companies and give support for continuous improvement of environmental management; prevention of pollution; regulatory compliance and for adequate resource allocation. However, the respondent from the company E does not commit to do these things, he stated that his company does not produce any pollutants, and the company complies with the environmental legislation.

7.5.3 Community Responsibilities

This research confirms earlier finding by Skanavis and Sarri (2002) that emphasizes that the involvement of the community in the preparation of environmental standards is essential and advantageous. The involvement ensures that the needs and views of the community are taken into consideration. It helps the decision-making process by including ideas and suggestions often not considered, by the companies nor by the government. Participation of the community maximises the chances that all alternatives are taken into account. The community their feels that they have contributed, and are respected in their communities. Community members may also have important responsibilities to help the government to monitor manufacturing industries' activities that may discharge pollutants into the community and report back to the government.

The government and industries interview results from this study indicate that the community members do not take part in preparation of environmental standards at both national and provincial levels. In particular, most of the government participants mention that community members from both in and outside of the Town are not interested in taking part in the preparation of such environmental standards.

This is of concern to the community respondents from both in and outside the Town. The community survey results show that the community is interested in environmental problems (question 30). Most of the community respondents in the Town area are interested to take part in preparation of environmental standards at both national and provincial levels, but only a few community members from outside of the Town area are interested enough to take part in preparation of environmental standards at both levels (question 35, and 36). However, it may be because the community members from outside the Town have not enough environmental standards information (question 33).

The industry interview results show that the local community may succeed in the responsibility to help the government to monitor manufacturing industries' activities that may discharge pollutants to community. Some of the manufacturers' respondents

mentioned that customer and community complaints may result in manufacturers moving to improve production and EM processes.

7.6 FURTHER RESEARCH

Since this study focuses on large size manufacturing companies in Thailand, it would be unwise to generalise and apply its findings to small and medium size manufacturing companies, or manufacturing companies in other countries. Further research is needed to inform small and medium size manufacturing companies about the development of EMSs. These companies often have different characteristics to large manufacturing companies and they may well have different perceptions about environmental quality and the need for an EMS. Manufacturers in other countries may also have different perceptions, cultures and needs, from manufacturing companies in Thailand. Therefore, more research is needed to test the applicability of these findings before making generalisations about manufacturing companies in other countries.

There are a number of areas for future research emanating from this study.

1. Other stakeholder groups may be surveyed, to ascertain their perceptions of quality and compare these with the perceptions from the groups used in this study, for example, manufacturers' operational level staff and local government agencies.
2. The questionnaire could be replicated in other industrial contexts. This will add to the reliability and validity of the findings of the present study. It would also be interesting to replicate the study in small and medium size manufacturing companies, to ascertain whether similar results are achieved and also with large size manufacturers in other provinces, such as Rayong, Patumtanee and Samut Prakran.
3. The survey could be replicated in other countries in order to compare their perceptions of environmental management quality with the perceptions of manufacturers in Thailand.

4. The questionnaire could be refined by examining the homogeneity of items within EMS parts and examining the number of items in each part, with the intention of reducing overlap and repetitions.

Moreover, as mentioned in Chapter Four, Thailand's government began reforms in the public services in 2002. Information collected from government agencies in Thailand in 2003 and 2004 may need to be re-evaluated, to ensure that the MONRE administration and management systems have not changed. Also, Thailand has a variety of legislation dealing with industrial environmental management. This study focused on four principle Acts: the Enhancement and Conservation of National Environmental Quality Act 1992; the Factory Act 1992; Industrial Estates Authority of Thailand Act; and Public Health Act 1992, together with the national plan – the Ninth National Economic and Social Development Plan (2002-2006).

7.7 CONCLUSION

The research that forms the basis for this study focused on the EMS that is most effective for all types of large manufacturers in Thailand studied in Chonburi Province – one of Thailand's largest industrial areas. The methodological triangulation of documents reviewed, individual interviews, observations and questionnaire administration, has provided a balance of qualitative and quantitative approaches, which adds strength to the study. This data triangulation has highlighted the meaning of quality in EMSs. The research has identified areas of good practice, that are valued by the four groups of stakeholders in the study. The survey results aim to answer the research objectives. The answers are below:

- The survey results show that most of the large manufacturers in the industrial town use ISO 14001 as their EMS. Whereas, many of large manufacturers outside of the industrial town use TQM/TQEM, and a few of them did not adopt any EMS systems (just complied with the Thai environmental legislation). The survey results also show that there are some differences between the EMSs that are used by large manufacturers in and outside of the Town in the areas of 'environmental and social effectiveness' and 'business

implication'. But there are only a few differences in the areas of 'EMS system' and 'environmental sustainability and management' issues. For example, the EMS that is used by manufacturers in the Town (ISO 14001) is the most internationally recognised system, compared to the less recognized EMSs that are used by companies outside of the Town. The ISO accredited companies express the benefits of the system as environmental protection, and of export trading on a defensible company image. However, implementation of ISO 14001 appears to have been difficult, largely due to the time, budgets, and paperwork involved in making the necessary changes. Therefore, companies have to compare the benefits, operation costs, financing and human resources of the company before selecting an EMS. If the company has enough financing and human resources, and exports to the US or the UK, it may adopt ISO 14001. If the company has a Japanese management style or has a Japanese partner, and exports to some countries in Asia, the company may adopt TQM/TQEM. But if the company does not have enough financing and human resources, and sells in the domestic market only, they may simply comply with the Thai environmental laws and regulations (Thai EMS).

- There are many factors that affect the quality of EMSs implemented by large manufacturers in Thailand. These may be classified into three main types, the effects of which influence the nature of the EMS chosen and then implementation which leads to achievement as a result. These three factors are: the human factor; manufacturing processes factor; and the environmental legislation factor. This model can be defined as the management and implement of the interaction between community, industries, and the government.
- There are a few significant differences between the responses of the manufacturers' staff in and outside of the Town. For example, The EMS system that is used by manufacturers in the Town (ISO 14001) requires an external audit and is more often audited than the EMS systems that are used by manufacturers from outside of the Town (TQM/TQEM, and the Thai EMS). While, the manufacturers' outside of the industrial town (who use TQM/TQEM) are monitoring the system to thoroughly check any process (but do not require an external audit), and the companies outside of industrial

towns may be randomly audited only by the DIW. With these results, the manufacturers' staff in the Town have more responses to environmental audit activities, and more paper work than manufacturers' staff from outside of the Town. However, the survey results show that there are many differences between the companies that have EMS (ISO and TQM/TQEM) and the company E who does not have an EMS. The company E does not have commitment for environmental quality and records of environmental audit but this company still has budgets for environmental training programmes for their staff and uses some management tools (control chart, flow chart, and histogram) in the company production line. It may be because the company knows that EMS can help the company to save production costs and the company may adopt an ISO 14001 when the company expands (from the interview results).

- There are also some significant differences in responses to environmental pollution problems from manufacturing industries between the communities' members in and outside of the Town areas. Although most of the communities' members from both sides are interest about environmental problems, only the respondents in the Town agreed that communities should take part in the preparation of environmental standards at both national and provincial levels, whereas only a few respondents outside of the Town believed the communities' members should take part in the preparation of environmental standards at both national and provincial levels. Less interest from the communities' members from outside the Town areas may be because the government does not provide them with enough environmental information, but for most of respondents in the Town the environmental information is available in their community (from the questionnaire results). These results are in accordance with the interview results that the government has problems with communicating with both industries and the local community. Moreover, the questionnaire results also show that the communities' members monitor the manufacturers that are located in their community and know the problems. It is very useful if the government develops a good communication channel with the local community and asks the local community to help the government to monitor environmental problems.

This study also provides conclusive evidence of environmental management demand, in that government and large manufacturing companies accept the importance of recognising environmental issues by seriously associating themselves with the problems. The current government approaches are a huge improvement on environmental management regulations, put in place up to ten years ago. The commitment to sustainable development provides a basis for government and industry to move forward, by supporting innovative approaches which encourage industry to further develop Thailand's EMSs and it also encourages the government to maintain high all-encompassing environmental standards.

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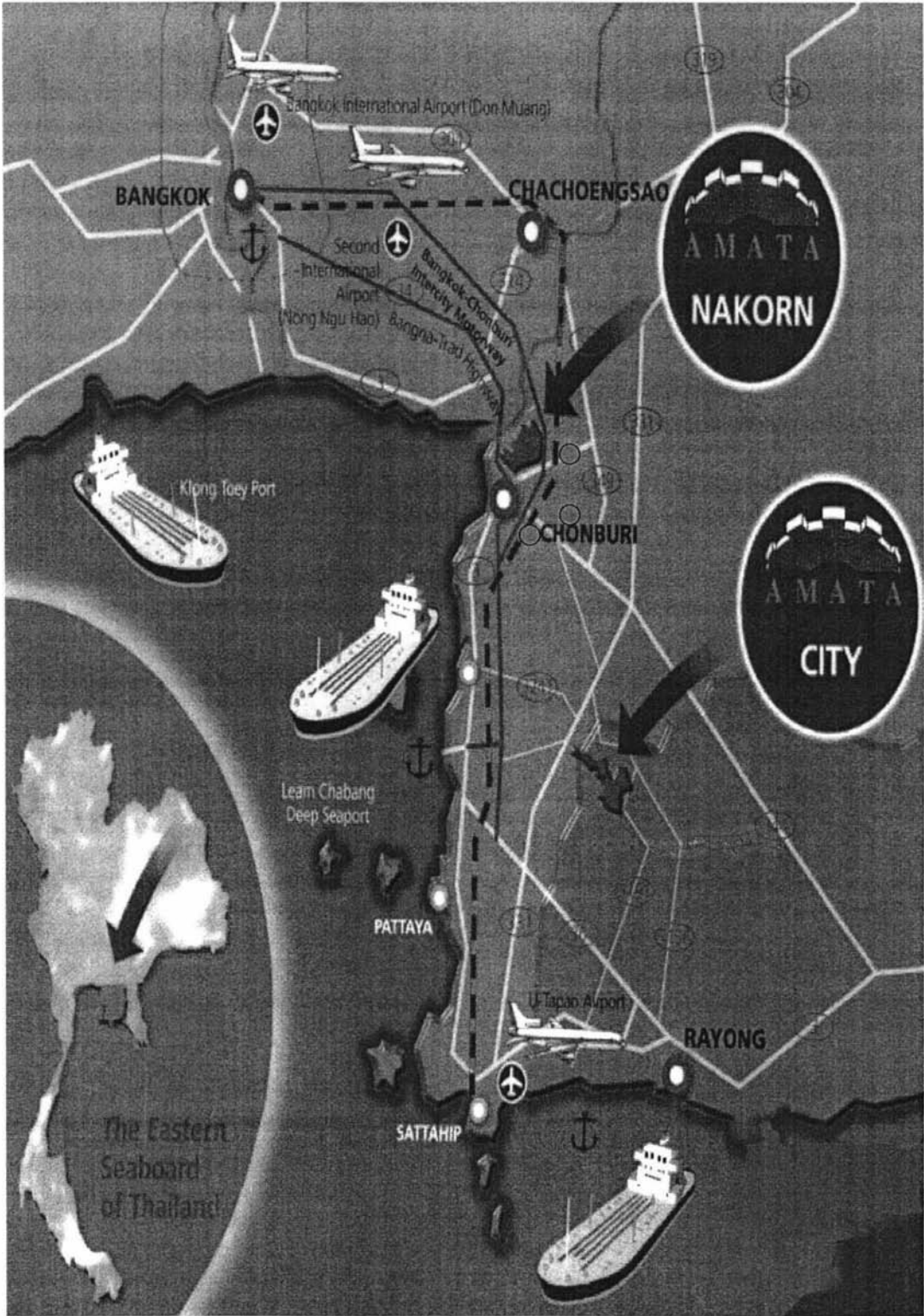
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APPENDIX 1: MAP OF AMATA NAKORN INDUSTRIAL TOWN AND THE OTHER THREE SAMPLING MANUFACTURERS OUTSIDE OF THE TOWN



Note: ● The sampling manufacturers

**APPENDIX 2: ETHICS APPROVAL LETTER – MASSEY UNIVERSITY
HUMAN ETHICS COMMITTEE**



14 February 2005

Arthorn Jitsoonthornchaikul
9-11 Baxter Hostel Room 52
Ranfurlly Street
PALMERSTON NORTH

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TO THE VICE-CHANCELLOR
(ETHICS & EQUITY)
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Dear Arthorn

Re: A comparison of environmental management system (EMS) applied by large manufacturing companies in Amata Nakorn industrial town and other areas of Chonburi Province, Thailand

Thank you for the Low Risk Notification that was received on 10 February 2005.

Your project has been recorded on the Low Risk Database which is reported in the Massey University Human Ethics Committee Annual Report.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by a campus human ethics committee.

Please ensure that the following statement is used on Information Sheets:

"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethics & Equity), telephone 06 350 5249, email humanethicspn@massey.ac.nz".

Please note that if a sponsoring organisation, funding authority, or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to a Campus Human Ethics committee. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

Professor Sylvia V Rumball, Chair
Assistant to the Vice-Chancellor (Ethics & Equity)

cc Professor Antonios Vitalis
HoD, Department of Management
PN214

Dr Johanna Rosier
School of People, Environment & Planning
PN402

APPENDIX 3: QUESTIONNAIRE AND INTERVIEW STRUCTURE

Comparison of Environmental Management System (E.M.S.)

Applied by Industry in Amata Nakorn Industrial Town and Outside the Town

SECTION 1: Background Information

Please provide the following information about yourself by ticking the appropriate box.

- | | | | |
|---|---|-------------------------------------|---|
| 1. Sex | Male | <input type="checkbox"/> | 1 |
| | Female | <input type="checkbox"/> | 2 |
| 2. Age | Under 20 years | <input type="checkbox"/> | 1 |
| | 20 – 29 years | <input type="checkbox"/> | 2 |
| | 30 – 39 years | <input type="checkbox"/> | 3 |
| | 40 – 49 years | <input type="checkbox"/> | 4 |
| | 50 – 59 years | <input type="checkbox"/> | 5 |
| | 60 and over | <input type="checkbox"/> | 6 |
| 3. Do you live in Chonburi Province? | | | |
| | Yes | <input type="checkbox"/> | 1 |
| | No | <input type="checkbox"/> | 2 |
| 4. Do you work for manufacturer in Chonburi Province? | | | |
| | Yes (Go to Q. 5) | <input type="checkbox"/> | 1 |
| | No (If you also answered No. to Q.3 go to Q.39) | <input checked="" type="checkbox"/> | 2 |
| 5. Where do you work? | | | |
| | Work for a manufacturer in Amata Nakorn Industrial Town | <input checked="" type="checkbox"/> | 1 |
| | Work for a manufacturer outside of the Town | <input type="checkbox"/> | 2 |
| | Do not work for manufacturer (Go to Q.30) | <input type="checkbox"/> | 3 |

6. What is your working level?

Top Management Level (manager or higher) 1

Management Level (supervisor or higher) 2

Operational Level 3

7. How long have you been employed at your present position?

Less than 2 years 1

2 – 5 years 2

6 – 10 years 3

More than 10 years 4

8. Does your company use an E.M.S.?

YES 1

NO 2

9. Which kind of EMS does your manufacturer use?

TQM / TQEM 1

ISO 14000 2

Others (please specify) 3

SECTION 2: The Environmental Management System (E.M.S.)

Please respond to each of the following statements by ticking which of the following questions about E.M.S. you regularly use, if any. Your own opinion is the appropriate response.

YES

10. Tick which of the following groups you believe are your customers?

- Consumers of your manufactured products 1
- Government regulators at a provincial level 2
- Government legislators at a national level 3
- Politicians 4
- People in Chonburi community 5
- National environmental lobby non-government organisations 6
- Your company employees 7
- Others 8

11. Tick which actions your management team is committed to?

- Definition of EMS policy 1
- Clear vision for future EMS 2
- Time allocated to learn about EMS across manufacturer 3
- Top management defines the policy 4
- Continual improvement and prevention of pollution 5
- Comply with relevant legal requirements 6
- Setting and reviewing objectives and targets 7
- Monitoring of strategies 8
- Set communication line in manufacturer 9
- Communicated E.M.S. to public 10

12. Are employees required to consider the following matters as part of their job?

- Manufacturing systems and procedures relevant to quality of the product 1
- Training programs about product quality 2
- Training programs about environmental quality 3
- Seeking innovative alternatives to outdated process and policies 4

13. Do you have feedback from your customer?

YES 1

NO 2

Comment: _____

14. Tick which decision making tools does your management team use in making decisions about environmental management?

- P-D-C-A cycle 1
- Solve problems by cause and effect diagram 2
- Monitor production process by control chart 3
- Analyse process flow Chart 4
- Histogram 5
- Benchmarking 6
- Brainstorming and team work 7

15. How often does your company audit environmental management system?

- | | | |
|--------------------------------|--------------------------|---|
| Five times or more over a year | <input type="checkbox"/> | 1 |
| 3 – 4 times a year | <input type="checkbox"/> | 2 |
| 1 – 2 times a year | <input type="checkbox"/> | 3 |
| Never | <input type="checkbox"/> | 4 |

16. Can you give me a copy of an environmental audit?

- | | | |
|-----------------------------|--------------------------|---|
| YES | <input type="checkbox"/> | 1 |
| NO (please give the reason) | <input type="checkbox"/> | 2 |

Reason _____

17. What percentage of annual production costs are spent on employees training about environmental management?

- | | | |
|----------------------|--------------------------|---|
| 40 percent or over | <input type="checkbox"/> | 1 |
| 30 – 39 percent | <input type="checkbox"/> | 2 |
| 20 – 29 percent | <input type="checkbox"/> | 3 |
| 10 – 19 percent | <input type="checkbox"/> | 4 |
| Less than 10 percent | <input type="checkbox"/> | 5 |

18. How many times a year does your manufacturer use an emergency plan as a result of equipment breakdown?

- | | | |
|--------------------|--------------------------|---|
| Five times or over | <input type="checkbox"/> | 1 |
| 3 – 4 times | <input type="checkbox"/> | 2 |
| 1 – 2 times | <input type="checkbox"/> | 3 |
| Never | <input type="checkbox"/> | 4 |

19. Tick which of the following affects would occur as a result of the breakdown?

- | | | |
|---------------------------------------|--------------------------|---|
| Discharge of the pollutants to air | <input type="checkbox"/> | 1 |
| Discharge of the pollutants to water | <input type="checkbox"/> | 2 |
| Discharge of the pollutants to ground | <input type="checkbox"/> | 3 |
| Injury to employee | <input type="checkbox"/> | 4 |
| Nothing | <input type="checkbox"/> | 5 |

20. Does environmental audit information result in changes to manufacturing process?

- | | | |
|-----|--------------------------|---|
| YER | <input type="checkbox"/> | 1 |
| NO | <input type="checkbox"/> | 2 |

21. How does management use record of incidents in management decision making?

22. List three actions used by your company to prevent accidents or environmental incidents?

Please rank your company communication with the following groups by placing the number that best expresses your feelings. Use a five point scale where:

1	2	3	4	5
Very Bad	Not Good	Neutral	Good	Very Good

For example

What do you think about the consumption of large amount of alcohol

23. National Government Departments

24. Provincial Government Department

25. Community groups

26. Employees in same department of your company

27. Employees from other departments in your company

28. Employees at the same working level

29. Employees at other levels

SECTION 3: Community respond

Please respond to each of the following statements by placing the number that best expresses your feelings about the response of your community to environmental problems. There are no right or wrong answers. Your own opinion is the appropriate response. Use a five point scale where:

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

For example

The environment should not be polluted

30. Your community needs to pay attention to environmental problems or issues

31. Good environmental management systems are important for manufacturers

32. The government provides communities with enough information
about environmental laws, regulations and education

33. Important government scientific information is available in communities
to assist decision making

34. Thailand national environmental standards result in safe environment
across the country

35. Communities take part in the preparation of environmental standards at a
national level

36. Communities take part in the preparation of environmental standards at a
provincial level

37. Environmental laws and regulations encourage manufacturers to improve
environmental quality

Please respond to each of the following statements by ticking which of the following questions about the response of community to environmental issues. Your own opinion is the appropriate response.

38. Tick which of the environmental pollutants from manufacturing in the following list affect your community?

- | | | |
|---------------------------------------|--------------------------|---|
| Discharge of the pollutants to air | <input type="checkbox"/> | 1 |
| Odour | <input type="checkbox"/> | 2 |
| Discharge of the pollutants to water | <input type="checkbox"/> | 3 |
| Discharge of the pollutants to ground | <input type="checkbox"/> | 4 |
| Nothing | <input type="checkbox"/> | 5 |

39. Would you like to receive a summary of the survey results?

- | | | |
|---------------------------------------|--------------------------|---|
| YES (please list address for results) | <input type="checkbox"/> | 1 |
| NO | <input type="checkbox"/> | 2 |

Name : _____

Address _____

THANK YOU

**Comparison of Environmental Management System (E.M.S.) Applies by
Industry in Amata Nakorn Industrial Town and Outside of the Town**

Interview mini structure

1. Do you think it is important for manufacturers to use environmental management systems to achieve environmental standards?
2. Does the national level of government provide communities with enough information about environmental laws, regulations and education?
3. Does the provincial level of government provide communities with enough information about environmental laws, regulations and education?
4. How does your department disseminate important government scientific information so it is available in communities to assist environmental decision making? (government officer only)
5. What are your department / company responsibilities and actions in protecting environment?
6. Do you think Thailand national environmental standards result in a safe environment across the country?
7. Which training processes does your department / company use with employees about environmental management?
8. How does your company audit environment management system (E.M.S.)? (manufacturer staff only)
9. From your experience, how do communities take part in the preparation of environmental standards at a national level?
10. Which decision making tools does your department / company used in making decisions about environmental management?

11. Do your department / company have complained from communities?
12. Do your department / company have an emergency plan for environmental incidents?
13. Do individual communities take part in the preparation of environmental standards at a provincial level?
14. Do you think environmental laws and regulations encourage manufacturers to improve environmental quality and work in partnership with government?
15. What further efforts are needed at a national level to improve laws and regulations related to management of environmental quality?
16. Do your department / company have a record of environmental incident?
17. How does a record of environmental incidents result in changes to manufacturing process? (manufacturer staff only)
18. What further efforts are needed at a provincial level to improve laws and regulations related to management of environmental quality?
19. If manufacturers applied E.M.S. in their industrial processes, could government at national and provincial levels reduce environmental regulations
20. Can you provide any examples of successful application of E.M.S. in Thailand industry (i.e. environmental performance of the company meets or exceeds government expectations)
21. Does the National Economic and Social Development Plan, provide clear direction for your department's role, responsibilities and targets please explain? (government officer only)
22. Are there any overlaps with the responsibilities of any other departments in MONRE? If so please explain

23. Is there are overlap of responsibilities between departments in difference ministry who concerned about environmental quality? If so please explain. (government officer only)
24. Does your department / company have enough financial resources, equipment, and education and trained personal?
25. What qualifications do your officers need to have before they liaise with industry to determine the needs of industry? (government officer only)
26. From your experience, what should be changed in environmental laws and regulations?
27. What are the factors that result in good environment outcomes for industry?
28. What are the factors that reduce the effectiveness of environmental policy in guiding industry?
29. Please rank your knowledge about the following topic by placing the number that best expresses your opinion. Use a five point scale where:
- 1 = Very Bad 5 = Very Good
- a. TQM / TQEM
 b. ISO 14001
 c. EMAS – Eco-Management Audit Scheme
 d. International Chamber of Commerce (ICC) Principles
30. What literature does your department provide about EMS in question 29?

**APPENDIX 4: INFORMATION SHEET FOR RESEARCH PARTICIPANTS –
INTERVIEWS AND OBSERVATIONS**

INFORMATION SHEET FOR RESEARCH INTERVIEW PARTICIPANTS FROM MANUFACTURING COMPANY

Research Project Title: Comparison of Environmental Management System (E.M.S.) applied by large manufacturing companies in Amata Nakorn Industrial Town and other areas of Chonburi Province, Thailand

This project aims to develop an environmental management system that is most affective for large manufacturers in Thailand and I am particularly interested to find out what senior managers in the large manufacturers perceive as the best aspects of an E.M.S. for large manufacturers.

I am doing this research for my Ph.D., which is being supervised by Professor Tony Vitalis and Dr. Johanna Rosier. You will need to be available for approximately one hour for an individual interview with me. The discussion will be open and unrestricted and will be tape recorded and then transcribed. The transcript will be made available to you if you request it.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committee. The researcher is responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethnic & Equity), telephone 06 350 5249, email: humanethnicspn@massey.ac.nz

If you take part in the study, you have the right to:

- refuse to answer any particular question, and to withdraw from the study at any time.
- ask any further question about the study that occurs to you during your participation.
- provide information on the understanding that it is completely confidential to the researcher. All information is collected anonymously, and it will not be possible to identify you in any reports that prepared from the study.

No preparation for the interview is required.

Arthorn Jitsoonthornchaikul
Ph.D. researcher
Department of Management
Massey University, Palmerston North
New Zealand

INFORMATION SHEET FOR RESEARCH INTERVIEW PARTICIPANTS FROM GOVERNMENT

Research Project Title: Comparison of Environmental Management System (E.M.S.) applied by large manufacturing companies in Amata Nakorn Industrial Town and other areas of Chonburi Province, Thailand

This project aims to develop an environmental management system that is most affective for large manufacturers in Thailand and I am particularly interested to find out what government officers in the Ministry concerned about environmental policy perceive as the best aspects of an E.M.S. for large manufacturers.

I am doing this research for my Ph.D. (Management System), which is being supervised by Professor Tony Vitalis and Dr. Johanna Rosier. You will need to be available for approximately one hour for an individual interview with me. The discussion will be open and unrestricted and will be tape recorded and then transcribed by the researcher. The transcript will be made available to you if you request it.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committee. The researcher is responsible for the ethnic conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethnic & Equity), telephone 06 350 5249, email: humanethnicspn@massey.ac.nz

If you take part in the study, you have the right to:

- refuse to answer any particular question, and to withdraw from the study at any time.
- ask any further question about the study that occurs to you during your participation.
- provide information on the understanding that it is completely confidential to the researcher. All information is collected anonymously, and it will not be possible to identify you in any reports that prepared from the study.

No preparation for the interview is required.

Arthorn Jitsoonthornchaikul
Ph.D. researcher
Department of Management
Massey University, Palmerston North
New Zealand

CONSENT FROM FOR RESEARCH INTERVIEW PARTICIPANTS

Research Project Title: Comparison of Environmental Management System
(E.M.S.) Applied by large manufacturing companies in
Amata Nakorn Industrial Town and other areas of Chonburi
Province, Thailand

I have read the Information Sheet for this study and have had the details of the study explained to me. My questions about the study been answered to my satisfaction, and I also understand that I am free to withdraw from the study at any time, or to decline to answer any particular questions in the study. I agree to the individual interview being tape recorded on the understanding that I can request that the tape recorder be turned off at any time. I also know that I can request a copy of the tape transcript.

I am happy to participate in this study under the conditions set out on the information sheet.

Signature.....(participant)

Name.....

Date.....

Interview Date.....

Government / Manufacturing company

LETTER FOR OBSERVATION

Dear the Environmental Management Representative (EMR) / Production Manager

I am conducting my Ph.D. research on the topic "Comparison of E.M.S. Applies by large manufacturing companies in Amata Nakorn Industrial Town and other areas of Chonburi Province, Thailand". My study gathers data from four methods; documents, interviews, questionnaires, and observations.

I would appreciate the opportunity to observe environmental management systems in your manufacturing company. This would take approximately one hour at a time convenient to you. I may take some picture in your manufacturing company during the observation period.

The project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committee. The researcher is responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethnic & Equity), telephone 06 350 5249, email: humanethicspn@massey.ac.nz.

I will phone you in one week to see if your company available for me to observe.

Yours sincerely

Arthorn Jitsoonthornchaikul
Ph.D. researcher
Department of Management
Massey University, Palmerston North
New Zealand

**APPENDIX 5: LETTER TO PARTICIPANTS FOR QUESTIONNAIRE
PRETEST, QUESTIONNAIRE COVERING LETTERS
AND FOLLOW-UP REMINDER LETTERS TO
QUESTIONNAIRE PARTICIPANTS**

LETTER TO PARTICIPANTS FOR QUESTIONNAIRE PRETEST

2 March 2005

Dear

Thank you for agreeing to participate in the pilot run of the enclosed questionnaire, which is part of my PhD research. The study examines the factors that influence the Environmental Management System (E.M.S.) used by manufacturers in Chonburi Province. As you may be aware, environmental laws and regulations in Thailand are mainly standards based and they do not assist managers in developing industry systems.

As you work your way through the questionnaire please note on it any ambiguities and repetitions. If you think there are serious omissions, please note these along with any other comments that you might wish to make. I would be grateful if you would indicate the time that it took you to complete the task on the top of the questionnaire form. Please return it to me in the enclosed pre-addressed envelopes as soon as possible.

The project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committee. The researcher is responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethnic & Equity), telephone 06 350 5249, email: humanethicspn@massey.ac.nz.

Thank you for your co-operation.

Yours sincerely

Arthorn Jitsoonthornchaikul
Ph.D. researcher
Department of Management
Massey University, Palmerston North
New Zealand

QUESTIONNAIRE COVERING LETTERS MANUFACTURING COMPANIES

20 March 2005

Dear Sir / Madam

Attached is a survey questionnaire, which asks for your opinion about a number of aspects of the environmental management system (E.M.S.) in your company. The responses gathered from this survey will present in my thesis at the Department of Management, Massey University, New Zealand. This survey will contribute towards improving the quality of E.M.S. by large manufacturers in Thailand.

I am conducting this survey as part of my Ph.D. research and would be very grateful if you would take the time to complete the questionnaire. As the survey is anonymous, do not identify yourself in any way. Individual responses cannot be identified in the results, as only group data will be reported.

The project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committee. The researcher is responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethnic & Equity), telephone 06 350 5249, email: humanethicspn@massey.ac.nz.

Thank you for your co-operation.

Yours sincerely

Arthorn Jitsoonthornchaikul
Ph.D. researcher
Department of Management
Massey University, Palmerston North
New Zealand

QUESTIONNAIRE COVERING LETTERS – COMMUNITY MEMBER

20 March 2005

Dear Sir / Madam

Attached is a survey questionnaire, which asks for your opinion about a number of aspects of the environmental management system (E.M.S.) in your community. The responses gathered from this survey will present in my thesis at the Department of Management, Massey University, New Zealand. This survey will contribute towards improving the quality of E.M.S. by large manufacturers in Thailand.

I am conducting this survey as part of my Ph.D. research and would be very grateful if you would take the time to complete the questionnaire. As the survey is anonymous, do not identify yourself in any way. Individual responses cannot be identified in the results, as only group data will be reported.

The project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committee. The researcher is responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethnic & Equity), telephone 06 350 5249, email: humanethicspn@massey.ac.nz.

Thank you for your co-operation.

Yours sincerely

Arthorn Jitsoonthornchaikul
Ph.D. researcher
Department of Management
Massey University, Palmerston North
New Zealand

FOLLOW-UP REMINDER LETTERS TO QUESTIONNAIRE PARTICIPANTS

20 April 2005

Dear Sir / Madam

Three weeks ago I sent you a questionnaire that asked for your opinion about a number of aspects of environment system (E.M.S.) in your manufacturing company. The result from this survey will present in my thesis at the Department of Management, Massey University, New Zealand.

As the survey is completely anonymous, I have no way of knowing whether or not you have completed and returned your questionnaire. If you have already done so, thank you. If you have not yet returned your questionnaire I would greatly appreciate you doing a new copy questionnaire in this time as soon as possible. The better the response from the survey, the more valid the results. Let your opinion count.

Yours sincerely

Arthorn Jitsoonthornchaikul
Ph.D. Researcher
Department of Management
Massey University, Palmerston North
New Zealand

APPENDIX 6: ENHANCEMENT AND CONSERVATION OF THAILAND

ENVIRONMENTAL QUALITY ACT, B.E. 2535 (1992)

BHUMIBOL ADULYADEJ, REX.

Given on the 29th Day of March B.E. 2535,

Being the 47th Year of the Present Reign

His Majesty King Bhumibol Adulyadej is graciously pleased to proclaim that Whereas it is deemed expedient to reform and improve the law on enhancement and conservation of national environmental quality.

Be it, therefore, enacted by the King, by and with the advice and consent of the National Legislative Assembly, acting as the National Assembly, as follows

Section 1 This Act shall be called "The Enhancement and Conservation of National Environmental Quality Act, B.E. 2535"

Section 2 This Act shall come into effect after the elapse of a period of sixty days from the date following its publication in the Government Gazette.

Section 3 The following Acts shall be repealed

1. The Enhancement and Conservation of National Environmental Quality Act, B.E. 2518.
 2. The Enhancement and Conservation of National Environmental Quality Act (No. 2), B.E. 2521.
 3. The Enhancement and Conservation of National Environmental Quality Act (No. 3), B.E. 2522
- Section 4** In this Act,

"Environment" means natural things which form the physical and biological conditions surrounding man and man-made things.

"Environmental Quality" means the balance of nature, being composed of animals, plants, natural resources and man-made objects which is for the benefit of subsistence of mankind and the sustenance of human-being and nature.

"Environmental Quality Standards" means the parameters of quality standards for water, air, noise and other conditions of the environment which are determined as the general criteria for enhancement and conservation of environmental quality.

"Fund" means the Environmental Fund.

"Pollutant" means wastes, hazardous substances and other polluting substances as well as residues, sediments or remainders of such matters, which are discharged from point sources of pollution or naturally occur in the environment, that have or are likely to have impacts on environmental quality or to cause conditions poisonous or harmful to the health and hygiene of the public, and shall mean to include radiation, heat, light, noise, odor, vibration or other nuisances emanated or discharged from point sources of pollution.

"Pollution" means the state or environment that has been affected, changed or contaminated by pollutants, resulting in deterioration of environmental quality, such as water pollution, air pollution, soil pollution.

"Point Source of Pollution" means any community, factory, building, structure, vehicle, place of business or activity or any other thing from which pollution is generated.

"Waste" means refuse, garbage, filth, dirt, wastewater, polluted air, polluting substances or any other hazardous substances which are discharged or originated from

point sources of pollution, including residues, sediments or remainders of such matters, either in the state of solid, liquid or gas.

"Wastewater" means waste in liquid state including polluting or contaminating substances contained in such liquid.

"Polluted Air" means waste in gaseous state in the form of vapor, steam, exhaust, fume, odor, smoke, gas, dust, soot, ash or other polluting substances in the form of particulate matters that can be suspended in the atmospheric air.

"Hazardous Substance" means explosive substances, inflammable substances, oxidizing and peroxidizing substances, toxic substances, pathogenic substances, radioactive substances, genetic transforming substances, corrosive substances, irritating substances, or other substances whether chemical or not, which may cause danger to human-being, animal, plant, property or the environment.

"Nuisance" means nuisance according to the law on public health.

"Factory" means factories according to the law on industrial plants.

"Building" means buildings according to the law on building control.

"Vehicle" means automobiles or motorcycles according to the law on automobiles, vessels according to the law on Thai vessels and aircraft according to the law on aviation.

"Monitoring Control Operator" means the person licensed to monitor, control, assess, operate and maintain wastewater treatment or waste disposal facility, or equipment, instrument, tools, appliances for control, treatment or disposal of any other pollution, which the owner or possessor of point source of pollution manages to construct and bring into operation by his own investment and expenses for the treatment of wastewaters or disposal of wastes or any other pollutants.

"Service Contractor" means the person licensed to render for hire the services of wastewater treatment or waste disposal or monitoring of environmental quality.

"Conservation Area" means the areas designated as national parks, wildlife reserves, tourism preserve and other protected areas pursuant to the governing laws related thereto.

"Local Official" means

1. President of the Municipal Council within a municipality.
2. President of the Sanitary District Board within a sanitary district.
3. Changwat Governor within a local administration organization.
4. Governor of the Bangkok Metropolitan Administration within Bangkok Metropolis.
5. Permanent Secretary of Pattaya City Administration within the City of Pattaya.
6. Head of local administrator in the administration of the local administration organization other than (1) to (5) above, established by specific law governing thereof, within such local administration organization.

"Pollution Control Official" means the person appointed by the Minister to perform the functions concerning pollution control under this Act.

"Competent Official" means the person appointed by the Minister to have power and duty to take action under this Act.

"Minister" means the Minister of Science, Technology and Environment.

Section 5 In case any provision under this Act refers to Changwat or mandates the power and duty of the Changwat Governor, such reference or mandate shall denote

the inclusion of Bangkok Metropolitan Administration or the power and duty of the Governor of Bangkok Metropolitan Administration, as may be the case.

Section 6 For the purpose of public participation in the enhancement and conservation of national environmental quality, the following rights and duties may be accorded to individual person as provided by this Act or governing law related thereto :

- (1) To be informed and obtain information and data from the government service in matters concerning the enhancement and conservation of environmental quality, except the information or data that are officially classified as secret intelligence pertaining to national security, or secrets pertaining to the right to privacy, property rights, or the rights in trade or business of any person which are duly protected by law.
- (2) To be remedied or compensated by the State in case damage or injury is sustained as a consequence of dangers arisen from contamination by pollutants or spread of pollution, and such incident is caused by any activity or project initiated, supported or undertaken by government agency or state enterprise.
- (3) To petition or lodge complaint against the offender in case of being a witness to any act committed in violation or infringement of the laws relating to pollution control or conservation of natural resources.
- (4) To co-operate and assist government officials in the performance of duty relating to the enhancement and conservation of environmental quality.
- (5) To strictly observe the provisions of this Act or other laws concerning the enhancement and conservation of environmental quality.

Section 7 In order to encourage public participation in the promotion and conservation of environmental quality, non-governmental organizations (NGOs) having the status of a juristic person under Thai law or foreign law which are directly engaged in activities concerning environmental protection or conservation of natural resources without any objective to be involved in politics or to make profits from the engagement in such activities, shall be entitled to register with the Ministry of Science, Technology and Environment as the NGOs for environmental protection and conservation of natural resources in accordance with the rules, procedures and conditions prescribed by ministerial regulation.

Section 8 The NGOs that have been registered pursuant to section 7 may request for government assistance or support in the following matters :

- (1) The organization of volunteers to assist in the performance of duty of government officials under this Act or other laws concerning the enhancement and conservation of environmental quality.
- (2) Public relations campaign and dissemination of information or data to promote public awareness and proper understanding and knowledge about environmental protection and conservation of nature and natural resources.
- (3) Providing assistance to people in certain areas of the country to initiate projects or activities for environmental protection and conservation of natural resources in such areas.
- (4) Conducting study and research in respect of environmental protection and conservation of natural resources and bringing to the attention of the Government or agencies concerned on what are the viewpoints and suggestions based upon the outcome of such study and research.
- (5) Providing legal aid to people who are in jeopardy of or afflicted by pollution damage caused by leakage of pollutants or contamination as well as acting as

representative of such pollution victims to bring lawsuit and litigate claim in court for compensation or damages to which they are entitled as legal remedies.

In case any registered NGOs, in the carrying out of activities indicated in the first paragraph, encounter problems or difficulties and request for help from the National Environment Board, the Prime Minister shall, with the recommendation of the National Environment board, have the power to direct for appropriate recourse or order the government agency or state enterprise concerned to render assistance or facilitation as seen fit under the circumstances.

The Fund Committee, with the approval of the National Environment Board, may consider to allocate grants or loans in support of any activity of the registered NGOs as deemed appropriate.

The registered NGOs may propose for nomination of candidates as representatives of the private sector to be appointed by the cabinet as qualified members of the National Environment Board.

In case any registered NGO's activities are undertaken by causing disturbances or contrary to public order or unsuitable, the Minister shall have the power to revoke the registration of the NGO involving in such activities.

Section 9 In case there is an emergency or public danger arising from natural disaster or pollution caused by contamination and spread of pollutants which will, if left without any remedial actions, seriously endanger the safety of life, body or health of the people, or aggravatedly cause damage to the properties of the people or the State, the Prime Minister shall have the power to order, as deemed appropriate, government agencies, state enterprises or any persons, including the persons who are or may be the victims of such danger or damage, to take prompt action, individually or jointly, in order to be able to control, extinguish or mitigate the adverse effects of such danger or damage. In case any polluters are known and can be identified, the Prime Minister shall be empowered to enjoin such persons from any acts which may aggravate the adverse effects of pollution during the occurrence of such endangering incident.

The Prime Minister may delegate the power to give orders pursuant to the first paragraph to the Changwat Governor to exercise such power and act on his behalf within the territorial jurisdiction of that Changwat. The said delegation of power shall be made by a written order and published in the Government Gazette.

When any order is given by the Prime Minister by virtue of the first paragraph, or by the Changwat Governor acting on behalf of the Prime Minister by virtue of the second paragraph, such order shall be published in the Government Gazette without delay.

Section 10 In order to prevent, remedy, extinguish or mitigate the emergency or danger of pollution envisaged by section 9, the Minister shall determine preventive measures and prepare a contingency plan to rectify the situation in advance.

Section 11 The Prime Minister and the Minister of Science, Technology and Environment shall have charge and control of the execution of this Act, insofar as it is concerned with their respective powers and duties conferred upon them under this Act.

The Minister of Science, Technology and Environment shall have the power to appoint pollution control officials and other competent officials, issue ministerial regulations prescribing fees not exceeding the rates attached hereto and prescribing other activities for the execution of this Act.

The Ministerial Regulations shall come into force upon their publication in the Government Gazette.

Chapter I National Environment Board

Section 12 There shall be a National Environment Board consisting of the Prime Minister as the Chairman, a Deputy Prime Minister designated by the Prime Minister as the first Vice Chairman, the Minister of Science, Technology and Environment as the second Vice Chairman, the Minister of Defense, the Minister of Finance, the Minister of Agriculture and Cooperatives, the Minister of Transport and Communications, the Minister of Interior, the Minister of Education, the Minister of Public Health, the Minister of Industry, the Secretary-General of the National Economic and Social Development Board, the Secretary-General of the Board of Investment, the Director of the Bureau of the Budget as members *ex officio* and members qualified in environmental matters not more than eight persons of which no less than half shall be representatives from the private sector and the Permanent Secretary of the Ministry of Science, Technology and Environment as member and secretary.

The appointment of qualified members shall be made by drawing from persons who are knowledgeable and known for their expertise, contributions and experiences in the matters concerning the enhancement and conservation of environmental quality.

Section 13 The National Environment Board shall have the power and duty as follows

- (1) To submit policy and plan for enhancement and conservation of national environmental quality to the cabinet for approval.
- (2) To prescribe environmental quality standards pursuant to section 32.
- (3) To consider and give approval to the Environmental Quality Management Plan proposed by the Minister according to section 35.
- (4) To consider and give approval to the Changwat Action Plan for environmental quality management according to section 37.
- (5) To make recommendations to the cabinet in respect of financial, fiscal, taxation and investment promotion measures for the implementation of the policy and plan for enhancement and conservation of national environmental quality.
- (6) To propose for amendment or improvement of laws relating to the enhancement and conservation of environmental quality to the cabinet.,
- (7) To consider and give approval to the action plan for prevention and remedy of danger caused by contamination of pollutants or spread of pollution proposed by the Pollution Control Committee pursuant to section 53 (1).
- (8) To consider and give approval to the setting of emission or effluent standards proposed by the Minister pursuant to section 55.
- (9) To supervise, oversee and expedite the enactment of royal decrees and issuance of ministerial regulations, rules, local ordinances, notifications, bye-laws and orders which are necessary to ensure systematic operation of the laws relating to enhancement and conservation of environmental quality to the fullest extent possible.
- (10) To submit opinion to the Prime Minister for his directions in case it appears that any government agency or state enterprise infringes or refrains from complying with the laws and regulations for environmental protection which may cause extensive damage to the environment.
- (11) To specify measures for the strengthening and fostering of co-operation and co-ordination among government agencies, state enterprises and the private sector in matters concerning the promotion and conservation of environmental quality.
- (12) To supervise the Fund management and administration.
- (13) To submit reports on national environmental quality situation to the cabinet at least once year.

(14) To perform other functions as may be provided by this Act or other laws to be within the authority of the National Environment Board.

Section 14 A qualified member appointed by the cabinet shall hold office for a term of three years and may be re-appointed for a period of not more than one consecutive term.

In case an additional appointment of qualified member is made during the term of those members who have already been appointed to hold office, the term of additional membership shall be equal to the remainder of the term of those members who have already been appointed before.

Section 15 In addition to the expiration of the term of office according to section 14, a qualified member appointed by the cabinet shall vacate office upon

- (1) death;
- (2) resignation;
- (3) being a bankrupt;
- (4) being an incompetent or quasi-incompetent person;
- (5) being punished by a final judgment to a term of imprisonment except for an offence committed through negligence or a petty offence.
- (6) Being dismissed by the cabinet for incompetence or misconduct or having vested interests in any activity or business that may have a direct impact on or adversely affect the environmental quality.

When a qualified member vacates office before the expiration of his term of office, the cabinet may appoint another person to fill the vacancy and such person shall hold office only for the remaining term of his predecessor.

Section 16 In convening the National Environment Board meeting, if the Chairman is absent or unable to perform the function, the first Vice Chairman shall act as the Chairman. If the Chairman and the first Vice Chairman are both absent or unable to perform the function, the second Vice Chairman shall act as the Chairman. If the Chairman and both the two Vice Chairmen are all absent or unable to perform the function, the members who attend the meeting shall elect one of the attending members to act as the chairman of the meeting.

Section 17 A meeting of the National Environment Board requires the presence of not less than one-half of the total member of its members to constitute a quorum.

The decision of a meeting shall be made by a majority of votes. In casting votes, each member shall have one vote. In case of an equality of votes, the Chairman of the meeting shall have an additional vote as a casting vote.

Section 18 The National Environment Board may appoint an expert committee or subcommittee to consider or carry out any matter as may be entrusted by the National Environment Board.

Section 16 and section 17 shall apply *mutatis mutandis* to the meeting of the expert committee or subcommittee.

Section 19 The National Environment Board shall have the power to require government agencies, state enterprises and other persons to deliver documents relating to the examination of impacts on environmental quality and documents or data concerning the projects or work plans of such government agencies, state enterprises and persons for its consideration. For this purpose, the Board may, summon persons concerned to give explanation. If the Board is of the opinion that any project or work plan may seriously affect the environmental quality, it shall recommend remedial measures to the cabinet.

In case the documents or data required to be delivered to the National Environment Board pursuant to the first paragraph are relevant to trade secrets in the nature of a

patent and protected by the law on patent rights, the National Environment Board shall specify suitable measures and methods for preventing such documents or data from being disclosed to anyone to ensure that they shall only be used strictly for the purpose of this section.

Section 20 In the performance of its function, the National Environment Board, the expert committee or the sub-committee may invite any person to present facts, explanation, opinion or technical advice as it deems fit and may request co-operation from any person with a view to ascertaining any fact or surveying any activity which may have an adverse effect on environmental quality.

Section 21 In the performance of its duties under this Act, the National Environment Board may entrust the Office of Environmental Policy and Planning, the Pollution Control Department or the Environmental Quality Promotion Department under the Ministry of Science, Technology and Environment with the operation or preparation of propositions to be made to the National Environment Board for further actions.

Chapter II Environmental Fund

Section 22 There shall be established a fund called the "Environmental Fund" in the Ministry of Finance with the following moneys and properties :

- (1) Money from the Fuel Oil Fund in the amount determined by the Prime Minister.
- (2) Money transferred from the Revolving Fund for Environmental Development and Quality of Life established by the Annual Budget for the Fiscal Year of B.E. 2535 Act, B.E. 2535.
- (3) Service fees and penalties collected by virtue of this Act.
- (4) Grants from the Government from time to time.
- (5) Moneys or properties donated by donors in the private sector both domestic and foreign, by foreign governments or by international organizations.
- (6) Interest and benefits accrued from this Fund.
- (7) Other moneys received for the operation of this Fund.

The Comptroller-General's Department, Ministry of Finance, shall keep the moneys and properties of the Environmental Fund and make disbursements from the fund in accordance with this Act.

Section 23 Fund disbursements shall be made for the following activities and purposes

- (1) As grants to government agency or local administration for investment in and operation of the central wastewater treatment plant or central waste disposal facility, including the acquisition and procurement of land, materials, equipment, instrument, tools and appliances necessary for the operation and maintenance of such facility.
- (2) As loans to local administration or state enterprise for making available of air pollution control system, wastewater treatment or waste disposal facilities to be used specifically in the activities of such local administration or state enterprise.
- (3) As loans to private person in case such person has the legal duty to make available and install an on-site facility of his own for the treatment of polluted air, wastewater or waste disposal or any other equipment for the control, treatment or eliminate pollutants that are generated by his activity or business undertaking, or such person is licensed to undertake business as a Service Contractor to render services of wastewater treatment or waste disposal under this Act.

(4) As aids or grants to support any activity concerning the promotion and conservation of environmental quality as the Fund Committee sees fit and with the approval of the National Environment Board.

(5) As expenditures for administering the Fund.

Section 24 There shall be a Fund Committee consisting of the Permanent Secretary of the Ministry of Science, Technology and Environment as the Chairman, the Permanent Secretary of the Ministry of Agriculture and Cooperatives, the Secretary-General of the National Economic and Social Development Board, the Director of the Bureau of the Budget, the Director-General of the Department of Local Administration, the Comptroller-General of the Comptroller-General's Department, the Director-General of the Department of Public Works, the Director-General of the Department of Industrial Works, the Director-General of the Department of Mineral Resources, the Director-General of the Pollution Control Department, the Director-General of the Environmental Quality Promotion Department and not more than five qualified persons appointed by the National Environment Board as members and the Secretary-General of the Office of Environmental Policy and Planning as member and secretary.

Section 14 and section 15 shall apply *mutatis mutandis* to the holding office of the qualified members of the Fund Committee.

Section 25 The Fund Committee shall have the power and duty as follows

(1) To consider on Fund allocation for use in the activities prescribed by section 23.

(2) To prescribe rules, conditions, procedures and methods concerning application for allocation or loan from the Fund.

(3) To lay down administrative rules and procedures concerning the power, duties and working methods of the Fund managers according to section 29 and section 30 as well as mechanisms for co-ordination among the Fund Committee, the Comptroller-General's Department and the Fund managers according to section 29 and section 30.

(4) To lay down rules and procedures for the receipt and disbursement of moneys from the Fund.

(5) To fix durations for repayment of loans from the Fund according to section 23 (2) or (3) as well as interest rates and securities as necessary and appropriate.

(6) To determine the ratio and criteria for deduction of service fees and penalties that are required by section 93 to be remitted to the Fund.

(7) To perform any other functions provided under this Act.

The prescription of rules according to sub-section (2), (3) or (4) and guidelines for action under sub-section (1) or (5) shall be approved by the National Environment Board.

The Fund Committee may appoint a subcommittee to consider or carry out any matter as may be entrusted by the Fund Committee.

Section 26 Section 16, section 17 and section 20 shall apply *mutatis mutandis* to the performance of functions of the Fund Committee and the subcommittee appointed by the Fund Committee.

Section 27 In consideration to allocate money from the Fund for the purpose of section 23 (1), the Fund Committee shall give first priority to the request for allocation under the Changwat Action Plan for environmental quality management according to section 39 to construct or operate the wastewater treatment plant or waste disposal facility, for which certain amount of government budget has been earmarked or revenues of the local administration have been allocated as additional contributions to the Fund allocation.

The proportion between the government budget or contributions from the local revenues and the Fund allocation to be determined by the Fund Committee according to the first paragraph shall be determined in accordance with the rules laid down by the National Environment Board.

Section 28 The Fund allocation as loans to the local administration, state enterprise or private person pursuant to section 23 (2) or (3) shall be determined by the Fund Committee in accordance with the rules and conditions stipulated by the National Environment Board.

in order to encourage compliance with this Act, the Fund Committee may, with the approval of the National Environment Board, allocate from the Fund as an exceptional long-term loan to any local administration, state enterprise, or private person and may determine to reduce the interest rates or make exemption to the payment of such interest as deemed appropriate.

Section 29 The Comptroller-General of the Comptroller-General's Department, Ministry of Finance, shall be the Fund manager in relation to such portion of the Fund to be allocated as grants to the government agency or the local administration for investment in and operation of the central facility for wastewater treatment or waste disposal according to section 23 (1) and those portions of the Fund to be allocated for the purposes other than those provided by section 23 (2) and (3).

Section 30 The Fund Committee may authorize an appropriate financial institution owned by the State or the Industrial Financing Corporation of Thailand to be the Fund manager in relation to such portion of the Fund that will be allocated as loans to the local administration, state enterprise or private person pursuant to section 23 (2) or (3). In carrying out the management of Fund according to the First paragraph, the Fund manager has the duty to study and analyze the investment and technical feasibility of the project and shall be empowered to enter the loan agreement on behalf of the Fund Committee in the capacity as the lender, to keep and disburse moneys to the borrowers from this portion of the Fund in accordance with the terms and conditions of the loan agreement, to pursue, demand and receive repayments and interest from the borrowers in order to pay back to the Fund, and shall be empowered to lay down rules and procedures, with the approval of the Fund Committee, for such matters. Under the loan agreement to be entered into according to the second paragraph, there must be a condition stipulated as an essential element of the agreement that the borrower shall have the duty to make use of the loan specifically for the purpose of meeting the requirements with which the borrower has the legal duty to comply under this Act or other related laws.

Section 31 The moneys received into the Fund and kept by the Comptroller-General's Department, Ministry of Finance, shall be managed by deposit in saving or fixed accounts with State owned financial institutions in order to earn accrued interest.

All moneys earned by the Fund according to section 22 shall be paid into its account for the purpose of uses in the activities indicated in section 23 and shall not be remitted to the Treasury as revenues of the Government.

Chapter III Environmental Protection

Part 1 Environmental Quality Standards

Section 32 For the purpose of environmental quality enhancement and conservation, the National Environment Board shall have the power to prescribe by notifications published in the Government Gazette the following environmental quality standards :

- (1) Water quality standards for river, canal, swamp, marsh, lake, reservoir and other public inland water sources according to their use classifications in each river basin or water catchment.
- (2) Water quality standards for coastal and estuarine water areas.
- (3) Groundwater quality standards.
- (4) Atmospheric ambient air standards.
- (5) Ambient standards for noise and vibration.
- (6) Environmental quality standards for other matters.

The prescription of environmental quality standards pursuant to the foregoing paragraph shall be based upon scientific knowledge, principles, criteria and evidence related thereto and shall also take into account the practicability of such standards from the viewpoint of economic, social and technological considerations.

Section 33 The National Environment Board shall, if deemed reasonable, have the power to prescribe special standards, which are higher than the environmental quality standards prescribed pursuant to section 31, for the protection of areas designated as conservation or environmentally protected area according to section 42, or areas designated according to section 44, or pollution control areas designated pursuant to section 58.

Section 34 The National Environment Board shall have the power to make appropriate modifications and improvements to the prescribed environmental quality standards in the light of scientific and technological progresses and changes in economic and social conditions of the country.

Part 2 Environmental Quality Management Planning

Section 35 The Minister shall, with the approval of the National Environment Board, formulate an action plan called "Environmental Quality Management Plan" for implementation of the national policy and plan for enhancement and conservation of environmental quality determined by virtue of section 13 (1).

The Environmental Quality Management Plan pursuant to the first paragraph shall be published in the Government Gazette.

It shall be the duty of all government agencies concerned to take actions within their powers and functions that are necessary for effective implementation of the Environmental Quality Management Plan and in order to ensure that actions are taken to achieve the objectives and goals as prescribed, it shall be the duty of the Ministry of Science, Technology and Environment to give advice to government agencies and state enterprises which are concerned with the formulation of work plans or the taking of any actions with a view to implementing the Environmental Quality Management Plan.

Section 36 The Environmental Quality Management Plan pursuant to section 35 may be a short, intermediate or long-term plan, as appropriate, and should contain work plan and guidance for action in the following matters :

- (1) Management of air, water and environmental quality in any other area of concerns.
- (2) Pollution control from point sources.
- (3) Conservation of natural environment, natural resources or cultural environment pertaining to aesthetic values.
- (4) Estimation of financing to be appropriated from government budget and allocated from the Fund which is necessary for implementation of the Plan.
- (5) Scheme for institutional arrangements and administrative orders by which co-operation and co-ordination among government agencies concerned and between the

public service and private sector could be further promoted and strengthened, including the determination of a manpower allocation scheme which is required for implementation of the Plan.

(6) Enactment of laws and issuance of regulations, local ordinances, rules, orders and notifications necessary for implementation of the Plan.

(7) Scheme for inspection, monitoring and assessment of environmental quality by which the results of implementation of the Plan and enforcement of law related thereto can be evaluated objectively.

Section 37 After the Environmental Quality Management Plan has been published in the Government Gazette, it shall be the duty of the Governor of the Changwat, in which there is a locality designated as environmentally protected area according to section 43, or as pollution control area according to section 59, to formulate an action plan for environmental quality management at Changwat level and submit it to the National Environment Board for approval within one hundred and twenty days from the date on which the Governor of that Changwat is directed by the National Environment Board to prepare the Changwat action plan for environmental quality management. If, however, there is a reasonable ground, the said duration may be extended as appropriate by the National Environment Board.

In preparing a Changwat Action Plan for the pollution control area according to section 59, the Governor shall incorporate into it the action plan for mitigation and elimination of pollution prepared by the local authority pursuant to section 60 and the local action plan shall form an integral part of the Changwat Action Plan.

In case there is any Changwat, in which no locality is designated as an environmentally protected area according to section 43, or as pollution control area according to section 59, that is nevertheless desirous to enhance and conserve the environmental quality within the limits of its territorial jurisdiction, the Governor of that Changwat may prepare a Changwat Action Plan, within the framework of and in conformity with the requirements of the Environmental Quality Management Plan, and submit it to the National Environment Board for approval.

Section 38 The Changwat Action Plan to be submitted to the National Environment Board shall be an action plan which proposes a system of integrated management of environmental quality in conformity with the guidance specified in the Environmental Quality Management Plan, taking into account the severity of the problems and economic, social and environmental conditions of that Changwat, and should address and contain essential elements in the following matters

(1) Plan for control of pollution from point sources.

(2) Plan for procurement and acquisition of land, materials, equipment, tools and appliances which are essential for the construction, installation, improvement, modification, repair, maintenance and operation of central wastewater treatment plants or central waste disposal facilities belonging to government agency or local administration concerned.

(3) Plan for collection of taxes, duties and service fees for operation and maintenance of central wastewater treatment plants or central waste disposal facilities referred to in sub-section (2) above.

(4) Plan for inspection, monitoring and control of wastewaters and other waste matters which are discharged from point sources of pollution.

(5) Law enforcement plan for the prevention and suppression of violation or infringement of laws and regulations pertaining to pollution control and conservation of nature, natural resources and cultural environment pertaining to aesthetic values.

Section 39 The Changwat Action Plan for environmental quality management to be given first priority for the consideration of the National Environment Board must propose an estimate of budgetary appropriation and allocation from the Fund for the construction or procurement for the acquisition of a central wastewater treatment plant or a central waste disposal facility pursuant to section 38 (2). In case any Changwat is not ready to take steps for the procurement and acquisition of the central wastewater treatment plant or the central waste disposal facility, it may instead propose a plan to promote private investment in the construction and operation of wastewater treatment or waste disposal facilities in order to make available of such services within its jurisdiction. The Changwat Action Plan to be prepared according to the first paragraph with a request for budgetary appropriation and allocation from the Fund shall be accompanied by drawings, plans, specifications and an estimated price of the project for construction, installation, improvement, modification, repair, maintenance as well as the process and method for operation of the proposed central wastewater treatment plant or central waste disposal facility. For the purpose of approving the Changwat Action Plan with a request for budgetary appropriation in accordance with the first paragraph, the Office of Environmental Policy and Planning shall be responsible for the gathering and analysis of the Changwat Action Plans for environmental quality management in order to make a proposal for annual budgets of the Office to be earmarked specifically for this purpose.

Section 40 In case the management of environmental quality in any matters will have to be carried out in an area adjoining the territorial jurisdictions of two or more provinces due to the geographical conditions or the characteristics of the natural ecosystems of that area, or for the purpose of a sound, systematic and proper management in accordance with the principle of integrated management of environmental quality and natural resources, the Governors of the relevant provinces shall jointly prepare the action plan mandatory required by section 37.

Section 41 In case any Changwat, which is mandatory required to prepare the action plan according to section 37, fails or is incapable to evolve such a plan, or has prepared and submitted the plan as required but failed to get the approval of the National Environment Board for any reason, the National Environment Board shall consider the nature of the problems encountered by that Changwat and evaluate whether its environmental quality is adversely affected to such an extent that any action is warrant to rectify the situation. If action is deemed necessary, the National Environment Board shall propose to the Prime Minister to issue an order directing the Ministry of Science, Technology and Environment to prepare the Changwat Action Plan on behalf of the Changwat in question.

Part 3

Conservation and Environmentally Protected Areas

Section 42 Protection and management of areas within the limits of national parks and wildlife reserves shall be in accordance with the Environmental Quality Management Plan effective by virtue of section 35 and governed by the laws related thereto.

Section 43 In case it appears that any area is characterized as watershed area, or characterized by unique natural ecosystems which are different from other areas in general, or naturally composed of fragile ecosystems which are sensitive and vulnerable to destruction or impacts of human activities, or worthy of being conserved due to its natural or aesthetic values or amenities, and such area is yet to be designated as a conservation area, the Minister shall, with the advice of the National

Environment Board, be empowered to issue ministerial regulation designating such area as an environmentally protected area.

Section 44 In issuing the ministerial regulation pursuant to section 43, any one or more of the following protective measures shall be prescribed thereunder

(1) Land use prescriptions for preserving the natural conditions of such area or for preventing its natural ecosystems or its aesthetic values or amenities from being adversely impacted.

(2) Prohibition of any acts or activities that may be harmful or adversely affect or change the pristine state of the ecosystems of such area.

(3) Specifying types and sizes of projects or activities undertaken by government agencies, state enterprises or private entities, to be constructed or operated in such area, which shall have the legal duty to submit reports of environmental impact assessment.

(4) Determination of management approach and method specific to the management of such area including the scope of functions and responsibilities of relevant government agencies for the purpose of co-operation and co-ordination that are conducive to efficient performance of work towards the preservation of natural conditions or ecosystems or aesthetic values and amenities in such area.

(5) Prescriptions of any other protective measures which are deemed proper and suitable to the conditions of such area.

Section 45 In any area, despite having been designated as a conservation area, a master town and country plan area, a specific town and country plan area, a building control area, an industrial estate area pursuant to the governing laws related thereto, or designated as a pollution control area pursuant to this Act, but which nevertheless appears to have been adversely affected by environmental problems which assume a critical proportion to such an extent that an immediate action has become imperative and yet no action is taken by government agencies concerned to rectify the situation due to a lack of clear legal authorization or otherwise failure to do so, the Minister shall, with the approval of the National Environment Board, propose for a cabinet authorization to take any one or several protective measures provided by section 44, as necessary and appropriate, in order to control and solve the problems in such area.

When cabinet authorization is obtained as provided in the first paragraph, the Minister shall, by notification published in the Government Gazette, determine the limits of such area and prescribe in detail the protective measures and the duration for which such measures shall be effectively taken therein.

With the approval of the National Environment Board and the cabinet, the duration of effectiveness specified according to the second paragraph may be extended by notification published in the Government Gazette.

Part 4 Environmental Impact Assessment

Section 46 For the purpose of environmental quality promotion and conservation, the Minister shall, with the approval of the National Environment Board, have the power to specify, by notification published in the Government Gazette types and sizes of projects or activities, likely to have environmental impact, of any government agency, state enterprise or private person, which are required to prepare reports on environmental assessment for submission to seek approval in accordance with section 47, section 48 and section 49. In the notification issued according to the first paragraph, procedures, rules, methods and guidelines shall be laid down for the preparation of environmental impact assessment report for each type and size of project or activity, including related documents that are required to be filed together

with the report. In case there has been an environmental impact assessment concerning project or activity of any particular type or size, or site selection for such project or activity in any particular area and such assessment can be used as a standard assessment applicable to the project or activity of the same type or size or to the site selection of such project or activity in the area of similar nature, the Minister may, with the approval of the National Environment Board, issue a notification in the Government Gazette exempting such project or activity of the same or similar nature from the requirement of environmental impact assessment, provided that the proponent of such project or activity shall express its consent to comply with various measures prescribed in the environmental impact assessment report which is applicable as the standard for assessment of such project or activity in accordance with the rules and methods specified by the Minister.

Section 47 In case the project or activity which is required to prepare the environmental impact assessment according to section 46 is the project or activity of a government agency or of a state enterprise or to be jointly undertaken with private enterprise which is required the approval of the cabinet in accordance with official rules and regulations, the government agency or state enterprise responsible for such project or activity shall have the duty to prepare the environmental impact assessment report at the stage of conducting a feasibility study for such project, such report shall be filed with the National Environment Board for its review and comments and then submitted to the cabinet for consideration.

In considering to give approval to the environmental impact assessment report filed according to the first paragraph, the cabinet may as well request any person or institution, being an expert or specialized in environmental impact assessment, to study and submit report or opinion for its consideration thereof.

For project or activity of government agency or state enterprise which is not required to be approved by the cabinet according to the first paragraph, the government agency or state enterprise responsible for such project or activity shall prepare and file the environmental impact assessment report in order to obtain approval prior to the initiation of such project or activity in accordance with the rules and procedures as provided by section 48 and 49.

Section 48 in case the project or activity which is required by section 46 to prepare the environmental impact assessment report is the project or activity which is required by law to obtain permission prior to construction or operation, the person applying for the permission shall have the duty to file the environmental impact assessment report with the permitting authority under such law and with the Office of Environmental Policy and Planning simultaneously. The report to be filed as aforesaid may be made in the form of an initial environmental examination (I.E.E.) in accordance with the rules and procedures determined by the Minister pursuant to section 46, second paragraph. The official who is legally authorized to grant permission shall withhold the granting of permission for the project or activity referred to in the first paragraph until having been notified by the Office of Environmental Policy and Planning of the result of consideration pertaining to the review of the environmental impact assessment report in accordance with section 49. The Office of Environmental Policy and Planning shall examine the environmental impact assessment report and related documents filed therewith. If it is found that the report as filed is not correctly made in accordance with the rules and procedures specified by virtue of section 46, second paragraph, or the accompanied documents and data are incomplete, the Office of Environmental Policy and Planning shall notify the person applying for permission who files the report within fifteen days from the date of receiving such report.

In case the Office of Environmental Policy and Planning finds that the environmental impact assessment report together with related documents as filed is duly made and completed with the data as required, or has been duly amended or modified in accordance with the foregoing third paragraph, it shall review and make preliminary comments on the report within thirty days from the date of receiving such report in order that the report together with the preliminary comments shall be referred to the committee of experts for further consideration.

The appointment of the committee of experts according to the foregoing fourth paragraph shall be in accordance with the rules and procedures determined by the National Environment Board. The committee shall be composed of expert members who are qualified or specialized in various fields of related disciplines and the authority legally competent to grant permission for the given project or activity under review, or its representative, shall be included in its membership.

Section 49 The review and consideration by the committee of experts according to section 48 shall be carried out within forty-five days from the date of receiving the environmental impact assessment report from the Office of Environmental Policy and Planning. If the committee of experts fails to conclude its review and consideration within the said period, the report shall be deemed to have been approved by it.

In case the committee of experts approves or is deemed to have given approval to the report, the official legally empowered to grant permission shall accordingly order that the permission be granted to the person who applies for it.

In case approval of the report is denied by the committee of experts, the permitting authority shall withhold the granting of permission to the person applying for it until such person will resubmit the environmental impact assessment report that has been amended or entirely redone in conformity with the guidelines and detailed requirements determined by the order of the committee of experts.

When such person has resubmitted the environmental impact assessment report that has been amended or entirely redone, the committee of experts shall review and conclude its consideration within thirty days from the date of receiving the resubmitted report. If the committee of experts fails to conclude its review and consideration within the said period, it shall be deemed that the committee has approved the report and the permitting authority shall accordingly grant permission to the person who applies for it.

In case it is deemed reasonable the Minister may issue notification in the Government Gazette requiring that the project or activity of the type and size specified by the notification issued by virtue of section 46 also file the environmental impact assessment report when the application is made for renewal of permission for such project or activity in accordance with the same procedures as applicable to the application for the permission.

Section 50 For the purpose of review and consideration of the environmental impact assessment report pursuant to section 48 and section 49 and site inspection is deemed appropriate, the committee of experts or the competent official assigned by the committee shall be authorized to inspect the site of the project or activity identified in the report for which approval thereof is sought.

When the committee of experts has approved the environmental impact assessment report pursuant to section 49, the official who is legally competent to grant permission or the renewal of permission shall stipulate as the conditions of permission or renewal thereof all the mitigation measures proposed in the environment impact assessment report and all such conditions shall be deemed the conditions prescribed by virtue of the governing laws on the subject matter.

Section 51 For the purpose of compliance with section 47 and section 48, the Minister may, with the approval of the National Environment Board, require that the environmental impact assessment report as required by section 46 be prepared or certified by the person who is licensed to be a specialist in environmental impact assessment.

Application and issuance of license, qualifications of specialists who will be eligible to prepare environmental impact assessment reports, control of the licensee's performance, renewal of license, issuance of certificate in lieu of the license, suspension or revocation of the license and fee payments for the application and issuance of license shall be in accordance with the rules, procedures and conditions stipulated by ministerial regulation.

Chapter IV Pollution Control

Part 1 Pollution Control Committee

Section 52 For the purpose of pollution control under this Act, there shall be a committee called the "Pollution Control Committee" (PCC) which consists of the Permanent Secretary of the Ministry of Science, Technology and Environment as the Chairman, the Director-General of the Department of Local Administration, the Director-General of the Police Department, the Director-General of the Department of Land Transport, the Director-General of the Harbor Department, the Director-General of the Department of Public Works, the Director-General of the Department of Mineral Resources, the Director-General of the Department of Industrial Works ' the Director-General of the Health Department, the Director-General of the Department of Agriculture, the Director-General of the Department of Environmental Quality Promotion, the Secretary-General of the Office of Environmental Policy and Planning, the Permanent Secretary for the Bangkok Metropolitan Administration and not more than five qualified persons appointed by the National Environmental Board as members and the Director-General of the Department of Pollution Control as member and secretary.

Section 14 and section 15 shall apply *mutatis mutandis* to the holding office of the qualified members in the Pollution Control Committee.

Section 53 The Pollution Control Committee shall have the power and duty as follows

1. To submit an action plan for prevention or remedy of pollution hazards or contamination to the National Environment Board.
2. To give opinion and recommend the National Environment Board on proposed amendments to or improvement of any laws concerning the control, prevention, reduction or eradication of pollution.
3. To propose incentive measures regarding taxation and private, investment promotion in relation to pollution control and promotion and conservation of environmental quality to the National Environment Board.
4. To recommend the National Environment Board on the determination of service fee rates for the central waste water treatment or central waste disposal services of the government.
5. To give advice to the Minister on the setting of emission or effluent standards under section 55.
6. To give advice to the Minister concerning the types of point sources of pollution that will be required to comply with section 68 and section 69.
7. To make recommendation on the issuing of ministerial regulations specifying the types and categories of hazardous wastes under section 79.

8. To coordinate government agencies, state enterprises and the private sector in their actions to control, prevent, mitigate or eradicate pollution.
9. To prepare and submit the report on pollution situation to the National Environment Board once a year.
10. To consider and resolve on the challenge to the order of the pollution control official under this Act.
11. To perform other functions designated by this Act or other law to be the power and duty of the Pollution Control Committee.
12. To carry out other matters assigned by the National Environment Board.

The Pollution Control Committee may appoint a subcommittee to consider or carry out any matter as may be assigned by the Pollution Control Committee.

Section 54 Section 16, section 17 and section 20 shall apply *mutatis mutandis* to the performance of functions of the Pollution Control Committee and subcommittee.

Part 2 Emission or Effluent Standards

Section 55 The Minister shall, with the advice of the Pollution Control Committee and the approval of the National Environment Board, have the power to publish notification in the Government Gazette prescribing emission or effluent standards for the control of wastewater discharge, polluted air emissions, or discharge of other wastes or pollutants from point sources into the environment, in order to meet the environmental quality standards set by virtue of this Act for the conservation of national environmental quality.

Section 56 In case there have been standards prescribed by virtue of the other laws concerning wastewater discharges, polluted air emissions, or discharge of other wastes or pollutants from point sources of pollution into the environment and such standards are no less stringent than the emission or effluent standards set by the Minister by virtue of section 55, such standards shall continue to be effective by virtue of the laws related thereto. If however, such standards are less stringent than the emission or effluent standards set by the Minister pursuant to section 55, the government agencies empowered by such laws shall amend such standards in conformity with the emission or effluent standards under this Act. If there is any obstacle preventing from doing so, the National Environment Board shall resolve on such matter and the government agencies concerned shall act in accordance with such resolution.

Section 57 In case any government agency is empowered by the other law to prescribe emission or effluent standards in any matter, but that government agency fails to exercise its power, the Minister shall, with the recommendation of the Pollution Control Committee and with the approval of the National Environment Board, publish notification in the Government Gazette prescribing the emission or effluent standards in question and such standards shall be deemed to have been set by the governing law on such matter.

Section 58 If it is deemed reasonable, the Changwat Governor shall have the power to publish notification in the Government Gazette prescribing a special set of emission or effluent standards applicable to the pollution control area designated by section 59, higher than the standards set pursuant to section 55 or the standards set by virtue of other law which remain in force according to section 56.

Part 3 Pollution Control Area

Section 59 In case it appears that any locality is affected by pollution problems and there is a tendency that such problems may be aggravated to cause health hazards to the public or adverse impact on the environmental quality, the National Environment Board shall have power to publish notification in the Government Gazette designating such locality as a pollution control area in order to control, reduce and eliminate pollution.

Section 60 For the purpose of the Changwat Action Plan for environmental quality management to be prepared according to section 37, the local official in the locality designated as the pollution control area pursuant to section 59, shall prepare and submit an action plan for reduction and eradication of pollution in such area to the Changwat Governor in order to incorporate such plan into the Changwat Action Plan for environment quality management.

In preparing the action plan for reduction and eradication of pollution, steps shall be taken as follows:

(1) to survey and collect data concerning point sources of pollution located within the limits of that pollution control area.

(2) to make an inventory showing the number, type and size of point sources of pollution under survey and collection of data according to (1) above.

(3) to study, analyze and assess the state of pollution, as well as the scope, nature, severity of the problem and impacts on environmental quality in order to specify suitable and necessary measures for mitigation and eradication of pollution in that pollution control area.

The pollution control official shall give advice and assistance to the local official necessary for the preparation of the action plan to reduce and eradicate pollution according to the first and second paragraphs.

Section 61 The action plan for reduction and eradication of pollution in the pollution control area under section 60 shall propose the estimation and request for government budget and Fund allocations for construction or operation of the central wastewater treatment plant or the central waste disposal facility necessary to reduce and eradicate pollution in that pollution control area.

Section 62 In case it is necessary to acquire a piece of land to be used as the site of the central wastewater treatment or central waste disposal facility for any pollution control area but State owned land is not available, steps shall be taken to select and acquire land for the siting purpose. If there are expenses, the estimate and request for government budget and Fund allocation shall be made in the Changwat Action Plan.

If it is unable to proceed under the first paragraph, suitable land shall be selected and proposed to the Minister in order to take steps to expropriate such land in accordance with the law on expropriation of immovable property.

Section 63 The Changwat Governor shall supervise and oversee the local official's actions under section 59. If no action is taken by the local official within a reasonable time, the Changwat Governor shall have the power to take action on behalf of the local authority upon notification to such local authority and the National Environment Board.

Part 4 Air and Noise Pollution

Section 64 Usable vehicle shall conform to the emission standards prescribed for such vehicle pursuant to section 55.

Section 65 If it is found that the use of any vehicle is in violation of section 64, the competent official shall have the power to prohibit the use of such vehicle

permanently or until it will have been modified or improved to meet the emission standard requirements prescribed pursuant to section 55.

Section 66 In issuing the order prohibiting to use of vehicle according to section 65, the competent official shall make the sign clearly shown by the words "Use Prohibited Permanently" or "Use Prohibited temporarily" or any other sign, known and understood by the general public to have the same meaning, on any part of such vehicle. The making or removal of the sign under the first paragraph, or the use of vehicle while the said sign is on, shall be in accordance with the rules, methods and conditions specified in the ministerial regulation.

Section 67 In performing his duty under section 65, the competent official has the power to stop and inspect the vehicle, enter into the vehicle or to do any act necessary to check and test the engine and equipment of such vehicle.

Section 68 The Minister shall, with the advice of the Pollution Control Committee, have the power to publish notification in the Government Gazette specifying the types of point sources of pollution that shall be controlled in regard to the emission of polluted air, ray, or other pollutants, in the form of smoke, fume, gas, soot, dust, ash, particle or any other form of air pollutant, to the atmosphere, in conformity with the emission standards prescribed under section 55, or standards prescribed by any government agency by virtue of the other law which remain in force according to section 56, or standards set by the Changwat Governor in special case for the pollution control area according to section 58. The owner or possessor of the point source of pollution under the first paragraph has the duty to install or bring into operation an on-site facility for air pollution control, equipment or other instrument as determined by the pollution control official in order to control, dispose, reduce or eliminate pollutants which may affect the air quality, unless such facility, equipment or instrument has already been in place and still in a working condition upon the inspection and test by the pollution control official. For the purpose of this section, the pollution control official may also require that the operation of such facility, equipment or instrument be controlled by the Monitoring Control Operator. The provisions of the first and second paragraphs shall apply *mutatis mutandis* to the point source of pollution which emit or generate noise or vibration in excess of the emission standards set pursuant to section 55, or the standards set by any government agency by virtue the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Part 5 Water Pollution

Section 69 The Minister shall, with the advice of the Pollution Control Committee, have the power to publish notification in the Government Gazette specifying the types of point sources of pollution that shall be controlled in regard to the discharge of wastewaters or wastes into public water sources or into the environment outside the limits of such point sources, in conformity with the effluent standards set pursuant to section 55, or the standards set by any government agency by virtue of the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Section 70 The owner or possessor of the point source of pollution under section 69 has the duty to construct, install or bring into operation an on-site facility for wastewater treatment or waste disposal as determined by the pollution control official. For this purpose, the pollution control official may also require that such owner or possessor commission a Monitoring Control Operator to control the wastewater

treatment or waste disposal facility that shall be constructed, installed or brought into operation accordingly. If any point source of pollution has had an on-site facility for wastewater treatment or waste disposal before the date of notification of the Minister under section 69, the owner or possessor of such point source of pollution shall inform the pollution control official to check the functioning system of the facility. If its capability to treat wastewaters or dispose of wastes fails to meet the applicable standards, the owner or possessor has the duty to modify or improve it in conformity with the pollution control official's directions.

Section 71 In any pollution control area or locality where a central wastewater treatment plant or a central waste disposal facility has been brought into operation by the administration concerned, the owner or possessor of the point source of pollution according to section 70, first paragraph, who has not yet constructed, installed or brought into operation the on-site facility for wastewater treatment or waste disposal according to the prescription of the pollution control official, or may not want to construct or make arrangements for such a system, shall have the duty to send the wastewaters or wastes generated by his activities to the central wastewater treatment plant or central waste disposal facility in the pollution control area or in that locality for treatment or disposal and shall have the duty to pay the service fees at the rates fixed by virtue of this Act or the other related laws.

Section 72 In any pollution control area or locality where the central waste water treatment plant or central waste disposal facility has been brought into operation by the administration concerned, the owner or possessor of any point source of pollution, except those under section 69, shall have the duty to send wastewaters or wastes from his source of pollution to the central waste water treatment plant or the central waste disposal facility in that pollution control area or locality for treatment or disposal and shall have the duty to pay service fees at the rates fixed by virtue of this Act or the other related laws, except such point source of pollution has already had its own wastewater treatment or waste disposal facility which is capable to meet the standards prescribed under this Act.

Section 73 No person shall be employed as a Monitoring Control Operator or as a Service Contractor, who renders for hire the services of wastewater treatment or waste disposal, without obtaining the license from the local official. Application and issuance of license, qualifications of the applicant, control of the licensee's performance, renewal of license, issuance of certificate in lieu of the license, suspension or revocation of the license and fee payments for the application and issuance of license shall be in accordance with the rules, procedures and conditions stipulated by ministerial regulation. The person who has obtained a license to be a Service Contractor shall also be deemed to have obtained a license to be a Monitoring Control Operator. In rendering the services of wastewater treatment or waste disposal by the Service Contractor according to the first paragraph, the service charges shall not exceed the rates fixed by the ministerial regulation.

Section 74 In any pollution control area or locality where the central wastewater treatment or central waste disposal facility of the public service is yet to be put into operation, but there is nonetheless a Service Contractor who is licensed to render such services within that area, the owner or possessor of the point source of pollution according to section 70 and section 71 shall be required to send the wastewaters or wastes from his point source for treatment or disposal by such Service Contractor in accordance with the rules, regulations, methods and conditions prescribed by the local official, with the advice of the pollution control official.

Section 75 In any pollution control area or locality where the central wastewater treatment or central waste disposal facility is yet to be put into service by the government and there is no licensed Service Contractor rendering services therein, the local official may, with the advice of the pollution control official, determine a temporary method necessary for the treatment of wastewaters or disposal of wastes from point sources of pollution under section 70 and section 71 until the central wastewater treatment or central waste disposal facility will have been constructed, installed and put into operation within such pollution control area or locality.

The temporary method for wastewater treatment or waste disposal according to the first paragraph shall mean to include the collection, transport or conveyance of wastewaters or wastes by whatever appropriate means to be treated or disposed by the central wastewater treatment plant or central waste disposal facility of the government in the other area; or to allow the licensed Service Contractor rendering services in the other area to render the same services in that pollution control area or locality temporarily; or to allow such licensed Service Contractor to collect and transport wastewaters or wastes to treat or dispose by his own wastewater treatment or waste disposal facility located outside that pollution control area or locality.

Section 76 Wastewaters treated by either the central wastewaters treatment plant of the government or by the wastewater treatment facility of the Service Contractor must also have the properties which meet the requirements of the effluent standards prescribed by virtue of section 55, or the standards prescribed by virtue of the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Section 77 The government agency or the local authority which makes provision for the services of central wastewater treatment or central waste disposal facilities by using government budget, or revenues of the local authority, and Fund allocations under this Act shall be responsible for the management and control of such facilities. In this respect, the responsible agency or local authority may employ a licensed Service Contractor under this Act to manage and control the operation of such facilities. Regulations, rules and methods for conveyance, collection and transport of wastewaters or wastes from the point sources of pollution to the central wastewater treatment plant or central waste disposal facility as well as prescriptions, prohibitions, restrictions and other conditions for discharging and draining of wastewaters or wastes from factories and other point sources of pollution under section 72 into the systems of central wastewater treatment or central waste disposal facilities shall be prescribed by the ministerial regulation.

Part 6 Other Pollution and Hazardous Waste

Section 78 The collection, transport and other arrangements for the treatment and disposal of garbage and other solid wastes; the prevention and control of pollution from mining both on land and in the sea; the prevention and control of pollution from the exploration and drilling for oil, natural gas and all kinds of hydrocarbon both on land and in the sea; and the prevention and control of pollution resulting or originated from the discharge of oil and the dumping of wastes and other matters from sea-going vessels, tankers, and other types of vessel, shall be in accordance with the governing laws related thereto.

Section 79 In case there is no specific law applicable thereto, the Minister shall, with the advice of the Pollution Control Committee, have the power to issue ministerial regulation specifying the types and categories of hazardous wastes generated from the

production and usage of chemicals or hazardous substances in the production process of industry, agriculture, sanitation and other activities which shall be brought under control. For this purpose, rules, regulations, measures and methods must also be prescribed for the control of collection, storage, safety measures, transportation, import into the Kingdom, export out of the Kingdom, and for proper and technically sound management, treatment and disposal of such hazardous wastes.

Part 7 Monitoring, Inspection and Control

Section 80 The owner or possessor of the point source of pollution, required by virtue of section 68 or section 70, to have his own facility for treatment of polluted air, equipment or instrument for control of the discharge of polluted air or other pollutants or the wastewater treatment or waste disposal facility, shall have the duty to collect statistics and data showing the daily functioning of the said facility or equipment and instrument, and make detailed notes thereof to be kept as recorded evidence at the site of that point source of pollution, and shall submit report summarizing the functioning results of the facility, equipment or instrument to the local official of the locality where such point source is situate at least once a month.

The collection of statistics and data, the making of notes and reports shall be in accordance with the rules, procedures, methods and format specified by ministerial regulation. In case the facility for treatment of polluted air, wastewaters or waste disposal or equipment and instrument indicated in the first paragraph requires a Monitoring Control Operator as determined by the pollution control official, the Monitoring Control Operator shall have the duty to act under the first paragraph on behalf of the owner or possessor.

The Service Contractor licensed to render wastewater treatment or waste disposal services shall have the duty to do the same as the owner or possessor of the point source of pollution is required under the first paragraph.

Section 81 The local official shall gather the reports received according to section 80 and send them to the pollution control official, who has jurisdiction over that locality, on a regular basis at least once a month. In doing so, the local official may make comments for consideration of the pollution control official.

Section 82 In order to perform his functions under this Act, the pollution control official is empowered as follows :

(1) To enter into the building, place and site of the factory or point source of pollution or the site of wastewater treatment or waste disposal facility which belongs to any person, between the sun rise and sun set or during the working hours, to inspect the functioning process of wastewater treatment or waste disposal facility, air pollution control system or equipment and other instrument for the control of polluted air or other pollutants, as well as to examine the notes, statistics or data on the functioning of the said facility, equipment and instrument, or when there is a reasonable suspicion that there is a non-compliance with this Act.

(2) To issue an order in writing directing the owner or possessor, the Monitoring Control Operator, or the licensed Service Contractor rendering the services of wastewater treatment or waste disposal, to correct, change, improve or repair the air pollution control, wastewater treatment or waste disposal facility or other equipment and instrument for the control of polluted air or other pollutants. If however, the point source of pollution is a factory, the official under the law on industrial plants s a be notified to take action within his power and duty. If such official fails to do so, the pollution control official shall have the power to take action in accordance with this Act.

(3) To issue a written order directing the owner or possessor of the point source of pollution which is not a factory to pay penalties as provided under section 90, section 91 or section 92. If the point source of pollution is a factory the official under the law on industrial plants shall be notified to order the owner or possessor of such factory to pay the penalties and, in doing so, such official under the law on industrial plants shall be deemed to be the pollution control official under this Act. If, however, such official fails to issue the penalty order within a reasonable time, the pollution control official shall then have the power to issue the order directing the owner or possessor of such factory to pay the penalties.

(4) To issue a written order directing the Service Contractor licensed to render the services of wastewater treatment or waste disposal to stop or shut down his services, or revoking his license in case such Service Contractor violates or does not comply with this Act, or any ministerial regulation, local ordinance, rule, notification or condition issued or stipulated by virtue of this Act, or does not comply with the order of the pollution control official issued by virtue of this Act.

(5) To issue a written order suspending the Monitoring Control Operator under section 68 or section 70 in case such Monitoring Control Operator violates or does not comply with this Act, or any ministerial regulation, local ordinance, rule, notification, or condition issued or stipulated by virtue of this Act, or does not comply with the order of the pollution control official issued by virtue of this Act.

Section 83 In case it is deemed reasonable in the interest of co-ordination of action among agencies concerned, the pollution control official may:

(1) Recommend the official who has the legal power to control the point source of pollution, to close down its operation, to suspend or revoke the license of its owner or operator, or to bar its use or utilization in any way, especially in connection with the point source of pollution under section 68, section 69 or section 74 which has no intention to treat the polluted air, wastewaters or other wastes and illegally discharges the untreated wastes into the environment outside the limits of its site and premise.

(2) Recommend the local official to take legal action against the owner or possessor of the point source of pollution under section 71 or section 72 in order to coerce him to send wastewaters or wastes to be treated or disposed in accordance with this Act.

(3) Give advice and suggestions to the local official or the government agency concerned in connection with the operation and maintenance of the central wastewater treatment plant or the central waste disposal facility under the responsibility of such local official or government agency.

Section 84 In the performance of duty under this Act, the competent official or the pollution control official must produce his identity card at the request of the person concerned. The identity card of the competent official and pollution control official shall be in such a form as prescribed in the ministerial regulation.

Section 85 The owner or occupier of premises, vehicles or any person concerned shall facilitate the performance of duty under this Act by the competent official or the pollution control official who shall be official under the Penal Code.

Section 86 The performance of duty by the competent official under section 50, first paragraph, or section 65 and the performance of duty by the pollution control official under section 82 (1) shall be done in the presence of the owner or occupier of the premise or vehicles; if such person cannot be found, it shall be done in the presence of at least two other persons requested by the competent official or the pollution control official to attend as witnesses.

Section 87 The owner or possessor of the point source of pollution, the Service Contractor licensed to render services of wastewater treatment or waste disposal, the

Monitoring Control Operator or any other person who is not satisfied with the order of the pollution control official under section 82 (2), (3), (4) or (5), is entitled to challenge such order by petition to the Pollution Control Committee within thirty days from the date of receiving the order of the pollution control official.

If the petitioner does not agree with the decision of the Pollution Control Committee, he shall appeal to the Minister within thirty days from the date of receiving notification of the Pollution Control Committee's decision.

The decision of the Minister shall be final.

Part 8 Service Fee and Penalty

Section 88 In any pollution control area or locality where a central wastewater treatment plant of a central waste disposal facility has been constructed and brought into operation as a public utility service, funded by government budget or revenue of the local administration and money allocated from the Fund as provided in this Act, the National Environment Board shall, with the advice of the Pollution Control Committee, fix the rates of service fee to be applicable within the limits of each pollution control area or locality, being the site of and served by the operation of such facility. The service fee rates fixed according to the foregoing first paragraph shall be notified and published in the Government Gazette.

Section 89 The rates of service fee fixed according to section 88 for treatment of wastewaters or for disposal of wastes emanated from point sources pursuant to section 71 and section 72 may be varied as appropriate.

The owner or possessor of the point source of pollution governed by the provision of section 72, in the category of domestic household, that can be classified as a small-scale user is entitled to be exempted from the payment of service fees in accordance with the rules and conditions stipulated by the National Environment Board, with the advice of the Pollution Control Committee.

Section 90 Any owner or possessor of point source of pollution who avowedly refrains from sending wastewaters or wastes to the central wastewater treatment plant or the central waste disposal facility as required by section 71 or section 72 and illegally discharges such wastewaters or wastes into the environment outside the limits of the site of the point source owned or possessed by him, or does send the wastewaters or wastes to the central wastewater treatment plant or the central waste disposal facility of the public service for treatment but fails or refuses to make payment for the service fees without being entitled to the exemption as provided by section 89, second paragraph, shall be liable to pay as a penalty four times as much the amount of service fee that he is liable to pay at the rate fixed in accordance with section 88 until the provision of this Act is observed by him.

Section 91 Any owner or possessor of the point source of pollution, required by section 70 to have an on-site facility for wastewater treatment or waste disposal, who illegally discharges wastewaters or wastes into the central wastewater treatment plant or the central waste disposal facility of the public service, shall be liable to pay as a daily penalty four times as much the amount of daily expenses for the normal operation of his on-site facility for wastewater treatment or waste disposal throughout the duration of such illegal discharge and shall also be liable to pay damages if such illegal discharge has caused any damage or defecation to the central wastewater treatment plant or the central waste disposal facility of the public service.

Section 92 Any owner or possessor of the point source of pollution subject to the requirements of section 68 or section 70, who refrains from using his on-site facilities or equipment for the control of air pollution, noise pollution and vibrations, or refrains

from operating his on-site facilities for the treatment of wastewaters or disposal of wastes and illegally discharges such untreated wastewaters or wastes into the environment outside the limits of the site of the point source of pollution, shall be liable to pay as a daily penalty four time as much the amount of daily expenses for the normal operation of his facilities, equipment or process for wastewater treatment or waste disposal throughout the duration of such illegal discharge.

Section 93 The local authority or the competent official of the government agency responsible for the operation of the public wastewater treatment plant or waste disposal facility shall have the power and duty to collect service fees, penalties and claim for damages as provided in this Part, particularly in connection with the operation of the central wastewater treatment plant or the central waste disposal facility of the public service which is made available by such local authority or government agency. The service fees and penalties collectable in accordance with the foregoing first paragraph shall be exempted from being remitted to the Treasury as government revenues, but shall be deducted and remitted to the Fund at the ratio specified by the Fund Committee, whereas the balance therefrom shall be used as expenditures for operation and maintenance of the central wastewater treatment plant or the central waste disposal facility of the local authority or government agency which is responsible to collect such service fees and penalties.

Chapter V Promotional Measures

Section 94 The owner or possessor of any point source of pollution, who has the duty according to this Act or other related laws to install an on-site facility for treatment of polluted air or wastewaters or for disposal of any other wastes, including the procurement of equipment, instrument, tools, appliances or materials necessary for control of pollution from such point source, or the Service Contractor licensed pursuant to this Act, is entitled to request for promotional supports and assistance from the government service in the following matters :

(1) Request for assistance regarding import duties for the import into the Kingdom of necessary machinery, equipment, instrument, tools, appliances or materials which are not available in the Kingdom.

(2) Application for permission to bring foreign experts or specialists into the country to carry out works concerning the installation, monitoring, control or operation of air pollution control systems, wastewater treatment works or waste disposal facilities in case qualified persons within the Kingdom are not available for recruitment and commissioning to supervise and control machinery, equipment, instrument or tools imported into the Kingdom pursuant to sub-section (1), including application for exemption of income tax that will incur from the performance of work as a supervisor of such person within the Kingdom.

The owner or possessor of the point source of pollution who has no legal duty as referred to in the foregoing first paragraph, but nonetheless wishes to install an on-site facility with his own equipment, instrument, tools or appliances for air pollution control, wastewater treatment or for disposal of other wastes emanated from his activities or business undertakings, is also entitled to request for promotional supports and assistance from the government service in accordance with the foregoing first paragraph.

Section 95 The request for promotional supports and assistance according to section 94 shall be made to the National Environment Board in accordance with the rules, procedures, methods and formats prescribed by ministerial regulation.

The National Environment Board shall consider and proceed with the request for promotional supports and assistance according to the foregoing first paragraph as it sees fit, taking into account the economic, financial and investment necessities of each individual applicant. In case it is considered appropriate to give assistance to the applicant, the National Environment Board shall recommend the government agencies concerned to act within their powers and functions to render promotional supports and assistance to the applicant accordingly.

Chapter VI Civil Liability

Section 96 If leakage or contamination caused by or originated from any point source of pollution is the cause of death, bodily harm or health injury of any person or has caused damage in any manner to the property of any private person or of the State, the owner or possessor of such point source shall be liable to pay compensation or damages therefor, regardless of whether such leakage or contamination is the result of a willful or negligent act of the owner or possessor thereof, except in case it can be proved that such pollution leakage or contamination is the result of

(1) Force majeure or war.

(2) An act done in compliance with the order of the Government or State authorities.

(3) An act or omission of the person who sustains injury or damage, or of any third party who is directly or indirectly responsible for the leakage or contamination.

The compensation or damages to which the owner or possessor of the point source of pollution shall be liable according to the foregoing first paragraph shall mean to include all the expenses actually incurred by the government service for the clean-up of pollution arisen from such incident of leakage or contamination.

Section 97 Any person who commits an unlawful act or omission by whatever means resulting in the destruction, loss or damage to natural resources owned by the State or belonging to the public domain shall be liable to make compensation to the State representing the total value of natural resources so destroyed, lost or damaged by such an unlawful act or omission.

Chapter VII Penal Provisions

Section 98 Any person who violates or refuses to observe the order issued by virtue of section 8 or obstructs any act done in compliance with such order shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both. In case the person who violates or refuses to observe the order or obstructs any act done in compliance with such order is the person who has caused danger or damage arisen from pollution, such person shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 99 Any person who illegally encroaches upon, occupies, or enters into public land to act in any manner which results in the destruction, loss or damage to natural resources or treasures worthy of being conserved, or causes the occurrence of pollution having impact on the environment within the limits of environmentally protected area designated by virtue of section 43 shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 100 Any person who violates or refrains from observing the restrictions stipulated by ministerial regulation issued according to section 44 or by notification given by the Minister according to section 45 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 101 Any person who spreads or disseminates false information about the danger from any point source of pollution with the intention to destroy its reputation or to undermine public trust on the lawful operation of its business or activity shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

If the spread or dissemination of information according to the foregoing first paragraph is done by means of publication, announcement, advertisement or reports through newspaper, radio, television or other forms of mass media, the person who commits such act shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 102 Any person who violates the order of competent official forbidding the use of vehicle according to section 65 shall be punished by fine not exceeding five thousand baht.

Section 103 Any person who refuses to observe the order given by competent official according to section 67 shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht, or both.

Section 104 Any owner or possessor of the point source of pollution who refrains from observing the provision of section 71, or any person who refrains from observing the provision of section 72, or the rules laid down by the local authority by virtue of section 74 or section 75, first paragraph, or the ministerial regulation issued by virtue of section 80 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 105 Any person who renders services as a Monitoring Control Operator or as a Service Contractor for wastewater treatment or waste disposal without the license granted according to section 73 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 106 Any owner or possessor of the point source of pollution or any Monitoring Control Operator or any Service Contractor rendering the services of wastewater treatment or waste disposal, who refrains from collecting statistics or data or from making notes or reports as required by Section 80 shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht, or both.

Section 107 Any Monitoring Control Operator or Service Contractor having the duty to make notes or reports according to this Act, who intentionally makes such notes or reports showing false

Information or statements shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 108 Any person who obstructs or refuses to comply with the order of the pollution control official given in the performance of his duty according to Section 82 (2) shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht, or both.

Section 109 Any Service Contractor rendering services for wastewater treatment or waste disposal ordered by the pollution control official to stop or close down his services pursuant to Section 82 (5), or any Monitoring Control Operator whose license has been revoked by the order of the pollution control official pursuant to Section 82 (6), who violates or refuses to comply with such order of the pollution control official or continues to carry on his service in violation of such order shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 110 Any owner or possessor of the point source of pollution who employs the person, whose license to be a Monitoring Control Operator has been revoked, to supervise and monitor the operation of air pollution control, wastewater treatment or waste disposal facility that he has the duty install and operate according to this Act, shall be punished by fine not exceeding fifty thousand baht.

Section 111 In case the offender who is liable to be punished according to this Act is a juristic person, the directors or managers of such juristic person, or any person who is responsible for the business operation of such juristic person, shall also be punishable by the same penalties prescribed by law for such offence, unless it can be proved that they have no part to play in the commission of such offence.

Interim Provisions

Section 112 In the period during which the National Environment Board is yet to be appointed in accordance with section 12 of this Act, the National Environment Board appointed prior to the date of effectiveness of this Act shall continue to hold office in order to perform its function until the new Board shall be appointed and take over the office.

Section 113 All ministerial regulations, rules, procedures, notifications or orders, issued by, virtue of the Enhancement and Conservation of National Environmental Quality Act, B.E. 2518 which remain in force on the date of effectiveness of this Act, shall continue to be effective, insofar as they are not in conflict with or contrary to this Act, unless and until ministerial regulations, rules, procedures, notifications or orders will have been issued in accordance with this Act.

Section 114 The person, who has been holding a license as an eligible person to prepare reports concerning the study and measures for the prevention of and remedy for the adverse effect on environmental quality by virtue of the Enhancement and Conservation of National Environmental Quality Act, B.E. 2518, shall continue to be eligible to prepare the environmental impact assessment report provided by this Act, until such person is required by the Minister to apply for license in accordance with this Act.

Section 115 For all the reports concerning the study and measures for the prevention of and remedy for the adverse effect on environmental quality required for any project or activity pursuant to the Enhancement and Conservation of the National Environmental Quality Act, B.E. 2518, that have been filed prior to the date on which this Act shall come into effect and still pending review by the Office of National Environment Board, the review and approval of such reports shall be further proceeded with in accordance with the rules and procedures laid down by virtue of the Enhancement and Conservation of National Environmental Quality Act, B.E. 2518. For this purpose, the power and duty of the Office of National Environment Board in become the power and duty of the Office of Environmental Policy and Planning.

Countersigned by:
Anand Panyarachun

**APPENDIX 7: LIST OF THAILAND'S MAJOR INTERNATIONAL
AGREEMENT CONCERNED WITH ENVIRONMENT
ISSUES**

- International Conservation for the Prevention of Pollution of the Sea by Oil, London, 1954 (as amended on 11 April 1962 and 21 October 1969)
- Agreement Concerning Cooperation in Marine Fishing, Warsaw, 1962
- International Conservation on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Brussels, 1971
- Convention Concerning the Protection of Workers Against Occupational Hazards in the Working Environment Due to Air Pollution, Noise, Geneva, 1977
- Convention on the Conservation of European Wildlife, Berne, 1979
- Protocol for the Conservation and Management of the Protected Marine and Coastal Areas of South-East Pacific, Paipa, 1989
- ASEAN Agreement on the Conservation of Nature and Natural Resources, Kuala Lumpur, 1985
- Joint Protocol Relating to the Application of Vienna Convention and the Paris Convention, Vienna, 1988
- Agreement on the Network of Aquaculture Centres in Asia and the Pacific, Bangkok, 1988
- Convention Concerning Safety in the Use of Chemicals at Work, Geneva, 1990
- Convention on Environmental Impact Assessment in a Trans boundary Context, Espoo, 1991
- United Nations Framework Convention on Climate Change, New York, 1992
- Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1987
- Agreement on the Action Plan for the Environmentally Sound Management of the Common Zambezi River System, Harare, 1987
- International Convention on Salvage, London, 1989
- Convention on Civil Liability for Damage Caused During Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels, Geneva, 1989
- International Convention on Oil Pollution Preparedness, London, 1990

APPENDIX 8: LIST OF ITEMS FROM THE QUESTIONNAIRE

- Q. 1 Sex
- Q. 2 Age
- Q. 3 Do you live in Chonburi Province?
- Q. 4 Do you work for manufacturer in Chonburi Province?
- Q. 5 Where do you work?
- Q. 6 What is your working level?
- Q. 7 How long have you been employed at your present position?
- Q. 8 Does your company use an E.M.S.?
- Q. 9 Which kind of E.M.S. does your manufacturer use?
- Q.10 Tick which of the following groups you believe are your customers
 - Item 10a. Consumers of your manufactured products
 - Item 10b. Government regulators at a provincial level
 - Item 10c. Government legislators at a national level
 - Item 10d. Politicians
 - Item 10e. People in Chonburi community
 - Item 10f. National environmental lobby non-government organisations
 - Item 10g. Your company employees
 - Item 10h. Others
- Q.11 Tick which actions your management team is committed to?
 - Item 11a. Definition of EMS policy
 - Item 11b. Clear vision for future EMS
 - Item 11c. Time allocated to learn about EMS across manufacturer
 - Item 11d. Top management defines the policy
 - Item 11e. Continual improvement and prevention of pollution
 - Item 11f. Comply with relevant legal requirements
 - Item 11g. Setting and reviewing objectives and targets
 - Item 11h. Monitoring of strategies
 - Item 11i. Set communication line in Manufacturer
 - Item 11j. Communicated EMS to public
- Q.12 Are employees required to consider the following matters as part of their job?
 - Item 12a. Manufacturing systems and procedures relevant to quality of the product
 - Item 12b. Training programs about product quality
 - Item 12c. Training programs about environmental quality
 - Item 12d. Seeking innovative alternatives to outdated process and policies
- Q.13 Do you have feedback from your customer?
 - Item 13a. No
 - Item 13b. Product quality
 - Item 13c. Production voice
 - Item 13d. Waste water

- Q.14 Tick which decision making tools does your management team use in making decisions about environmental management?
- Item 14a. P-D-C-A cycle
 - Item 14b. Cause and effect diagram
 - Item 14c. Control chart
 - Item 14d. Flow chart
 - Item 14e. Histogram
 - Item 14f. Benchmarking
 - Item 14g. Brainstorming and teamwork
- Q.15 How often does your company audit environmental management system?
- Q.16 Can you give me a copy of an environmental audit?
- Item 16a. Yes
 - Item 16b. Do not has information about environmental audit
 - Item 16c. Do not has authority to give information about environmental audit
- Q.17 What percentage of annual production costs are spent on employees training about environmental management?
- Q.18 How many times a year does your manufacturer use an emergency plan as a result of equipment breakdown?
- Q.19 Tick which of the following affects would occur as a result of the breakdown?
- Item 19a. Discharge of the pollutants to air
 - Item 19b. Discharge of the pollutants to water
 - Item 19c. Discharge of the pollutants to ground
 - Item 19d. Injury to employee
 - Item 19e. Nothing
- Q.20 Does environmental audit information result in changes to manufacturing Process?
- Q.21 How does management use record of incidents in management decision making?
- Item 21a. To planning environmental plan
 - Item 21b. To set an environmental budget
 - Item 21c. To solve environmental problems
 - Item 21d. To develop production process
 - Item 21e. To making decision about raw materials
 - Item 21f. To evaluate environmental plan
- Q.22 List three actions used by your company to prevent accident accidents or environmental incidents?
- Item 22a. Use raw materials which have less effect on environment
 - Item 22b. Reduce materials used
 - Item 22c. Developing a good inspector system
 - Item 22d. Train staff about environmental management system
 - Item 22e. Set up the respondent in any job
 - Item 22f. Save electricity
 - Item 22g. Reused process
 - Item 22h. Contact companies specializing in hazardous waste disposal
 - Item 22i. Set up a good maintenance system
 - Item 22j. Maintain a good record system
 - Item 22k. Establish separation of all wastes in specific/safe area
 - Item 22l. Establish waste treatment system
 - Item Q22m. Prepare a good production plan

Please rank your company communication with the following groups by placing the number that best expresses your feelings.

- Q.23 National Government Departments
- Q.24 Provincial Government Department
- Q.25 Community groups
- Q.26 Employees in same department of your company
- Q.27 Employees from other departments in your company
- Q.28 Employees at the same working level
- Q.29 Employees at other levels

Please respond to each of the following statements by placing the number that best expresses your feeling about the response of your community to environmental problems.

- Q.30 Your community needs to pay attention to environmental problems or issues
- Q.31 Good environmental management systems are important for manufacturers
- Q.32 The governmental management provides communities with enough information about environmental laws, regulations and education
- Q.33 Important government scientific information is available in communities to assist decision-making
- Q.34 Thailand national environmental standards result in safe environment across the country
- Q.35 Communities take part in the preparation of environmental standards at a national level
- Q.36 Communities take part in the preparation of environmental standards at a provincial level
- Q.37 Environmental laws and regulations encourage manufacturers to improve environmental quality
- Q.38 Tick which of the environmental pollutants from manufacturing in the following list affect your community?
 - Item 38a. Discharge of the pollutants to air
 - Item 38b. Odour
 - Item 38c. Discharge of the pollutants to water
 - Item 38d. Discharge of the pollutants to ground
 - Item 38e. Nothing
- Q.39 Would you like to receive a summary of the survey results?
 - Item 39a. Yes
 - Item 39b. No

**APPENDIX 9: THE SURVEY RESULTS, BETWEEN STAFF IN THE TOWN
AND OUTSIDE OF THE TOWN**

Part A: Performance Agreement for the Environmental Program

Items	N	n	Means	Level of sig.
Q10. Which of the following groups you believe are your customer?				
Item 10a. Consumers of your manufactured products				0.898
Staff in the Town	15	14	0.93	
Staff outside of the Town	18	17	0.94	
Item 10b. Government regulators at a provincial level				0.065
Staff in the Town	15	7	0.47	
Staff outside of the Town	18	3	0.17	
Item 10c. Government legislators at a national level				0.015*
Staff in the Town	15	6	0.40	
Staff outside of the Town	18	1	0.06	
Item 10d. Politicians				1.000
Staff in the Town	15	0	0	
Staff outside of the Town	18	0	0	
Item 10e. People in Chonburi community				0.805
Staff in the Town	15	9	0.60	
Staff outside of the Town	18	10	0.56	
Item 10f. National environmental lobby non-government organisations				0.494
Staff in the Town	15	3	0.20	
Staff outside of the Town	18	2	0.11	
Item 10g. Your company employees				0.389
Staff in the Town	15	9	0.60	
Staff outside of the Town	18	8	0.44	
Item 10h. Others (sub contactors)				0.280
Staff in the Town	15	1	0.07	
Staff outside of the Town	18	0	0	
Q11. Tick which actions your management team is committed to?				
Item 11a. Definition of EMS policy				0.240
Staff in the Town	15	9	0.60	
Staff outside of the Town	18	7	0.39	
Item 11b. Clear vision for future EMS				0.125
Staff in the Town	15	14	0.93	
Staff outside of the Town	18	13	0.72	
Item 11c. Time allocated to learn about EMS across Manufacturer				0.624
Staff in the Town	15	7	0.47	
Staff outside of the Town	18	10	0.56	
Item 11d. Top management defines the policy				0.455
Staff in the Town	15	13	0.87	
Staff outside of the Town	18	17	0.94	

Item 11e. Continual improvement and prevention of Pollution				0.276
Staff in the Town	15	7	0.47	
Staff outside of the Town	18	5	0.28	
Item 11f. Comply with relevant legal requirements				0.703
Staff in the Town	15	9	0.60	
Staff outside of the Town	18	12	0.67	
Item 11g. Setting and reviewing objectives and targets				0.670
Staff in the Town	15	14	0.93	
Staff outside of the Town	18	16	0.89	
Item 11h. Monitoring of strategies				0.065
Staff in the Town	15	9	0.60	
Staff outside of the Town	18	5	0.28	
Item 11i. Set communication line in Manufacturer				0.283
Staff in the Town	15	6	0.40	
Staff outside of the Town	18	4	0.22	
Item 11j. Communicated EMS to public				0.690
Staff in the Town	15	4	0.27	
Staff outside of the Town	18	6	0.33	

Note: * Significant at the $p < 0.05$ level

** Significant at the $p < 0.01$ and $p < 0.05$ level

Part B: Plan for Transformation Implementation

Items	N	n	Means	Level of Sig.
12. Are employees required to consider the following matters as part of their job?				
Item 12a. Manufacturing systems and procedures relevant to quality of the product				0.262
Staff in the Town	15	11	0.73	
Staff outside of the Town	18	16	0.89	
Item 12b. Training programs about product quality				0.902
Staff in the Town	15	8	0.53	
Staff outside of the Town	18	10	0.56	
Item 12c. Training programs about environmental Quality				0.703
Staff in the Town	15	9	0.60	
Staff outside of the Town	18	12	0.67	
Item 12d. Seeking innovative alternatives to outdated process and policies				0.530
Staff in the Town	15	10	0.67	
Staff outside of the Town	18	10	0.56	

Q13. Do you have feedback from your customer?				
Item 13a. Yes				0.451
Staff in the Town	15	7	0.47	
Staff outside of the Town	18	6	0.33	
Item 13b. Product quality				0.451
Staff in the Town	15	7	0.47	
Staff outside of the Town	18	6	0.33	
Item 13c. Production noise				0.280
Staff in the Town	15	5	0.33	
Staff outside of the Town	18	3	0.17	
Item 13d. Waste water				0.194
Staff in the Town	15	0	0	
Staff outside of the Town	18	2	0.11	
Q14. Tick which decision making tools does your management team use in making decisions about environmental management?				
Item 14a. P-D-C-A cycle				0.474
Staff in the Town	15	11	0.73	
Staff outside of the Town	18	11	0.61	
Item 14b. Cause and effect diagram				0.812
Staff in the Town	15	3	0.20	
Staff outside of the Town	18	3	0.17	
Item 14c. Control chart				0.798
Staff in the Town	15	2	0.13	
Staff outside of the Town	18	3	0.17	
Item 14d. Flow chart				0.690
Staff in the Town	15	11	0.73	
Staff outside of the Town	18	12	0.67	
Item 14e. Histogram				0.703
Staff in the Town	15	6	0.40	
Staff outside of the Town	18	6	0.33	
Item 14f. Benchmarking				1.000
Staff in the Town	15	0	0	
Staff outside of the Town	18	0	0	
Item 14g. Brainstorming and teamwork				0.305
Staff in the Town	15	11	0.73	
Staff outside of the Town	18	10	0.56	

Note: * Significant at the $p < 0.05$ level

** Significant at the $p < 0.01$ and $p < 0.05$ level

Part C: Standards and Process

Items	Staffs in Town (n)	Staffs Out Town (n)	Level of Sig.
Q15. How often does your company audit environmental management system?			0.046*
5 times or more over a years	1	1	
1 – 2 times a year	13	7	
Never	1	10	
Total	15	18	
Q18. How many time a year does your manufacturer use an emergency plan as a result of equipment breakdown?			0.065
1 – 2 times a year	7	3	
Never	8	15	
Total	15	18	

Items	N	n	Means	Level of Sig.
Q16. Can you give me a copy of an environmental audit?				
Item16a. Yes				0.147
Staff in the Town	15	7	0.47	
Staff outside of the Town	18	4	0.22	
Item16b. Do not have information about an environmental audit				0.027*
Staff in the Town	15	6	0.40	
Staff outside of the Town	18	13	0.72	
Item16c. Do not have authority to give information about an environmental audit				0.898
Staff in the Town	15	1	0.07	
Staff outside of the Town	18	1	0.06	
Q19. Which of the following affects would occur as a result of the equipment breakdown?				
Item19a. Discharge of the pollutants to air				0.751
Staff in the Town	15	10	0.67	
Staff outside of the Town	18	11	0.61	
Item19b. Discharge of the pollutants to water				0.665
Staff in the Town	15	7	0.47	
Staff outside of the Town	18	7	0.39	
Item19c. Discharge of the pollutants to ground				0.000**
Staff in the Town	15	10	0.67	
Staff outside of the Town	18	2	0.11	

Item19d. Injury to employee				0.100
Staff in the Town	15	4	0.27	
Staff outside of the Town	18	10	0.56	
Item19e. Nothing				0.227
Staff in the Town	15	1	0.07	
Staff outside of the Town	18	4	0.22	

Note: * Significant at the $p < 0.05$ level

** Significant at the $p < 0.01$ and $p < 0.05$ level

Part D: Continuous Improvement Process

Items	Staffs in Town (n)	Staffs out Town (n)	Level of Sig.
Q17. What percentage of annual production costs are spent on employees training about environmental management?			0.584
30 – 39%	1	1	
10 – 19%	6	5	
Less than 10%	8	12	
Total	15	18	

Items	N	n	Means	Level of Sig.
Q20. Does environmental audit information result in changes to manufacturing process?				0.008 **
Yes				
Staff in the Town	15	11	0.73	
Staff outside of the Town	18	5	0.28	
Q21. How does management use record of “incidents” in management decision making?				
Item21a. To planning environmental plan				0.253
Staff in the Town	15	12	0.80	
Staff outside of the Town	18	11	0.61	
Item21b. To set an environmental budget				0.805
Staff in the Town	15	9	0.60	
Staff outside of the Town	18	10	0.56	
Item21c. To solve environmental problems				0.805
Staff in the Town	15	9	0.60	
Staff outside of the Town	18	10	0.56	

Item21d. To develop production process				0.624
Staff in the Town	15	7	0.47	
Staff outside of the Town	18	10	0.56	
Item21e. To making decision about raw materials				0.474
Staff in the Town	15	4	0.27	
Staff outside of the Town	18	7	0.39	
Item21f. To evaluate environmental plan				0.617
Staff in the Town	15	3	0.20	
Staff outside of the Town	18	5	0.28	
Q22. List three actions used by your company to prevent accidents or environmental incidents?				
Item22a. Use raw materials which have less effect on environment				1.000
Staff in the Town	15	5	0.33	
Staff outside of the Town	18	6	0.33	
Item22b. Reduce materials used				0.261
Staff in the Town	15	8	0.53	
Staff outside of the Town	18	6	0.33	
Item22c. Developing a good inspector system				0.100
Staff in the Town	15	4	0.27	
Staff outside of the Town	18	10	0.56	
Item22d. Train staff about environmental management system				0.050
Staff in the Town	15	4	0.27	
Staff outside of the Town	18	11	0.61	
Item22e. Set up the respondent in any job				0.128
Staff in the Town	15	5	0.33	
Staff outside of the Town	18	2	0.11	
Item22f. Save electricity				0.019
Staff in the Town	15	4	0.27	*
Staff outside of the Town	18	0	0	
Item22g. Reused process				0.670
Staff in the Town	15	1	0.07	
Staff outside of the Town	18	2	0.11	
Item22h. Contact companies specializing in hazardous waste disposal				0.851
Staff in the Town	15	2	0.13	
Staff outside of the Town	18	2	0.11	
Item22i. Set up a good maintenance system				0.494
Staff in the Town	15	3	0.20	
Staff outside of the Town	18	2	0.11	
Item22j. Maintain a good record system				0.455
Staff in the Town	15	2	0.13	
Staff outside of the Town	18	1	0.06	
Item22k. Establish separation of all wastes in specific/safe area				0.851
Staff in the Town	15	2	0.13	
Staff outside of the Town	18	2	0.11	

Item22l. Establish waste treatment system					0.798
Staff in the Town	15	2	0.13		
Staff outside of the Town	18	3	0.17		
Item22m. Prepare a good production plan					0.107
Staff in the Town	15	2	0.13		
Staff outside of the Town	18	7	0.39		

Note: * Significant at the $p < 0.05$ level

** Significant at the $p < 0.01$ and $p < 0.05$ level

Questions	1	2	3	4	5	Mean
23. National Government Departments						
Staff in the Town	4	4	1	5	1	2.67
Staff outside of the Town	5	7	5	0	1	2.17
24. Provincial Government Department						
Staff in the Town	3	5	3	3	1	2.60
Staff outside of the Town	3	7	6	2	0	2.39
25. Community groups						
Staff in the Town	2	5	4	2	2	2.80
Staff outside of the Town	4	3	8	2	1	2.61
26. Employees in same department of your company						
Staff in the Town	0	0	3	7	5	4.13
Staff outside of the Town	0	0	6	8	4	3.89
27. Employees from other departments in your company						
Staff in the Town	0	1	8	5	1	3.40
Staff outside of the Town	1	1	9	6	1	3.28
28. Employees at the same working level						
Staff in the Town	1	0	5	7	2	3.60
Staff outside of the Town	0	0	8	8	2	3.67
29. Employees at other levels						
Staff in the Town	1	1	7	5	1	3.27
Staff outside of the Town	0	0	10	7	1	3.50

Note 1: Scale 1 = Very Bad, 5 = Very Good

Note 2: There were no significant differences between the two groups

Questions	1	2	3	4	5	Mean
30. Your community needs to pay attention to environmental problems or issues						
Staff in the Town	0	0	0	1	4	4.8
Staff outside of the Town	0	1	3	3	8	4.2
31. Good environmental management systems are important for manufacturers						
Staff in the Town	0	0	0	1	4	4.8
Staff outside of the Town	0	0	3	4	8	4.33
32. The government provides communities with enough information about environmental laws, regulations and education						
Staff in the Town	0	2	0	2	1	3.4
Staff outside of the Town	6	4	2	0	3	2.33
33. Important government scientific information is available in communities to assist decision making						
Staff in the Town	0	0	2	2	1	3.8
Staff outside of the Town	8	3	1	0	3	2.13
34. Thailand national environmental standards result in safe environment across the country						
Staff in the Town	0	0	4	1	0	3.2
Staff outside of the Town	2	2	9	1	1	2.8
35. Communities take part in the preparation of environmental standards at a national level						
Staff in the Town	0	0	1	4	0	3.8
Staff outside of the Town	2	6	4	2	1	2.6
36. Communities take part in the preparation of environmental standards at a provincial level						
Staff in the Town	0	0	1	4	0	3.8
Staff outside of the Town	2	6	4	2	1	2.6

37. Environmental laws and regulations encourage manufacturers to improve environmental quality						
Staff in the Town	0	0	1	4	0	3.8
Staff outside of the Town	0	2	9	2	2	3.27

Note: Scale 1 = Strongly Disagree, 5 = Strongly Agree

Items	N	n	Means	Level of Sig.
Q38. Tick which of the environmental pollutants from manufacturing in the following list affect your community?				
Item38a. Discharge of the pollutants to air				0.008
Staff in the Town	5	2	0.40	
Staff outside of the Town	15	14	0.93	
Item38b. Odour				0.317
Staff in the Town	5	2	0.40	
Staff outside of the Town	15	10	0.67	
Item38c. Discharge of the pollutants to water				0.038
Staff in the Town	5	2	0.40	
Staff outside of the Town	15	13	0.87	
Item38d. Discharge of the pollutants to ground				0.217
Staff in the Town	5	0	0	
Staff outside of the Town	15	4	0.27	
Item38e. Nothing				0.083
Staff in the Town	5	1	0.20	
Staff outside of the Town	15	0	0	
Q39. Would you like to receive a summary of the Survey results?				0.735
Item39a. Yes				
Staff in the Town	5	1	0.20	
Staff outside of the Town	15	2	0.13	
Item39b. No				
Staff in the Town	5	4	0.80	
Staff outside of the Town	15	13	0.87	

**APPENDIX 10: THE EFFECTIVENESS OF SEVEN DIFFERENT GROUPS
IN COMMUNICATION**

Groups	1	2	3	4	5	Mean
National Government Departments						
Staffs in Amata Nakom Industrial Town	4	4	1	5	1	2.62
Staffs outside of the Town	5	7	5	0	1	2.13
Province Government Department						
Staffs in Amata Nakom Industrial Town	3	5	3	3	1	2.62
Staffs outside of the Town	3	7	6	2	0	2.27
Community groups						
Staffs in Amata Nakom Industrial Town	2	5	4	2	2	2.85
Staffs outside of the Town	4	3	8	2	1	2.73
Employees in same department in your company						
Staffs in Amata Nakom Industrial Town	0	0	3	7	5	4.23
Staffs outside of the Town	0	0	6	8	4	3.80
Employees in other departments in your company						
Staffs in Amata Nakom Industrial Town	0	1	8	5	1	3.38
Staffs outside of the Town	1	1	9	6	1	3.27
Employees in the same working level						
Staffs in Amata Nakom Industrial Town	1	0	5	7	2	3.62
Staffs outside of the Town	0	0	8	8	2	3.60
Employees in other levels						
Staffs in Amata Nakom Industrial Town	1	1	7	5	1	3.23
Staffs outside of the Town	0	0	10	7	1	3.53

Note: Scale 1 = Very Bad, 5 = Very Good

**APPENDIX 11: LIST OF ITEMS FROM SECTION TWO OF THE
QUESTIONNAIRE**

- Q.10 Tick which of the following groups you believe are your customers
- Item 10a. Consumers of your manufactured products
 - Item 10b. Government regulators at a provincial level
 - Item 10c. Government legislators at a national level
 - Item 10d. Politicians
 - Item 10e. People in Chonburi community
 - Item 10f. National environmental lobby non-government organisations
 - Item 10g. Your company employees
 - Item 10h. Others
- Q.11 Tick which actions your management team is committed to?
- Item 11a. Definition of EMS policy
 - Item 11b. Clear vision for future EMS
 - Item 11c. Time allocated to learn about EMS across manufacturer
 - Item 11d. Top management defines the policy
 - Item 11e. Continual improvement and prevention of pollution
 - Item 11f. Comply with relevant legal requirements
 - Item 11g. Setting and reviewing objectives and targets
 - Item 11h. Monitoring of strategies
 - Item 11i. Set communication line in Manufacturer
 - Item 11j. Communicated EMS to public
- Q.12 Are employees required to consider the following matters as part of their job?
- Item 12a. Manufacturing systems and procedures relevant to quality of the product
 - Item 12b. Training programs about product quality
 - Item 12c. Training programs about environmental quality
 - Item 12d. Seeking innovative alternatives to outdated process and policies
- Q.13 Do you have feedback from your customer?
- Item 13a. Yes
 - Item 13b. Product quality
 - Item 13c. Production voice
 - Item 13d. Waste water
- Q.14 Tick which decision-making tools does your management team use in making decisions about environmental management?
- Item 14a. P-D-C-A cycle
 - Item 14b. Cause and effect diagram
 - Item 14c. Control chart
 - Item 14d. Flow chart
 - Item 14e. Histogram
 - Item 14f. Benchmarking
 - Item 14g. Brainstorming and teamwork

- Q.15 How often does your company audit environmental management systems?
- Q.16 Can you give me a copy of an environmental audit?
- Item 16a. Yes
- Item 16b. Do not has information about environmental audit
- Item 16c. Do not has authority to give information about environmental audit
- Q.17 What percentage of annual production costs are spent on employee training about environmental management?
- Q.18 How many times a year does your manufacturer use an emergency plan as a result of equipment breakdown?
- Q.19 Tick which of the following affects would occur as a result of a breakdown of equipment?
- Item 19a. Discharge of the pollutants to air
- Item 19b. Discharge of the pollutants to water
- Item 19c. Discharge of the pollutants to ground
- Item 19d. Injury to employee
- Item 19e. Nothing
- Q.20 Does environmental audit information result in changes to the manufacturing process?
- Q.21 How does management use record of incidents in management decision Making processes?
- Item 21a. To planning environmental plan
- Item 21b. To set an environmental budget
- Item 21c. To solve environmental problems
- Item 21d. To develop production process
- Item 21e. To making decision about raw materials
- Item 21f. To evaluate environmental plan
- Q.22 List three actions used by your company to prevent accidents or environmental incidents?
- Item 22a. Use raw materials which have less effect on environment
- Item 22b. Reduce materials used
- Item 22c. Developing a good inspector system
- Item 22d. Train staff about environmental management system
- Item 22e. Set up the respondent in any job
- Item 22f. Save electricity
- Item 22g. Reused process
- Item 22h. Contact company specializing in hazardous waste disposal
- Item 22i. Set up a good maintenance system
- Item 22j. Maintain a good record system
- Item 22k. Establish separation of all wastes in specific/safe area
- Item 22l. Establish waste treatment system
- Item Q22m. Prepare a good production plan
- Please rank your company communication with the following groups by placing the number that best expresses your feelings.
- Q.23 National Government Departments
- Q.24 Provincial Government Department
- Q.25 Community groups
- Q.26 Employees in same department in your company
- Q.27 Employees in other departments in your company
- Q.28 Employees in the same working level
- Q.29 Employees in other levels

APPENDIX 12: RESPONSES FROM THE LOCAL COMMUNITIES

Questions	1	2	3	4	5	Mean
Q30. Your community needs to pay attention to environmental problems or issues						
Community in the Town area	0	0	0	1	4	4.80
Community outside of the Town area	0	1	3	3	8	4.20
Q31. Good environmental management systems are important for manufacturers						
Community in the Town area	0	0	0	1	4	4.80
Community outside of the Town area	0	0	3	4	8	4.33
Q32. The government provide communities with enough information about environmental laws, regulations and education						
Community in the Town area	0	2	0	2	1	3.40
Community outside of the Town area	6	4	2	0	3	2.33
Q33. Important government scientific information is available in communities to assist decision making						
Community in the Town area	0	0	2	2	1	3.80
Community outside of the Town area	8	3	1	0	3	2.13
Q34. Thailand national environmental standards result in safe environment across the country						
Community in the Town area	0	0	4	1	0	3.20
Community outside of the Town area	2	2	9	1	1	2.80
Q35. Communities take part in the preparation of environmental standards at a national level						
Community in the Town area	0	0	1	4	0	3.80
Community outside of the Town area	2	6	4	2	1	2.60
Q36. Communities take part in the preparation of environmental standards at a provincial level						
Community in the Town area	0	0	1	4	0	3.80
Community outside of the Town area	2	6	4	2	1	2.60

Q37. Environmental laws and regulations encourage manufacturers to improve environmental quality						
Community in the Town area	0	0	1	4	0	3.80
Community outside of the Town area	0	2	9	2	2	3.27

Note 1: Scale 1 = Very Bad, 5 = Very Good

Note 2: There were no significant differences between the two groups

Questions	Com. in Town	Com. out Town
Q38. Tick which of the environmental pollutants from manufacturing in the following list effect to your community		
Discharge of the pollutants to air	2	14
Odour	2	10
Discharge of the pollutants to water	2	13
Discharge of the pollutants to ground	0	4
Nothing	1	0
Q39. Would you like to receive a summary of the survey Results?		
Yes	1	2
No	4	13