Proactive Policies and Business Strategies for Strengthening Corporate Environmental Management in Developing Asia

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Institute for Global Environmental Strategies

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Preface

The fast growth of economy in developing Asian countries has caused various problems on the environment. Corporate environmental management (CEM) is still obviously poor and thus needs to be greatly improved. With aims to fill up the gap of policies encouraging better CEM, Kansai Research Centre, Institute for Global Environmental Strategies (KRC/IGES) initiated a project under its study field of 'Business and the Environment' in April 2007. Within a period of three years scheduled for the project, various study activities have been developed to give in-depth analyses of proactive policies and business strategies for strengthening CEM in developing Asia. In particular, this project targeted three representative countries, China, India and Thailand by focusing on two emerging environmental management approaches. One is environmental information disclosure (EID) strategy and another is green supply chain management (GSCM).

In collaboration with the research partners from the three countries, this project has involved in comprehensive literature and policy overview, a range of informal consultations with related experts and governmental officials, questionnaire and hearing surveys to the companies, and statistical practices for policy evaluation and analysis. This report is the final summary of the research outcomes obtained through the hard works for the 4th phase CEM project. In overall, this report consists of four main sections. The first section provides a synthesis summary of the project activities and findings as a whole. The following three sections summarised the case studies in the three target countries consecutively.

I would like to appreciate the great efforts of researchers at KRC/IGES involved in this project, and to acknowledge the cooperation of local research partners from the three countries. My earnest thanks also go to the peer-review experts who provided constructive comments and inputs. The publication of this report is hoped to make a real contribution to ongoing debate of related policies for enhancing CEM in the region of Asia.

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Prof. Yutaka Suzuki
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The authors would like to thank Prof. Hironori Hamanaka, Mr. Hideyuki Mori, Prof. Yutaka Suzuki and Dr. Tomohiro Shishime for their guidance and support of the project implementation. The authors would also like to appreciate the Hyogo Prefectural Government for kindly providing financial source for this project. Many colleagues at IGES headquarter and KRC provided assistances at various stages of this research and in the preparation of this report. Grateful thanks are especially given to Mr. Yasuhiro Sakai, Ms. Akiko Mizumoto and Ms. Keiko Shibanai for their logistics arrangements in many ways.

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Abbreviations and Acronyms

BE	Business and the Environment
BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
BT	Business Today
Btu	British Thermal Unit
CBRC	China Banking Regulatory Commission
CDM	Clean Development Mechanism
CEID	Corporate Environmental Information Disclosure
CEM	Corporate Environmental Management
CERES	Coalition for Environmentally Sustainable Economies
CFC	Chlorofluorocarbon
CII	Confederation of Indian Industries
CITES	Convention on International Trade in Endangered Species of flora and fauna
CNY	Chinese Currency Yuan
COD	Chemical Oxygen Demand
CP	Cleaner Production
CPCB	Central Pollution Control Board
CREP	Corporate Responsibility for Environmental Protection
CSE	Centre for Science and Environment
CSR	Corporate Social Responsibility
DIP	Department of Industrial Promotion
DIW	Department of Industrial Works
DoE/DoF	Department of Environment/Department of Forest
EA	Environmental Activism
EIA	Environmental Impact Assessment
EID	Environmental Information Disclosure
EMD	Environmental Management Department
EMS	Environnemental Management System
EPBs	Environmental Protection Bureaus
ESI	Environmentally Sensentive Industry
FICCI	Federation of Indian Chambers of Commerce and Industry
FTI	Federation of Thai Industries
FY	Fiscal Year
FYEP	Five-Year Environmental Plan
GDP	Gross Domestic Product
GHG	Greenhouse gases
GIOV	Gross Industrial Output Value
GP	Green Purchasing
GRI	Global Reporting Initiatives
GRP	Green Rating Program

GSCM	Green Supply Chain Management
ICBC	Industrial and Commercial Band of China
IEAT	Industrial Estate Authority of Thailand
IFC	International Finance Corporation
IPO	Initial Public Offering
IS	Indian Standard
ISIC	International Standard Industries Classification
ISO	International Standards Organization
IT	Information Technology
KRC	Kansai Research Centre
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
MICT	Ministry of Information and Communication Technology
MNCs	Multinational Corporations
MoEF	Ministry of Environment and Forests
MOEP	Ministry of Environmental Protection
MoMSME	Ministry of Micro, Small and Medium Enterprises
MSME	Micro, Small and Medium Enterprises
MTEC	National Metal and Materials Technology Center
NDRC	National Development and Reform Commission
NESDP	National Economic and Social Development Plan
NGOs	Non Governmental Organisations
NSO	National Statistic Office
OECD	Organization for Economic Cooperation and Development
OEMs	Original Equipment Manufactures
OHSAS	Occupation, Health and Security Administrative System
OSMEP	Office of Small and Medium Enterprises Promotion
PBC	People's Bank of China
PCD	Pollution Control Department
PM	Particulate Matter
ROE	Return of Equity
RoHS	Restrictions on the use of Certain Hazardous Substances
Rs	Rupee
RTI	Right to Information
SEPA	State Environmental Protection Administration
SCE	Standard Coal Equivalent
SCG	Siam Cement. PCL Co. Ltd.
SMEs	Small and Medium Enterprises
SMEP	Small and Medium Enterprises Promotion
SPCB	State Pollution Control Boards
SSI	Small Scale Industry
TBCSD	Thailand Business Council for Sustainable Development
TEI	Thailand Environment Institute

TISI	Thai Industrial Standards Institute
TRF	Thai Research Fund
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
U.S.	United States
VOC	Volatile Organic Compounds
WEEEs	Waste Electrical and Electronic Equipments
WTO	World Trade Organization

Section Ⅰ:

Synthesis Summary of the CEM Project

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Chapter 1: Synthesis summary of the CEM project

1. Introduction

Sustainable development according to triple bottom lines, a balance between the environment, economy and social welfare, is of obvious importance for the rapidly industrialising Asia. However, effective policy mix for balancing the environment and economic development has not yet been developed or well implemented. In overall, corporate environmental management (CEM) policies can be categorised into three types: command and control, market-based and informal/voluntary initiatives. Numerous studies have been done concerning regulatory tools, such as environmental laws, emission standards and environmental enforcement, and economic approaches like environmental subsidies and emission levies mainly by international organisations. On the other hand, much less information is available on the policies and strategies for promoting environmental management of industries in voluntary, particularly for developing Asia. Although it has been widely recognised that it is important for business to move beyond basic environmental compliance and shift from being reactive to proactive, there is large gap of theoretical discussions and empirical studies for promoting practices of the third-wave environmental policies.

With the aim to fill the environmental management policy gaps mentioned above, IGES Kansai Research Centre (KRC), which was founded in 2001, initiated a Fourth Phase (April 2007 - March 2010) project under its main research field of Business and the Environment (BE). The project title is 'Proactive Policies and Business Strategies for Strengthening Corporate Environmental Management in Developing Asia', which is abbreviated as 'the CEM project'.

Given the IGES mission of conducting strategic policy researches on global environmental issues with the focus on the Asia-Pacific region, the CEM project was carried out with financial support from the government of Hyogo Prefecture, where KRC is based, by considering the advantage of fruitful environmental management experiences of private businesses of Kansai region. This chapter gives a synthesis summary of research activities and major outcomes of the CEM project.

2. Project objectives and target countries

The overall goal of this project is to examine the strengths and deficiencies of current CEM practices in selected developing Asian countries, and to suggest proactive policies and business strategies that can further strengthen CEM efforts. The specific objectives of the research tasks in the Fourth Phase include:

a) To outline the current status of proactive policy tools that concern CEM in the target countries;

b) To demonstrate and select pathways that could be implemented as strategies for improving environmental performances of companies;

c) To summarise the advantages of those strategies, outline the major challenges and design enabling policy framework responsive to business demands, and;

d) To motivate key decision-makers by establishing appropriate dialogues and creating a platform to share information on good practices and policy experiences.

This project is envisioned to be a multi-country study within a common policy field, but allowing certain differences in defining specific research questions considering the local conditions and implementation feasibility. China, India and Thailand were selected as the target countries of this project as they share certain common characteristics, such as rapid economic growth through aggressive industrialisation and resultant environmental vows.

3. Research framework and components

The overall framework and research components are indicated in Fig.1.1.

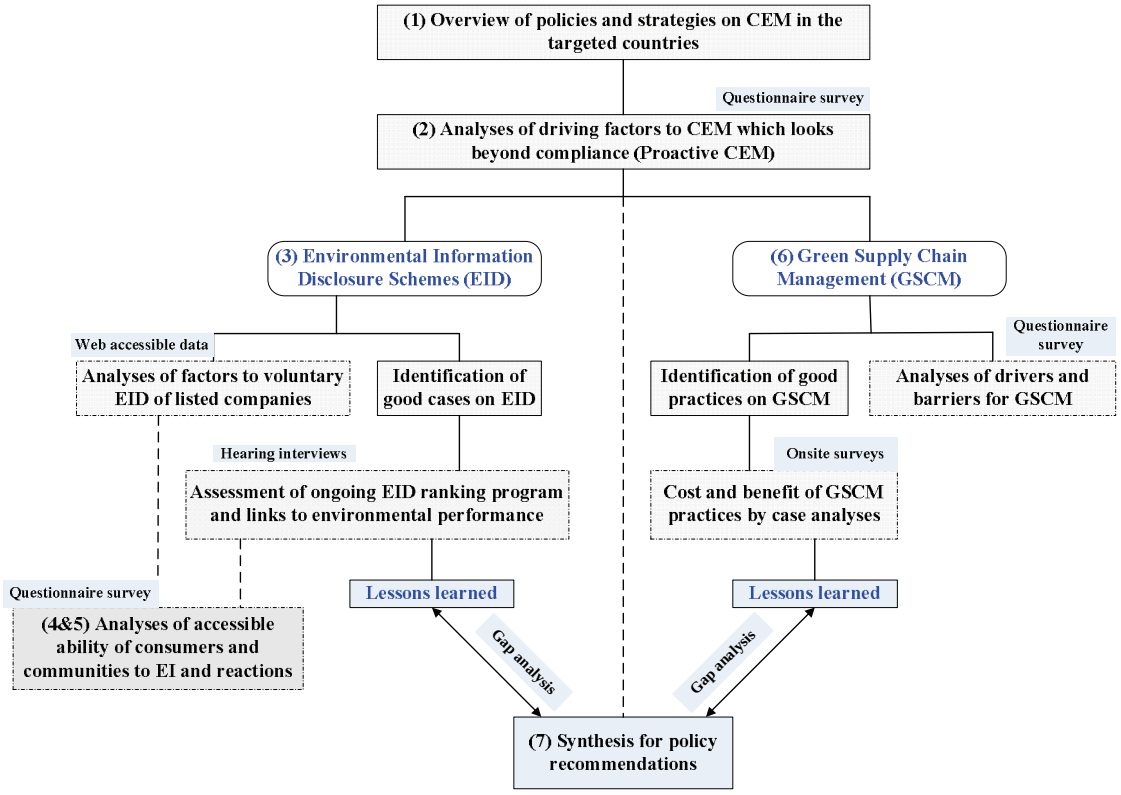

Fig.1.1: Overall framework and research components of the CEM project.

There are seven components for this project. As component 1, the research starts from a thorough overview of CEM policies in the three target countries. The second component is to give an analysis of determinant factors of proactive CEM which is a prerequisite step to identify the direction for developing policy tools which might be effective. Corporate Environmental

Information Disclosure (EID) and Green Supply Chain Management (GSCM) are defined as two major research components (Component 3 and 6) of the project. Various activities with clear research questions and appropriate methodologies were conducted to observe these two strategies from different perspectives. Regarding the EID component, the driving factors of voluntary EID of listed companies were analysed by using accessible data from the websites. Corporate environmental performance ranking and disclosure programme were explored in-depth as a typical mandatory disclosure policy. In a similar manner, a series of research activities was carried out for the GSCM component, including the determinant factor analysis of GSCM practices and cost-benefit analysis of GSCM activities by individual case studies. Component 4 and 5 were added later for observing the effectiveness of EID strategy from the viewpoints of company's related stakeholders. We selected the general consumers and company neighbouring communities and conducted questionnaire surveys to monitor their reactions to the available product-based and process-based environmental information of companies. The last part (Component 7) is to have synthesis analysis for policy recommendations.

Due to the difficulties of data collection for empirical policy studies and certain arrangement problems, the research tasks originally scheduled for the project were fully finished for the case studies in China. The field work in the other two countries could only be carried out partially with the tasks in dot-line boxes in Fig.1.1 being omitted. Nevertheless, fruitful outputs have been generated.

4. Human resource structure for the project

Fig.1.2 shows the structure of human resource input for the implementation of the CEM project.

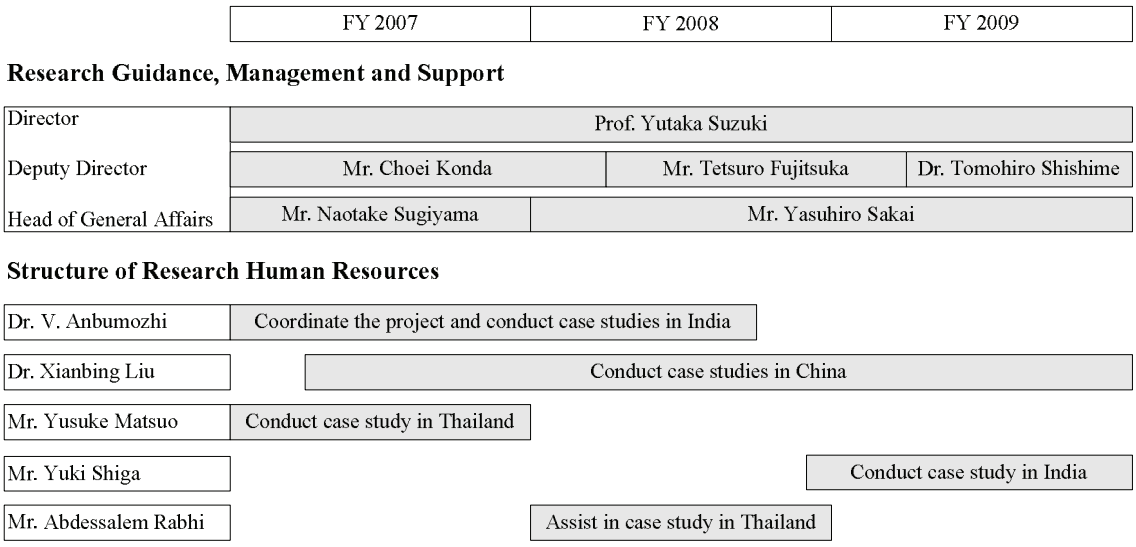

Fig. 1.2: Human resource structure for the project.

Under the guidance and support of administrative staffs at KRC, three regular researchers were

involved in the case studies in the three target countries respectively in the first fiscal year. Just before the final year, one more full-time visiting researcher was recruited to continue the case study in India soon after the project manager resigned from KRC. Accordingly, the study activities were carried out during the whole phase for China and India, while the case studies in Thailand were conducted only in the first two years.

5. Research methodologies

The methodologies applied for carrying out this project include: comprehensive overview of existing literatures and consultation with local experts and officials for understanding the current status and policy trend with relevance to CEM in the target countries; development of analytical frameworks based on the institutional and stakeholder theories for evaluating the changes of environmental behaviours of individual companies; preparation of survey documents; Field works like questionnaire surveys and onsite hearings to the companies and their related stakeholders for data collection; database construction and statistical analysis of the policies especially on corporate EID strategy; identification of GSCM practices and cost-benefit analysis of good cases; and arrangement of international seminars and symposiums for the outreach of research outcomes.

6. Main findings from the project

6.1 Current CEM status and ongoing policy processes

The preliminary overview indicated a generally low level of CEM in the three developing countries. A series of environmental policies have been adopted for promoting CEM with regulative measures still being the dominated approach.

Manufacturing industries are the major environmental polluters in China. A relatively complete environmental regulatory system has been established in the past two decades. A wide gap in CEM still exists due to the weak enforcement in reality. Chinese environmental authorities have practiced certain market-based instruments, such as pollutant discharge levy system and a pilot programme of major pollutant emissions trading. It is encouraging that the Chinese government has recognised the shortage of traditionally regulative and administrative CEM tools, and recently started to emphasise the supportive measures. The basic principle for adding complementary CEM policies is to enhance the interactions between the companies and more related stakeholders. As examples, ‘green credit’ policy enhanced the role of the banking system in promoting environmental performance of companies by using their power of determining the loans. Information disclosure related approaches have encouraged the public participation in promoting CEM in overall.

Considerable differences of CEM among various industrial sectors were observed in India.

While some sectors are significantly proactive on the environment and even incorporate CEM as their business strategies, most companies are unconcerned. Industries facing legal problems are more proactive, and those companies, which have been integrated into global supply chains, appear to be more proactive in CEM. India has an extensive environmental governance system with a comprehensive set of laws, regulations and institutional framework for the implementation of environmental requirements. However, there is a lack of effective environmental enforcement mechanism at local level. The rise of juridical activism is a typical phenomenon in India and has increased the pressure on CEM at certain degree. Although there is growing attention on market-based instruments as an option to internalise the environmental externalities of industrial activities, no measures or plans have been contemplated in India as so far.

CEM has received more and more concern in Thailand. Many acts have been promulgated to monitor and control the environmental activities of companies. The Thai government has also used market-based incentives to promote CEM practices. Corporate proactive initiatives in Thailand are mainly related to the certification of environmental management system (EMS), green labelling and cleaner production (CP). However, these voluntary initiatives are taken only by limited large and multinational companies.

6.2 Driver and barriers for CEM practices

Determinant factors of CEM practices have been identified and analysed from the institutional and stakeholder perspectives in the research.

A questionnaire survey to 1,300 Chinese companies, which successfully obtained 117 valid responses, confirmed a significantly positive effect of external pressures from the business competitors to proactive CEM practices. This indicates a high sensitivity of Chinese companies to the market factors. However, the roles of general public and industrial associations are weak, showing the marginal power of selected normative pressures for CEM in current Chinese context. Companies which view environmental issues as opportunities and have higher management capacities, are more likely to adopt proactive CEM activities.

The questionnaire survey to three industrial sectors in India, which only obtained limited responses from the companies, indicated a considerable difference between sectors in terms of CEM awareness. The automobile and textile industries, which have more experience in legal conflicts regarding environmental problems, seem to be relatively more proactive than the food processing industry. Consumer pressure seems to have a considerable impact on CEM of Indian companies. A linkage with global markets and the avoidance of legal risk appears to be influencing the CEM level in Indian companies.

The main driving factors for Thai companies to adopt CEM practices are internal company

policy and market demand but not the fear of environmental regulations. The main barriers for CEM in Thailand include limited technical and financial capacities and lack of cooperation with the related stakeholders, in particular for those small and medium enterprises (SMEs).

6.3 The level of corporate EID in voluntary

In this project, we monitored the level of EID of companies in a voluntary capacity, and looked at the three target countries in different ways. The result indicated a low level of voluntary EID in quantity and quality as a whole.

In China, voluntary EID is still only carried out in a limited number of large state-owned companies. The statistical analysis of 175 Chinese listed companies confirmed a marginal level of voluntary corporate EID. Their EID strategy is mainly oriented to satisfy the government's concerns. The corporate EID effort is significantly relative to its environmental sensitivity and its size. The role of other stakeholders, like shareholders and creditors, is found to be still weak. Another interesting finding is that the sampled companies are selectively opening their environmental information. Companies operating in eastern coastal regions, where the economy has been relatively developed, are more likely to disclose emission-related data. The better the company's economic performance, the more information on environmental investment and pollution control cost is disclosed.

A simple survey referring to voluntary environmental disclosure through websites and annual reports draws out current situation of Indian companies. Due to the nature of different sectors, the service sector is relatively reluctant to conduct EID initiatives compared with manufacturing sectors. Besides, public companies are slightly more reluctant to open their environmental information compared with the private companies.

In Thailand, both government and business sectors see the importance of EID. Some national companies have disclosed environmental information through annual sustainability or environmental reports. An overview of environmental reports of Thai companies confirmed the low extent of environmental information available. Companies are more willing to disclose subjective information rather than the information on actual environmental performances. Being part of the environmental policy of the company is viewed as the main determinant factor for voluntary corporate EID. However, the companies can hardly ever identify the environmental and economic benefits of EID efforts.

6.4 The functions of mandatory corporate EID programme

As a key component of this project, we gave a policy analysis for the ongoing EID programme arranged by Chinese environmental authorities. This mandatory disclosure programme firstly ranked the environmental performances of participating companies into five colours and then shared the ranked results with the public. Using the database provided by the environmental

protection bureau of a county-level city, the companies participating in this programme, which was around 200 in total, showed an improved environmental performance in general. The onsite hearing for the managers of 32 participating companies showed that the companies with worse rating records would be more likely to improve their environmental performances. The in-depth policy analysis confirmed that the programme did encourage the firms to be more reflexive to their internal environmental problems. The deterrent and enhancement functions of the programme are weak due to the weak reactions from the classified stakeholders, such as investors, business partners and creditors. The influence of the public, like neighbouring communities and environmental NGOs, is weak too.

In India, a similar environmental performance rating programme organised by an environmental NGO, the Green Rating Program (GRP), is known to effectively pressure companies. GRP was able to significantly reduce pollution load from the worst polluters.

6.5 The responses of stakeholders to a company's environmental information

In order to observe the role of environmental information availability in changing the behaviour of a company's related stakeholders, we also carried out questionnaire surveys to two groups of people in China. One was the urban citizens as general consumers. The other group was the residents living close to industrial polluting companies.

The data gathered from urban residents were used to explore their green purchasing (GP) behaviours. People's involvement in GP activities is currently low. Nearly half of the respondents have seldom bought green products in the past. People are more likely to choose high energy efficient home appliances and organic foods. Environmental attitude, especially the perception of self-responsibility for better environment, greatly influences the intention to GP practices. The availability of information on green products largely determines people's actual GP efforts.

One more survey study discussed the environmental activism (EA) of residents living close to the polluting companies in China. The communities are reluctant to act against their neighbouring polluters. The EA efforts, which require the residents to directly communicate with the governments or polluters, achieved very low participation. The residents have an obvious tendency to act collectively against the polluters. There is a large gap between the environmental information available from the companies and what the residents really are concerned about. The people want to know the amount of pollutant emissions and worry about their health impacts. However, the polluters are unwilling to give out this kind of quantitative data.

6.6 GSCM practices of companies

We also explored the GSCM practices of companies in the target countries.

The questionnaire survey monitoring GSCM activities of companies of China indicates that the companies are still at a preliminary stage GSCM practices. The overall level of GSCM practices is significantly and positively associated with the external pressures from regulatory, domestic clients and competitors. Learning capacity greatly determines the level of GSCM practices as an internal factor and significantly mediates the influences of external pressures. Although it is difficult to establish a direct linkage between the environmental performance changes and GSCM activities, the case studies of three selected companies in China confirmed the role of GSCM in enhancing their environmental indicators.

In Thailand, GSCM activities are scarce and mainly practiced by multinational companies. Existing GSCM practices have resulted in tangible environmental and financial benefits for participating companies regardless of they are suppliers or buyers on the supply chain.

7. List of publications generated by the project

7.1 Research Reports

1) Research Report of the 4th Phase Business and Environment (BE) Project on Corporate Environmental Management in Asia: Outcomes of the Research Activities in the First Half of FY2007, KRC/IGES.

2) Corporate Environmental Management: Policy Initiatives and Business Responses, Research Report of FY2007, KRC/IGES.

3) Corporate Environmental Management in Thailand, Unpublished research report for FY 2008, KRC/IGES.

4) Corporate Environmental Management: A study of Indian Industry, Unpublished research report for FY 2008, KRC/IGES.

7.2 Journal articles

1) Liu X., Anbumozhi, V., 2009. Determinant factors of corporate environmental information disclosure: an empirical study of Chinese listed companies. Journal of Cleaner Production 17: 593-600.

2) Liu et al., 2010. Functional mechanism of mandatory corporate environmental disclosure: an empirical study in China. Journal of Cleaner Production 18: 823-832.

3) Liu et al., 2010. An empirical study on the driving mechanism of proactive corporate environmental management in China. Journal of Environmental Management 91: 1707-1717.

4) Liu et al., 2010. Environmental activisms of firm's neighboring residents: an empirical study in China. Journal of Cleaner Production 18: 1001-1008.

5) Liu et al., 2010. Sustainable consumption: green purchasing behaviors of urban residents

in China. In press, Sustainable Development.

6) Liu et al., Determinant factors of green supply chain management: a survey study in the Yangtze Delta of China, under review, Business Strategy and the Environment.

7.3 Conference papers

1) Liu X., Fujitsuka T., Shishime T., Green firm's profile via green supply chain environmental management: observations from Asian countries, the 9th International Conference on ECOMATERAILS, Kyoto, Japan, Nov. 23-26, 2009.

2) Liu X., Wang C., Shishime T., Environmental activisms of firm's neighboring residents in China, Environmental Governance Conference, University of Duisburg, Muhlheim, Germany, May 18-20, 2010.

3) Shiga Y., Liu X., Shishime T., Rabhi A., Ogisu K., Fujitsuka T., 2010. Preliminary survey on environmental information disclosure in India, The 18th Global Environment Symposium, Japan Society of Global Environment, Chino, Japan, August 27-28, 2010.

4) Rabhi A., Shishime T., 2010. Assessment of corporate environmental information disclosure in Thailand, The 32nd Symposium of the Association of Environmental & Sanitary Engineering Research, Kyoto, Japan, July 30-31, 2010.

8. Policy implications and impacts of the project

The outcomes of this project provide various implications for related policy progress to enhance CEM in developing Asia. In general, development of a much more comprehensive policy mix is highly necessary to facilitate better CEM in Asian countries.

Among the optional environmental tools, EID strategy may greatly assist in the communications between the firms and their stakeholders and therefore attract the concern and involvement of more social actors for better CEM. The government agencies shall play an active role in bridging the information gap existing between what the companies would like to supply and what is actually necessary for the public to correctly understand company's environmental performance. A good example is the mandatory EID programme oriented by the government in China, which provides the public with concise but integrative information of environmental performances of companies. More efforts shall be taken to encourage actual reactions of the receipts of environmental information to generate pressures or incentives with sufficient strength for changing company's environmental behaviours.

It is also important to educate the companies to understand the concept and optional approaches of GSCM practices. As an innovative strategy, GSCM have obvious advantages in improving CEM due to the benefits of collectively environmental efforts of related companies. Good GSCM practices can be disseminated to assist in sustainable businesses operations by strategic

and long-term cooperation of the supply chain members.

In addition, our survey found that the companies are quite sensitive to the environmental attitudes and reactions of relevant market actors. Economic policy tools can be addressed for enhancing CEM in developing Asia from the future perspective.

This project studied the environmental management of companies at micro-level and addressed KRC's research focus of the relationship of business and the environment. The project components scheduled at an earlier stage was based on a clear understanding of CEM policies in developing Asia. All the research activities are policy-oriented and provide convincible evidences for the development of new CEM strategy or the modification and dissemination of existing policies. In this sense, the project has strong relevance with environmental policies and strategies for sustainable development in Asian region.

Regarding the impacts of the project, the kick-off workshop held in Japan and several roundtable meetings arranged in the target countries facilitated the communications of researchers, companies and policy-makers. The joint study activities with local experts enhanced the research networking in the Asian region. It is encouraging that several parts of this project have been published in distinguished journals around the world. These publications can raise discussions in the environmental management policy field. Actually, some research output has been linked to specific policy processes. The field surveys and in-depth analyses on the corporate EID programme in China provided useful policy suggestions for modifying and expanding the current EID programme. As an example, the information disclosure programme evaluation in China helps to improve its implementation. The three eastern provinces (Jiangsu, Zhejiang and Shanghai) have agreed to implement this programme jointly by applying identical criteria for environmental performance ranking and sharing the rating results for effectively improving CEM. One more meaningful message is that India would like to learn from the experience of the Chinese mandatory EID programme and try to practice this strategy to promote CEM.

9. Conclusions

The CEM project was conducted in an efficient way, especially for the case studies in China. All the pre-designed research tasks were completed and the primary objectives were achieved in a short term. Due to the difficulty of requesting cooperation from the companies, the studies provided less information for India and Thailand, which limited us to conducting a comparative analysis and picking up the common issues from the three target countries. In addition, our research emphasised the traditional environmental pollution problems and mainly used the managerial environmental performances as the indicators for policy analysis qualitatively. The quantitative and operational environmental indicators such as energy efficiency and carbon

emission intensities shall be added in the future studies to have a more comprehensive observation of CEM even in developing countries. Nevertheless, this project can be regarded as a successful case of CEM policy research for this region.

Section Ⅱ:

CEM Policy Studies in China

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Chapter 2: Overview of CEM policies in China

1. Country profile

The People's Republic of China is situated in eastern Asia, bound by the Pacific Ocean in the east. As the third largest country in the world, after Canada and Russia, it has a total area of 9.6 million square kilometers, or one-fifteenth of the world's landmass. China's administrative units are currently based on a four-level system dividing the nation into provinces, prefecture-level cities, counties or county-level cities, and townships. At provincial level, China is divided into 23 provinces, five autonomous regions, four metropolises directly under the Central Government, and two special administrative regions (Hong Kong and Macao). Chinese population has doubled over the past 50 years. Total population exceeded 1.3 billion in 2005, accounting for around one-fifth of the world's total. Along with the rapid urbanisation of the last two decades, people living in urban areas reached 562 million by the end of 2005, up 7% from five years ago. Urban population shares 43% of the total recently. Due to a huge population base and fast urbanisation, agriculture, energy supplies, urban infrastructure and housing, all have come under increasing stress in China.

Since China initiated economic reforms in 1978, Gross Domestic Product (GDP), in total and per capita average, has increased dramatically. Chinese GDP kept growing with a yearly ratio of around 10% during 1990-2005, and reached CNY18308.48 billion in 2005 (Chinese currency unit, USD1 ≈ CNY6.8 currently) (NBSC, 2006). However, the per capita GDP of China is still quite low. It ranks 110th in a world list which covers 180 countries or regions. Economic development is the highest priority for China in the medium and even long run in order to eradicate poverty and alleviate other social pressures such as environmental pollution. One problem for Chinese economic development is the geographically uneven growth. There is obviously a large gap between the most developed coastal eastern regions and the broad but relatively undeveloped western provinces. Aiming to balance the national-wide development, a series of national-level strategies, e.g. western development, prospering traditional industrial bases in northeast and promoting economic rise in central, have been initiated to speed up the social and economic growth in the backward regions.

2. Industrial portfolio

In China, industrial sectors are categorised into primary agriculture, secondary manufacturing and construction, and tertiary services. Chinese industrial structure changed significantly during the 1990s. Agricultural outputs accounted for nearly 25% of the total economy in 1990. This ratio decreased to 12.6% by 2005. Accordingly, the ratio of tertiary industry increased from 30% to 40% in the same period. Manufacturing industry and construction continued to share about

half of the total economy.

The number of state-owned and non-state-owned enterprises above a designated size, with yearly sales over CNY5 million, was 271,835 in 2005. Out of these, 89% were small-sized, 10% were medium-scale, and the large enterprises comprised only 1% (Note: The large enterprises refer to those having 2,000 or more staff, CNY 300 million or more annual sales and CNY 400 million or more total capital; The small enterprises are those having less than 300 staff, or less than CNY 30 million annual sales or less than CNY 40 million total capital; the remainder are medium-sized). Looking at the ratio of ownership of enterprises in 2005, about 10% were state-owned or state-held, 21% were funded by investments from Hong Kong, Macao, Taiwan and foreign countries, the rest comprising 69% were private, joint ownership or shared holdings. Large companies possessed 39% of the total capital of all manufacturers. The capital share of medium sized enterprises was 34%, and the other 27% was operated by small enterprises (NBSC, 2006). In the industrial sectors with more than 1 million employees in 2005, textile manufacturers employed about 2.716 million people . The next sectors were transport equipment, information technology & product, electricity and heat generation & supply, chemical product manufacturing, non-metallic mineral products and ferrous metals processing. These sectors played major roles in providing employment.

3. Current status and challenges of CEM

3.1 High energy intensity of economic activities

The energy intensity of the economy of China is still high, although total energy consumption doubled so as to achieve an increase of nearly 10 times for GDP growth between 1990-2005. Average energy use decreased from 5.29 to 1.49 tons of SCE per CNY10,000 in output in the 1990s (SCE: Standard coal equivalent). Manufacturing industry used 71% of the total energy in 2005. Non-production activities used 10% of the total energy. The ratios for agriculture and construction are 4% and 2% respectively. The remaining 13% was consumed by other social service activities (NBSC, 2006). Coal is the dominant source of energy supply even though its share appeared to be on a slightly decreasing trend (from 75% in 1995 to 68.9% in 2005). The ratios of oil and renewable energy such as hydro and wind power have been increasing. The coal dominated energy structure in China is unique in the world if it is compared with other countries, with the ratio of coal in developed countries being typically 5-25% in the total energy supply.

As illustrated in Fig.2.1, average energy consumption in China was 13.56 tons of SCE per USD 10,000 of GDP in 2006, which was more than eight times that of Japan and about five times that of U.S. It was also much higher than some other large developing countries like India and Brazil. Low energy efficiency in China could be partially attributed to the structure of energy sources. The lack of clean manufacturing technologies is another important reason explaining the high energy intensity of and heavy pollution load from industries. This has limited the quality and

sustainability of economic growth of China. Improving energy efficiency is crucial for energy conservation and pollutants mitigation in the near future.

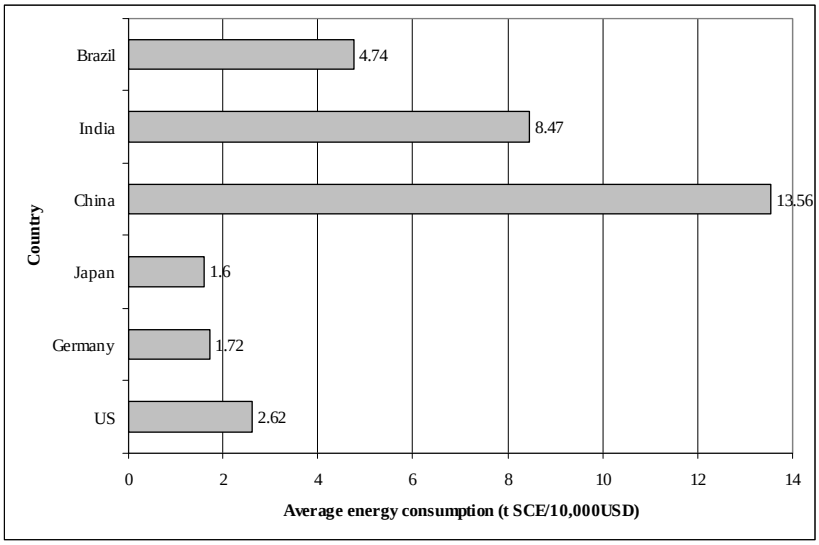

Fig.2.1: Energy consumption averaged by GDP in selected countries in 2006.

3.2 Overall status of environmental pollution

Undoubtedly, environmental pollution and resource degradation are severe in China and negatively affect human health and quality of life, as well as economic and social development (Economy, 2004; World Bank, 2001). In the past 20 years, the advances in technology and economic efficiency, coupled with pollution control policies, have positively affected air and water pollution loads. Challenges remain in further improving environmental quality as a whole.

Regarding air pollution, cities in China still rank among the most polluted in the world, although levels of SO_2 and particulates have declined since the 1980s. Suspended particulate levels are higher in northern cities due to industrial activities and geographic and meteorological conditions making these cities more vulnerable to particulate pollution. Tab.2.1 presents the distribution of monitored cities by PM_{10} and SO_2 levels in 2003 and 2004.

Tab.2.1: Distribution of PM10 and SO2 levels in 341 monitored cities (in 2003-2004)

Distribution of PM_{10} levels	% of cities		Distribution of SO_2 levels	% of cities	
	2003	2004		2003	2004
$PM_{10} \leq 100 \mu g/m^3$	46	47	$SO_2 \leq 60 \mu g/m^3$	74	74
$100 < PM_{10} \leq 150 \mu g/m^3$	33	39	$60 < SO_2 \leq 100 \mu g/m^3$	14	17
$150 \mu g/m^3 < PM_{10}$	21	14	$100 \mu g/m^3 < SO_2$	12	9

About 50% of China's cities still could not meet national air quality standards. In 2003, 54% of the 341 monitored cities, sharing 58% of the urban population, reported annual PM_{10} levels in excess of $100 \mu g/m^3$, which is twice the U.S. yearly average standard. Three quarters of the

monitored cities have SO_2 levels below the U.S. annual average standard (60 μg/m^3), suggesting that particulate air pollution is likely to be a more important concern in the near future.

Surface water quality in China is poor in the most densely populated regions in spite of the rapidly increasing capacity of municipal wastewater treatment. Recent trends suggest that quality is worsening in the main river systems in the North, while improving in the South. In 2004, about 25,000 km of Chinese rivers failed to meet the water quality standards for aquatic life and about 90% of the sections of rivers across urban areas were seriously polluted (MWR, 2005). Out of 593 places where rivers were monitored by National Environmental Monitoring Network in 2006, 40% met the Grade I-III surface water quality standards, being safe for human being use, 32% met grade IV-V standards, and 28% failed even to meet Grade V. The water quality of the seven major river basins in 2006 is indicated in Fig.2.2. The southern Yangtze and Pearl rivers had better water quality than those in the north. Liaohe and Haihe rivers were heavily polluted. The main pollutants are COD, oil and NH_3-N (SEPA, 2007a). Pollution of lakes is also serious. Some degree of eutrophication appears in 75% of the lakes . Three large lakes, namely Taihu, Chaohu and Dianchi, were selected as key areas for water pollution control, and they failed to meet the Grade V water quality standard. Total nitrogen and phosphorus were the main pollutants (SEPA, 2005).

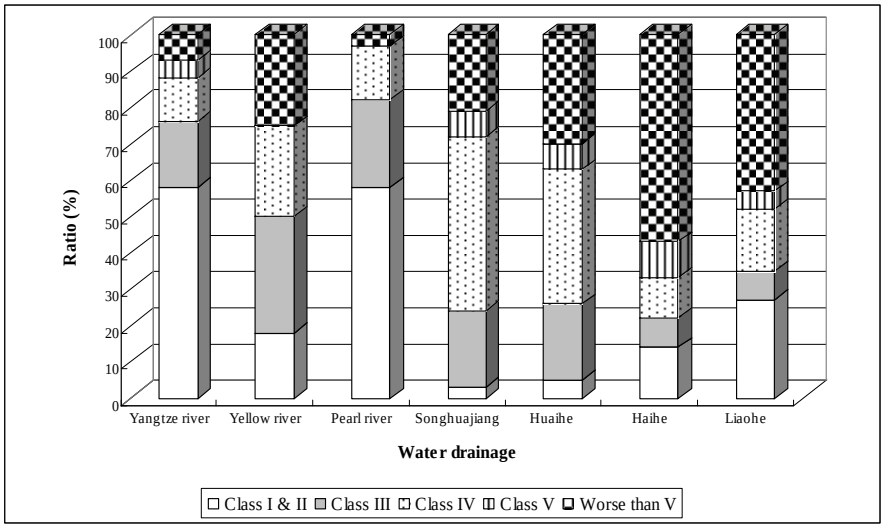

Fig.2.2: Water quality of seven major water drainages in China in 2006.

3.3 Cost of the environmental pollution

A World Bank study conducted in 1995 showed that air and water pollution damage, especially the dangers that fine airborne particulates posed to human health, have been estimated to be at least USD 54 billion annually, or nearly 8% of the GDP of China (World Bank, 1997). Many researchers (e.g. Rogers et al., 1997) also pointed out that GDP growth in China continued to reduce the opportunities of future generations to enjoy natural resources and the environmental

base for satisfying their needs.

According to another recent study co-organized by the State Environmental Protection Administration (SEPA, now escalated to the Ministry of Environmental Protection, MOEP) and National Bureau of Statistics (CAEP et al., 2006), the total cost of environmental pollution and deterioration was CNY 511.82 billion in 2004 and accounted for 3.05% of GDP in China. Pollution of water and air caused major environmental damage. It was shown that 55.9% and 42.9% of the total cost was due to water and air pollution, respectively. The cost of environmental damages by macro-regions is indicated in Fig.2.3. The cost of environmental deterioration in the 11 eastern provincial regions was CNY 283.13 billion, which was 55.8% of the total estimation. Those in the middle and western regions were CNY 132.17 and CNY 91.7 billion, respectively. Their share of local total GDP was 2.85%, 3.32% and 3.2%.

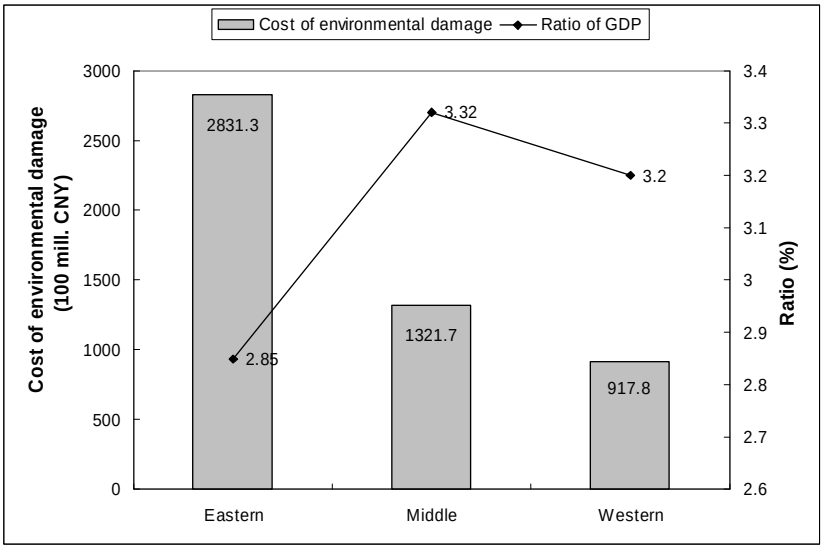

Fig.2.3: Cost of environmental damages by regions in 2004.

3.4 Pollution from manufacturing industries

Manufacturing industries are the major environmental polluters in China. Industrially sourced emissions accounted for 60-70% of national total pollution loads over the past two decades. Over 19.4 billion tons of wastewater, 7.04 million tons of organic pollutants in term of COD (Chemical Oxygen Demand), 16.12 million tons of SO_2, 9.53 million tons of soot, 10.92 million tons of powder dust and 31.83 million tons of industrial solid waste were released from industries in 2000 (SEPA, 2001).

Fig.2.4 shows the share of certain major pollutants discharged from industries out of the total amount of emissions during 2001-2005. The amount of industrial wastewater discharge accounted for nearly half of the total. The share of COD and NH_3-N fluctuated slightly at around 40% and 30% respectively. More than 80% of SO_2 emissions were from industrial

activities.

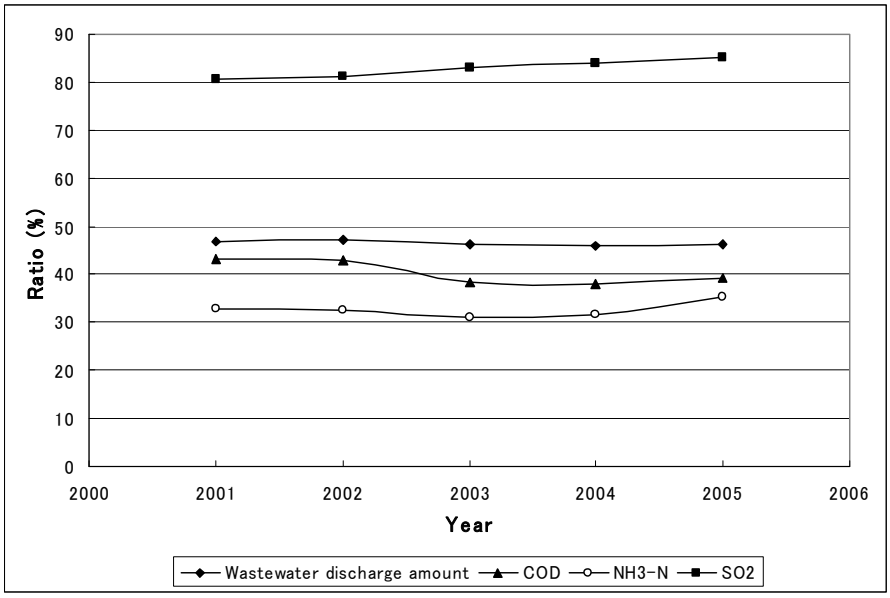

Fig.2.4: Contribution ratio of industries to the total emissions (2001-2005).

In particular, the sectors of pulp and paper, food production and processing, textiles and tanning contributed the most to water pollution with all these sectors retaining their respective shares of the Gross Industrial Output Value (GIOV). This implies that China has not substantially abated water pollution derived from industries by adjusting its industrial structure.

Between 1997-2005, there was a significant decrease in soot generated from fuel burning and dust from manufacturing processes. About 45% of soot and dust emissions were cut. Most industries hesitated to take measures to reduce their SO_2 emissions due to the lack of national policies and the high cost. There is great market potential for de-sulfurisation technologies and equipments.

The amount of industrial solid waste doubled from 659 million tons to more than 1.3 billion tons during 1996-2005. The integrative amount of wastes increased dramatically from 43% to 56.1%. There was an obvious increase in the generated waste to be disposed of. About 262 million tons of solid waste from industries was left out of proper management in 2005.

3.5 Institutional arrangement of CEM at the company level

Fig.2.5 shows a generalised and regular example of the institutional framework for environmental management of companies in China. The company usually has a specific board for environmental management. The general manager is the director of the board and the person in charge of environmental responsibilities. The environmental department acts as the administrative wing of the board. The members of the board are the head or representative of each department or production unit. Under the board, there are several sub committees which

deal with the main environmental impact factors of the company such as energy conservation, waste reduction, and chemicals management. The sub committees are headed by the staff on duty from the environmental department and made up of the representatives from other related departments. This institutional arrangement at the company level addresses the responsibility of the top leaders on environmental problems, and the participation of all units concerned in the company.

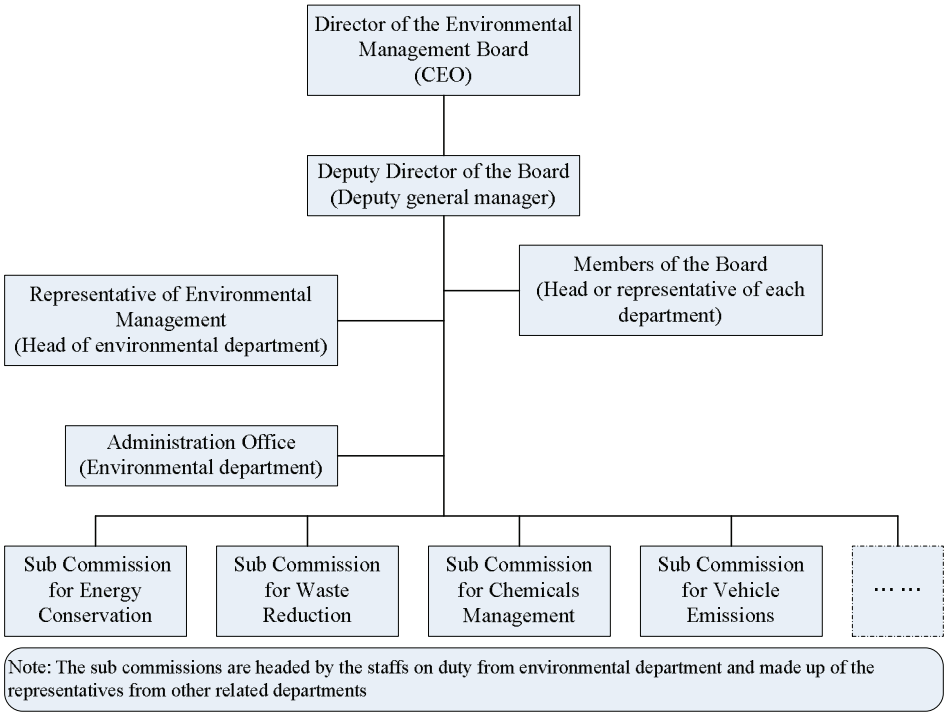

Fig.2.5: An example of institutional framework of CEM at the company level in China.

3.6 Proactive CEM practices in China

Besides activities to satisfy the environmental requirements of the government, some Chinese companies have started to adopt proactive CEM practices, like pursuing ISO14001 and eco-labelling certification, receiving cleaner production (CP) audit, or achieving better environmental performance by mutual cooperation.

The number of companies with ISO14001 certifications in China has expanded fast. A total of 18,979 organisations achieved the certification as of 2006. This ranked China as second in the world by the number of ISO14001 certificates, following Japan (Li, 2007). The five sectors holding the most ISO14001 certificates in 2006 are: construction; service; electrical and optical equipment; chemicals, chemical products and fibers; rubber and plastic products .

As a voluntary certification scheme, China's Environmental Labeling scheme recognises the efforts of producers on environmental friendly products and enhances the environmental awareness of the consumers. China Certification Committee for Environmental Labeling of

Products (CCEL) was formed in 1994. The Secretariat of CCEL is authorised by SEPA as the only organisation to conduct third party certification and award China Environmental Labels. Annual inspection and random sampling are carried out to ensure that appropriate standards are met. During 1994-2005, assessments were conducted in 800 enterprises, and 12,000 products were awarded the labels. The enterprises holding environmental labels gained a competitive advantage in domestic and international trade.

In response to the United Nations Conference on Environment and Development in 1992, China devoted itself fully to the sustainable development strategy, including preventive CP measures. In China's Agenda 21 published in 1994, CP was further regarded as a key strategy for achieving national goals of sustainable development, and from that point on, CP was introduced in China and began to be implemented in industrial sectors. As a result of the effort, China is now recognised as a developing country which has placed particular emphasis on CP advances (Duan, 2003). Some estimates show that CP audits contributed to a 20% reduction of emission from the enterprises while generating economic returns of 5 million CNY annually in average.

The concept of cycle economy (CE) was introduced into China and started to flourish since 2003. The theme of the CE is the exchange of materials where waste from one facility, including energy, water, materials as well as information, may become another facility's inputs. By working together, the business community seeks a collective benefit that is larger than the sum of the benefits which each individual enterprise, industry and community would gain. Development of eco-industries based on the CE theory is essential for China to reach an overall well-off society. To encourage eco-industrial initiatives in China, SEPA has supported pilot projects in eco-industrial development. As of May, 2007, SEPA had encouraged 26 demonstration sites of eco-industrial clusters to come into existence (SEPA, 2007b). These include 26 potential eco-industrial parks (EIP), one demonstration city (Guiyang city) and one demonstration province (Liaoning province) for CE at the national level (see Fig.2.6 for the locations of the pilot schemes).

3.7 Green supply chain management practices

All stages of a product's life cycle can influence the environmental burden of a supply chain. Green supply chain management (GSCM) has emerged as a systematic and integrated approach for some leading companies to seek win-win opportunities (Zhu and Sarkis, 2004). The degree of GSCM practices of Chinese enterprises was monitored in companies in the electricity supply, petrochemical, electric & electronic and automobile sectors (Zhu and Geng, 2006). It was found that Chinese companies did not integrate environmental management into the cooperation with their suppliers and customers. As described earlier, companies taking the lead environmentally have made efforts on internal environmental activities such as achieving ISO14001 certification and adopting CP measures. They have just started to think about external GSCM activities. The

companies lagging behind, which comprise nearly 20% of the total samples, had no plans for GSCM. The environmental and economic performances of the leading enterprises were better than the others.

In China, environmental pressure is much higher for large corporations than small ones. Conventional industries such as power plants face quite high pressure (Zhu and Geng, 2001). Automotive original equipment manufacturers (OEMs) have been required to take up environmentally-friendly practices by their clients, the auto-makers, since China's entry into the World Trade Organization (WTO)) in 2001. Chinese electronic companies showed better behaviour on GSCM (Zhu and Sarkis, 2006). Companies in China pay great attention to their chemical substance management in order to comply with the Chinese version of RoHs (Casio, 2007). Companies expect their suppliers to adhere to certain requirements and some also have added their own criteria. Acer, for example, requests suppliers to comply with the requirements of OHSAS18000 and SA8000 (Acer, 2007). Lenovo, requires its suppliers to meet its own Engineering Specification 'Baseline Environmental Requirements for Materials, Parts and Products for Lenovo Products' (Lenovo, 2007). China Mobile and eight major cell phone makers, including Nokia, Motorola and Bird, have participated in a 'Green Box' programme for recycling end-of-life cell phones and accessories. Cell phone consumers can dispose of their cell phones and accessories in recycling boxes at China Mobile stores and manufacturer sales and service centres.

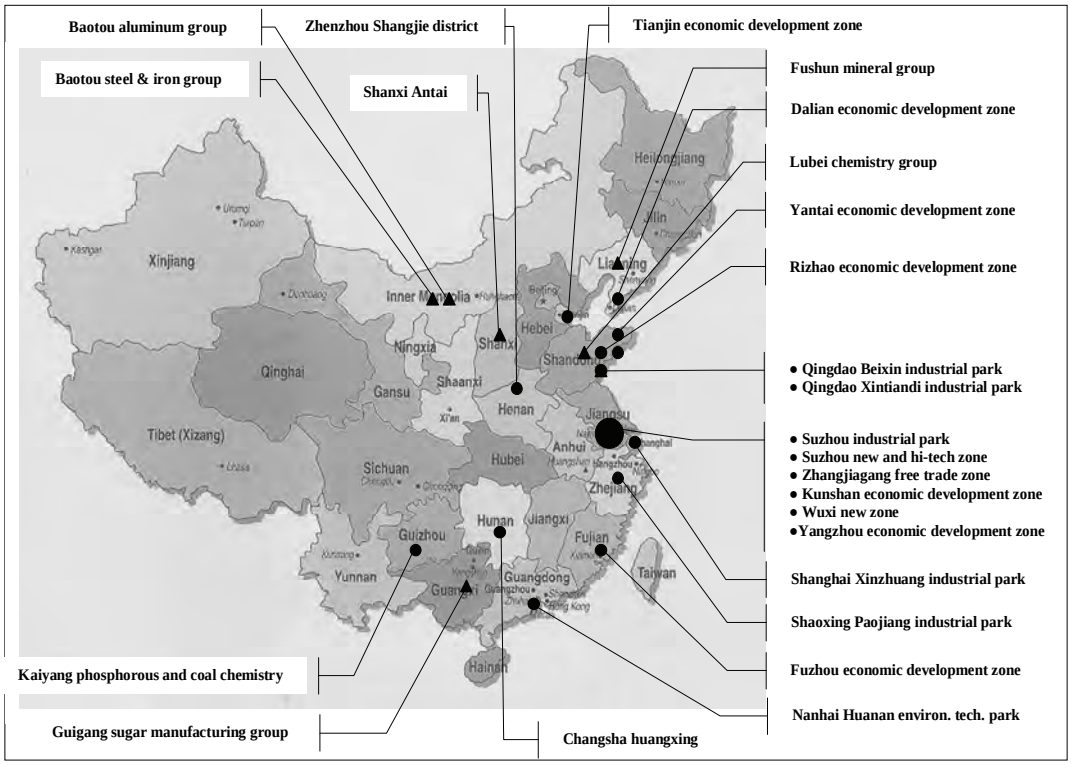

Fig.2.6: Locations of national eco-industrial development projects.

3.8 Industrial sectors focused on for CEM

Looking at energy intensities in 2005, non-metallic mineral products used the largest amount of energy per unit of value added. The key sectors in a decreasing order are smelting and pressing of ferrous metals, raw chemical materials & chemicals, petroleum & coking, smelting and pressing of non-ferrous metals, electricity production & supply, paper & paper products, etc. Based on the wastewater discharge data in 2005, the pulp and paper industries discharged 17% of the total industrially-sourced wastewater. The next sectors included chemical materials and products, electricity and heat production, ferrous metals processing, agricultural food processing, and so on. The top five industries shared nearly 58% of the total wastewater discharge from industries. Similarly, the sector with largest SO_2 emissions in 2005 was the production and supply of electricity and heat, which shared nearly 59% of the total SO_2 emissions of industries. Non-metallic minerals production, ferrous metals processing and chemical products manufacturing were also classified as major SO_2 polluters.

According to the comparison of energy intensities and environmental load contributions of the sectors, pulp and paper, textile, agriculture food processing, chemical products, non-metallic minerals, nonferrous metals, ferrous metals, petroleum and coking, and electricity and heat production & supply could be identified as key sectors with high environmental impacts. They may be selected as the targets for case studies for enhancing CEM in China.

4. Overview of CEM policies in China

4.1 Institutional framework for environmental protection

At national level, the following government organisations are involved in environmental protection.

(1) *The Environmental and Resource Protection Committee (ERPC) of the National People's Congress* is responsible for developing, reviewing and enacting environmental laws. It is also in charge of supervising the implementation of environmental regulations and the environmental performance evaluation of the government.

(2) *Ministry of Environmental Protection (MOEP)* is the highest administration responsible for environmental protection within the government. MOEP is responsible for developing environmental policies, programmes and standards, as well as, to some extent, supervising local Environmental Protection Bureaus (EPBs). MOEP deals with the activities that are of national significance. Local EPBs implement industrial pollution control rules and deal with enterprises on a daily basis.

(3) *A number of ministries and administrations of the State Council (other than MOEP),* such as *National Development and Reform Commission (NDRC), Ministry of Water Resources, etc.,* is involved in natural resource and environmental management, playing different but sometimes critical roles. One of the vice premier ministers is responsible for environmental issues.

At the local level, due to the great heterogeneity in various regions, Chinese local governments have plenty of discretionary powers in local administration by directing local economic development and providing public services. Local EPBs are created from provincial to municipal and county level governments (see Fig.2.7). They are the major departments of local government responsible for making and implementing environmental regulations. The People's Congress at all levels make environmental statutes and reviews the work of EPBs. EPBs receive budgets from the corresponding local government and collect effluent fees from enterprises under their jurisdiction. Since these bureaus are part of local administrations at the same level, MOEP has limited influences over EPBs although it does provide them with guidance on the implementation of policies. Only recently, MOEP acquired the right to comment on the nomination of the heads of provincial EPBs. Local EPBs should report to both an upper environmental protection department and the government to which they belong. The main responsibilities of local EPBs include:

- Overseeing environmental impact assessment and other procedures for new development projects;
- Monitoring pollution releases from industries;
- Assessing fees for pollution charges;
- Initiating legal actions against firms that fail to meet environmental requirements;
- Environmental reporting, education and awareness raising activities, etc.

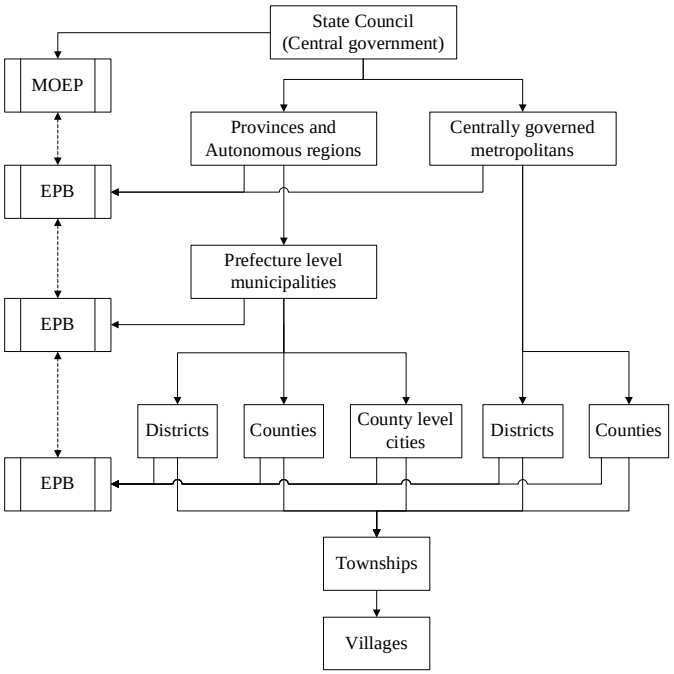

Fig.2.7: Local institutional structure for environmental policies implementation.

Both the number of environmental organisations and the staff have grown fast, especially in the second half of the 1990s. There were 166,774 staff working in the 11,528 organisations for environmental protection as of 2005.

4.2 Environmental legislative system

A relatively comprehensive environmental regulatory system has been established mainly by the Central Government of China. As indicated in Fig.2.8, subject to the Constitution of the People's Republic of China, the legal provisions related to the environment consists of laws, regulations, provisions and ministerial and local ordinances. All of them are based on the Environmental Protection Law. The laws and regulations, which form the legislative framework on environmental protection in China, can be classified as follows:

a) The constitution of the PRC [1982, revised in 2004]: Article 26 states that the nation protects and improves environment, and prevents pollution;

b) The Criminal Law of the PRC [1979, revised in 1999]: Article 9 states that who destroys environmental protection regulations should take penal offense;

c) The Environmental Protection Law [1989]: It is the basic law of environmental protection and was approved by the People's Congress of PRC;

d) Specialized Laws on environmental protection: such as prevention and control of water pollution, air pollution and so on;

e) The Environmental Impact Assessment Act of the PRC [2002]: It requires all major projects to implement an EIA and the EIA report must be approved by environmental

protection agencies before launching the project;

f) The Cleaner Production Promotion Act of the PRC [2002]: Companies who produce excessive pollutants and who use or produce toxic materials must implement cleaner production auditing;

g) Laws on resource protection: With relevance to environmental protection such as energy conservation, forest protection and so on;

h) Provisions for environmental protection prepared by MOEP and other related ministries, and approved by State Council, providing guidance on implementing laws;

i) Ministerial level regulations released by the departments under State Council;

j) Local provisions and regulations, seeking to address local particular environmental problems;

k) Environmental standards: including mainly environmental quality and emission standards, with most issued by MOEP but also including those issued by the provincial governments;

l) Multilateral Environmental Agreements (MEAs) to which China has agreed;

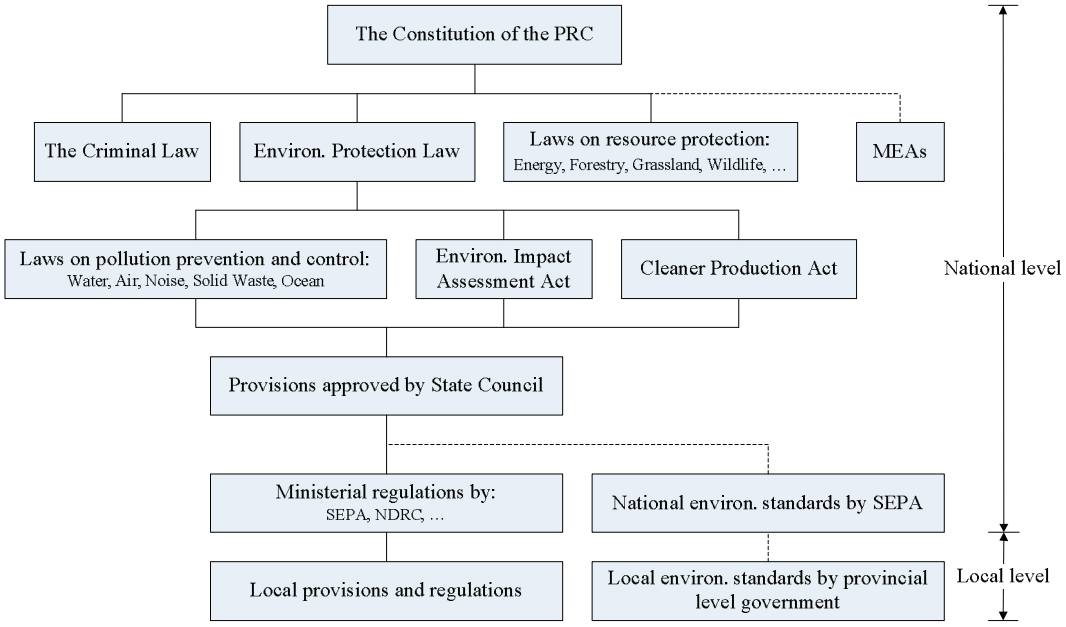

Fig.2.8: Environmental related legislative framework of China.

4.3 Environmental compliance and enforcement of companies

The monitoring and inspection of industries in China, as indicated in Fig.2.9, follows a precise procedure. Apart from regular inspection activities, it can be noted that complaints made by citizens regarding environmental incidents may increase the number of field inspections. If the polluters are found at fault, various administrative penalties may then be imposed. These may

also include a request for the polluter to install treatment facilities. In extreme cases, the plant may be ordered to cease and relocate its operations.

Even though several types of non-compliance sanctions are used by environmental authorities, a wide gap exists between what EPBs are authorised and what they actually do when enterprises violate environmental rules. In many cases, industrial polluters are more interested in saving the operational costs. The installed pollution control equipments are put in operation only when inspectors' visits are expected. A significant proportion of SMEs are not often inspected due to the lack of capacity or conflicts of interest between economic and environmental sections of the administration. Pragmatic enforcement also pushes EPBs to target big polluters first and leave SMEs untouched although their aggregated pollution volume may be much larger. Some local governments prohibit the environmental authorities from inspecting and imposing fees and fines on companies which are significant pollution contributors but are regarded as important to the local economy in terms of providing tax and employment. This kind of interference renders environmental enforcement ineffective.

As a result, the violation cases appeared to be increasing nationwide during 1998-2005 although the penalties for illegal environmental activities are becoming heavier. The environmental violation cases were about 40,000 in 1998. This number soon doubled and was around 90,000 cases in recent years.

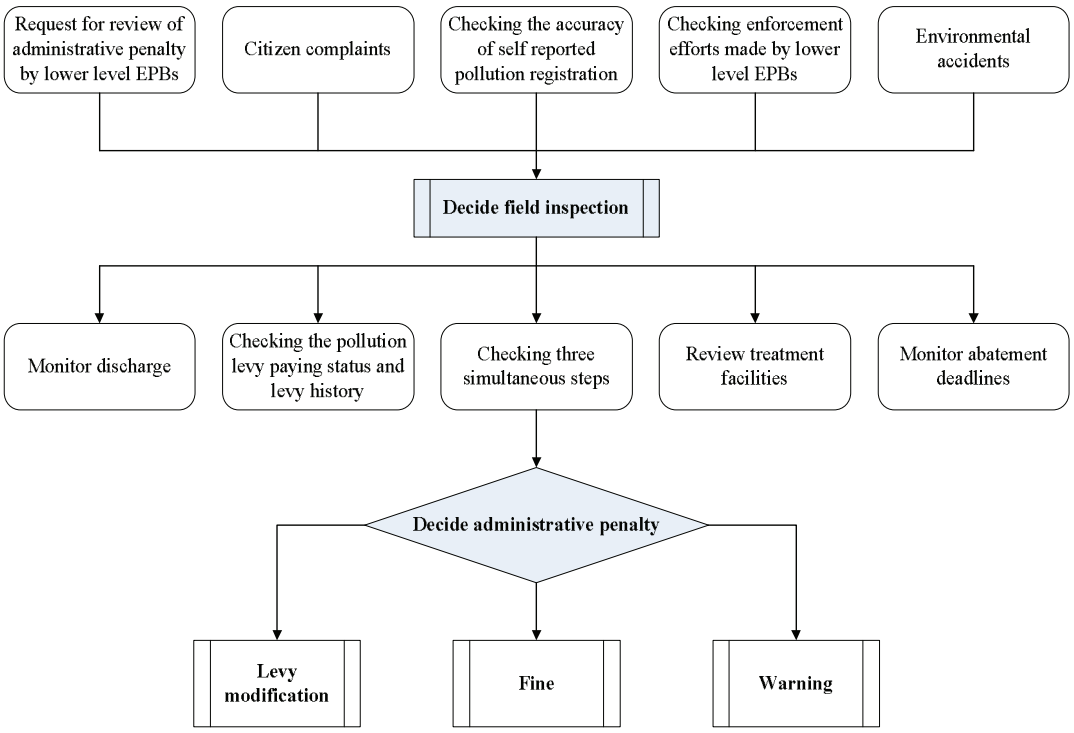

Fig.2.9: Procedures of field inspection to industrial facilities.

4.4 Market-based instruments for enhancing CEM

To complement the regulatory system, economic instruments have been adopted to curtail environmental pollution from industries in China. Discharge fees are calculated based on the concentrations and types of the pollutants in the effluents. These are applied to industries covering discharges of wastewater, waste gases, solid waste, noise and low-level radioactive waste. Pollution levies are collected by local EPBs with jurisdiction and earmarked for environmental protection purposes. The pollution fee charged during 1996-2005 increased quickly, especially after the enacting of new "Ordinance on the Management of Pollution Fee Charging and Utilization" in 2003. The total emission fees charged in 2005 reached CNY12.32 billion.

In addition, a financing mechanism for environmental protection has been set up by the government, which includes: funds for enterprise expansion and redevelopment, municipal maintenance funds, earmarked grants from revenues supported by the pollution levy, and provision for retention of enterprise owned profit resulting from waste reuse and access to bank credits. Supported by the growing economy, direct investments on the establishment of pollution control facilities increased dramatically (see Fig.2.10). The investment amount was CNY9.56 billion in 1996, which reached CNY45.82 billion in 2005. The investments for water and air pollution control grew steadily. They shared more than 75% of the total. On the growing curves, a sudden increase of investment on pollution control of the enterprises in operation occurred in 2000. It was because of a mandate issued by the central government in 1996 which required all the industries to meet national or local environmental discharge standards by the end of 2000. This kind of Chinese specific environmental enforcement campaign sometimes played certain roles.

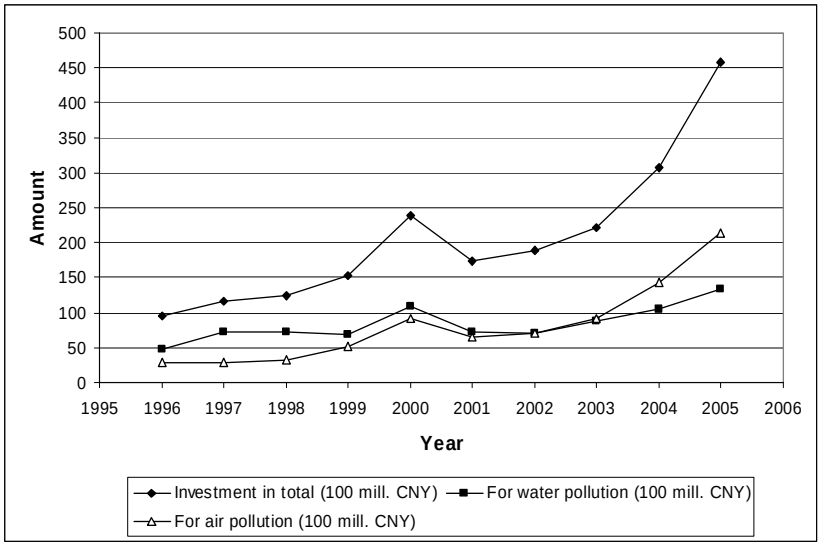

Fig.2.10: Pollution control investment for the enterprises in operation (1996-2005).

SEPA made efforts to stimulate companies to improve their environmental performances by introducing certain new economic tools.

A system allowing companies to trade major pollutants emissions is being developed and tested in certain areas of China. Under this system, the government sells the permits to enterprises, and for those that do not use up their quotas, they are allowed to sell the allowance to other enterprises that need additional permits. As a result, enterprises whose treatment cost is lower than the transaction price, can make profits through the trade. Moreover, they will abate their emissions as much as possible to gain more benefits. Meanwhile, enterprises that have a high impact on the environment will gradually reduce pollution for fear that the price would be too high for them to afford. The policy of emission trade impels enterprises to conserve their allowance for future use, and thus cut pollution discharge. A system allowing enterprises around Lake Taihu to trade water pollution permits has been tested since the beginning of 2008. Enterprises have to pay for the permits they initially get. COD was the first pollutant to be traded in 2008. In 2009, the trade expanded to ammonia nitrogen and total phosphorus, to gradually build up a trading market.

Chinese enterprises rely overwhelmingly on bank loans to finance their new projects and expansions. The Chinese government is working to develop a scheme of curbing environmental pollution by tightening loans to polluting enterprises. In June, 2007, the People's Bank of China (PBC) issued the ‘Guideline on Improving and Strengthening the Work of Financial Service in Environmental Protection Field’, indicating the principle of rationalising industrial structure through loan controlling. On 12 July 2007, SEPA, PBC and the China Banking Regulatory Commission (CBRC) jointly issued a policy called ‘Notes on Reducing Loan Risk by Enforcing Environmental Protection Policies and Regulations’, promoting “green credit” policy to all enterprises in the country. Soon after that, the ‘Notice on the Prevention and Control of Loan Risk from High Pollution and Energy Consumption Enterprises’ was released by CBRC. Some commercial banks also declared their own requirements with regard to green credit. For example, the Industrial and Commercial Bank of China (ICBC) proposed the establishment of one-vote veto system, which is that once an enterprise fails to comply with the environmental regulations, it is no longer eligible for loans.

SEPA periodically hands over the names of heavy polluters to the central bank and CBRC. Loans applied for by disqualified enterprises are strictly limited. The policy soon took effect, and is supported by most of the financial sectors and environmental departments at local levels. Environmental protection departments in more than 20 provinces and cities have cooperated with local financial regulatory sectors to issue green credit programmes and the implementation rules. According to news released by SEPA, 12 polluting enterprises have had crucial bank loans recalled, suspended or rejected by local financial sectors. However, the green credit policy still

faces technical difficulties, such as inadequate exchange of information between relevant sectors, lack of detailed guidelines for green loans, and not enough incentive tools to attract the banking sectors (Pan, 2008). Recently, SEPA signed a deal with the International Finance Corporation (IFC) to introduce Equator Principles, a globally-recognised benchmark for social and environmental issues with consideration to project finance, to promote sustainable development in green credit policy.

Taking 'green credit' policy as the first step, SEPA soon introduced the second economic policy. In December, 2007, SEPA, together with China Insurance Regulatory Commission, issued the 'Guidelines on Environmental Pollution Liability Insurance', officially drawing up a roadmap to establish an environmental pollution liability insurance system. Pilot projects have been carried out in key industries and regions to gradually promote the new system. Since the insurance premium is proportional to the severity of pollution, it urges enterprises of high environmental risk, facing expensive premiums, to improve their environmental performance.

4.5 Informal approaches for promoting CEM

SEPA and some local EPBs evaluate industrial performance within their jurisdictions and name excellent performers 'environmental friendly' or 'green' enterprises. From 1989 to 1997, this kind of assessment was conducted six times, and 500 enterprises were awarded 'National Advanced Enterprise on Environmental Protection'. The effect of such a programme seems limited since there is a lack of follow-up measures to enable excellent environmental performers to capitalise on their environmental friendly behaviours.

Other compliance promotion tools include faster approval of upgrading or expansion of pollution control installations, and lower inspection frequency the good environmental performers. In overall, compliance promotion in China is less developed than punitive measures. The EPBs seldom provide technical assistance to help the industrial polluters clean up, and rarely impose compliance schedules with differentiated penalties to induce polluters to reach compliance levels or even perform better.

In more recent years, environmental information disclosure was attempted to promote company environmental performance. 'Measures for the Disclosure of Environmental Information (for Trial Implementation)', enacted from 1 May 2008, enables in-depth participation of the public in environmental affairs. The public can request the government and certain enterprises to publicise their information. Enterprises exceeding pollution emission standards are requested to disclose four kinds of information and other enterprises are also encouraged to voluntarily publicise their environmental information on a wider range.

Since 1998, SEPA worked together with experts from the World Bank and Nanjing University to establish 'Green-Watch', a public disclosure programme for polluters. Following specific

procedures and using certain indices, enterprises are rated from best to worst using five colors: green, blue, yellow, red and black, standing for excellent, good, fair, bad, and very bad respectively. The programme draws on four principal sources of information: reports on pollution emissions of industrial companies; inspection reports; records of public complaints, regulatory actions and penalties; and surveys that record company characteristics that are relevant for rating environmental performance. The ratings are disseminated to the public through the media. Municipal-level pilot Green-Watch programmes were implemented. Zhenjiang, Jiangsu Province and Hohhot, Inner Mongolia are the two pilot cities. Reactions to these programmes are positive, and many firms chose to improve their environmental performance. After the disclosure, the companies made active responses and communicated with environmental management sectors to discuss how they could improve their ratings. From the pilot disclosure period to the public disclose phase in Zhenjiang, the percentage of companies with superior performance (Green or Blue) rose from 31% to 62%, and the overall compliance rate (Yellow, Blue or Green) increased from 75% to 85% (Wang, et al., 2004).

As the results were encouraging, Jiangsu EPB started to promote the programme in the whole province in 2000. The number of enterprises rated then increased to 12,257 in 2007 compared to 1,059 in 2001. As shown in Fig.2.11, together with the dramatic growth of number of enterprises, the total compliance rate also increased.

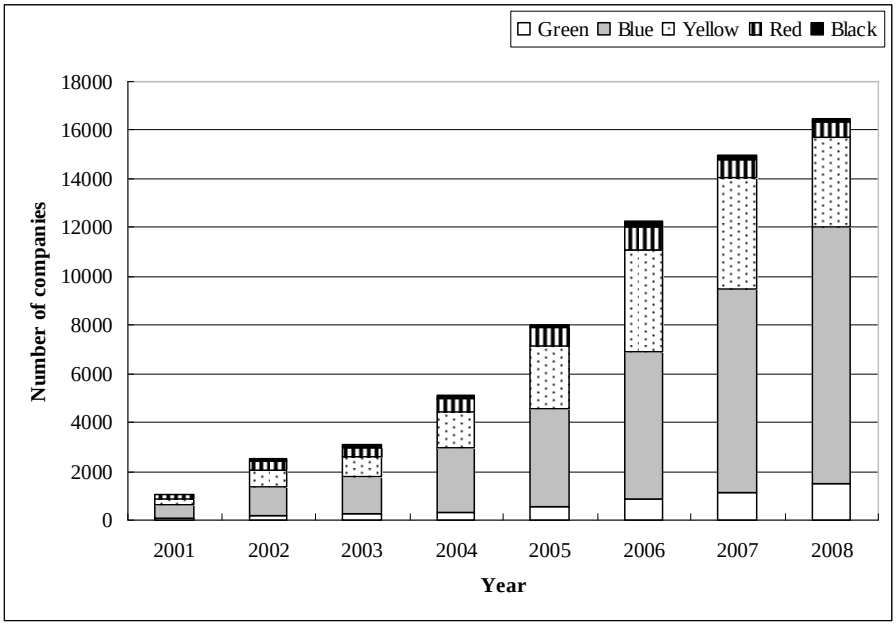

Fig.2.11: Performance ranking results during 2001-2008 in Jiangsu Province.

In 2003, SEPA started to launch pilot programmes in other areas, such as Zhejiang, Anhui, Shandong and Gansu Provinces in preparation for nation-wide implementation. In 2005, 'Technical Guide for Corporate Environmental Performance Rating' was released to instruct

local departments. Although some local governments tend to conceal information on poor environmental performance by companies within their jurisdiction, the compliance performance rating system is used by the banks as a guide for giving loans to individual companies in some provinces. This system may well prove to become a persuasive instrument to foster greater environmental responsibility in industry.

5. Perspective of CEM policies in China

The National Five-Year Social and Economic Development Plan (FYP) is the basis for coordinating public policy priorities in China. In line with FYP, the Chinese environmental authority has developed a Five-Year Environmental Plan (FYEP). The 11th FYP (2006-2010) was adopted in March 2006. Moving away from planned economic and production targets, this document set broader and ambitious goals and planned a set of public investment projects. Environmental targets were also identified in the overall plan (see Box 2.1 below). In order to meet the environmental targets, CEM should be strengthened by combined measures in the future.

Box 2.1: Environmental targets in the 11th FYP (2006-2010)

- Reduce energy intensity by 20%;
- Reduce water consumption per unit of industrial value-added by 30%;
- Maintain water consumption for irrigation in agriculture at current level;
- Increase recycling of industrial waste by 60%;
- Retain the area of farmland at 120 million hectares;
- Reduce the total discharge quantity of major pollutants by 10%;
- Reach forest coverage of 20%

5.1 Industrial restructuring

The current industrial structure is irrational in China. The production capacities carry a surplus but have low quality in some sectors or geographical regions. Companies are consuming large amounts of energy and natural resources, causing the cost of the products to rise and placing a heavy burden on the environment. Many companies are reducing their overall competence by continuing to use less advanced or even out-of-date technologies. Economic growth in China is mainly driven by industrial manufacturing, in which heavy industries have a big share. The adjustment of industrial structure is expected to play a key role for energy conservation and emission mitigation in the 11th FYP and in the medium term. The indicator of energy consumption of per unit of GDP has been regulated by NDRC as a kind of mandatory index. On fixed capital investment, a project will not be approved if it cannot pass checks on its performance with regard to energy conservation. SEPA even suspended approval to all new

projects in certain listed regions to restrain the expansion of industries with high pollution and energy consumption.

5.2 Greening the industries using a combined approach

In China, compulsory enforcement is still the dominant method for CEM. In the past, government authorities at different levels actually provided limited supportive assistance to companies by promoting the dissemination of good pollution control practices or giving some financial aid. Economic incentives are not effectively used for encouraging the industries to improve their environmental performances. The government has introduced related stakeholders to participate in management and supervision of the implementation of CEM. Supportive and encouraging policies are made to enhance interactions between the multi-actors. Other than pressure caused by stricter environmental regulations, the introduction of market and civil society has meant that companies are facing many-faceted pressures. Information-related tools have made access to environmental information easier than before, strengthening citizens' partnership in promoting CEM. Companies are striving to seek a balance between economic benefits and environmental performance.

From the future perspective, China should adopt a combined approach which is more effective for the solution of complex environmental problems. More measures should be studied and introduced which could create sufficient pressures from economic or social aspects to companies which fall behind in terms of environmental compliance. Market-based tools should play more of a role in energy conservation and emission mitigation, alongside enforcement efforts. Environmental economic policies may become hot topics for China in near future.

An integrated policy framework is therefore proposed as in Fig.2.12 for promoting CEM. Environmental policies should be more feasible and should be more strongly enforced. Inspection capacity needs expansion in order to keep a wider watch on company behaviour. Since information-related tools play a significant role, government at all levels has the responsibility to provide credible environmental information to the public. Accurate environmental data is the basis for implementing many incentive tools, such as green credit policy. Well-established benchmarks and impartial judgment are absolutely necessary for corporate environmental disclosure strategy. Increased public participation may also contribute to a more effective, efficient and transparent system of environmental governance.

In order to testify the effectiveness of the optional policies or business strategies, the major factors for the decision-making process of enterprises on environmental issues should be identified. The relationship between CEM behaviours and corporate economic performances shall be quantitatively evaluated by case studies.

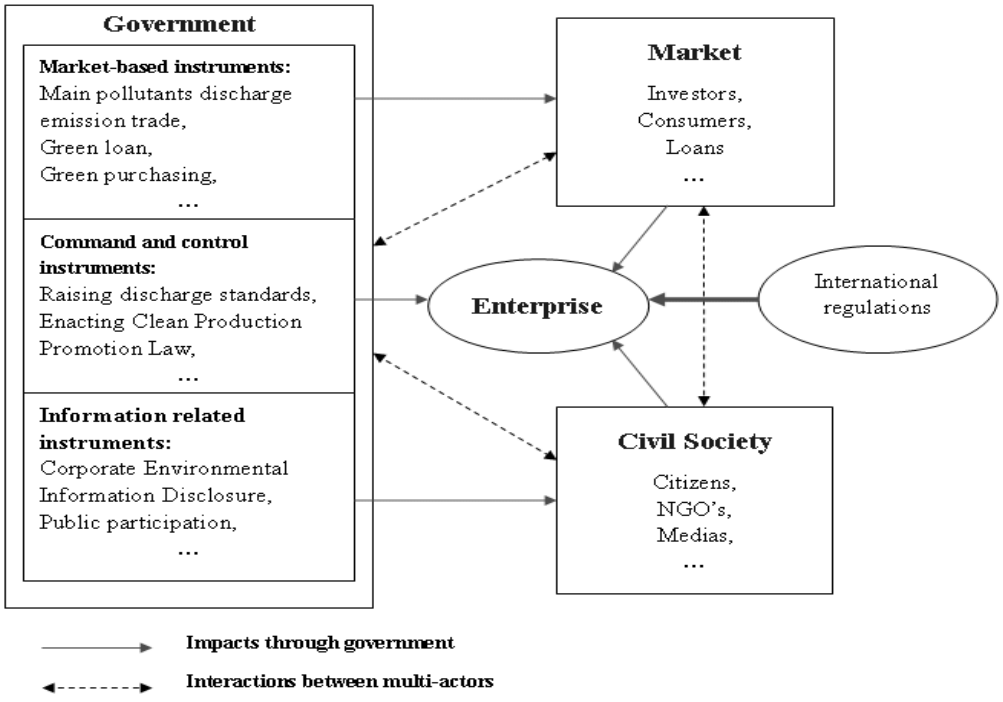

Fig 2.12: An integrated policy framework for promoting CEM in China.

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Chapter 3: Determinant factors of proactive CEM in China

1. Introduction

Since the 1980s, a series of environment-related laws and policies have been enacted and carried out in China to harmonise the development of the economy, society and the environment. Chinese environmental policy can be typically classified as a regulative model in the past. The regulatory-dominated approach has played an active role in alleviating further environmental deterioration. However, the traditional command and control measures for industrial pollution control, which solely address the simple interactions between government and business as the determinant of company environmental performance, are insufficient partly due to the weak enforcement capacity at the practical level. There is strong evidence to show that Chinese companies are becoming more aware of the importance of environmental issues and trying to improve their environmental performances. With the purpose to go beyond basic compliance and fulfill higher environmental values, some of them have started certain proactive environmental practices like self-reporting of environment-related information (Liu and Anbumozhi, 2009). The environmental behaviour of Chinese companies has been influenced not only by the government but also by other stakeholders like investors, surrounding residents, industrial associations, as well as employees themselves (Clark, 2005).

Nevertheless, it is unclear so far to what extent improved environmental performance by Chinese companies could be attributed to the ongoing policy changes. As is well known, the barrier to further development of alternative environmental instruments lies in understanding whether the approach is well-suited, and then making the company respond effectively. This gap prioritises research exploring the elementary motivations and principal factors which may shape the way a company engages in environmental efforts. By observing the driving factors behind proactive management activities by companies in China, we aim to analyse both the influences of external stakeholders and t internal factors indicating the capacity to moderate existing external pressures. Beyond developing a comprehensive framework on how the classified factors may determine proactive environmental practices, various measures are practiced to clarify the relationships between the institutional drivers, company characteristics and proactive environmental behaviours.

2. Analytical framework

The analytical framework, depicted in Fig.3.1, admits the importance of externally coercive, normative and mimetic factors recognised by the institutional sociology (DiMaggio and Powell, 1983). It is expected to illustrate the complementary nature of the drivers for Chinese companies at an early stage of environmental policy transformation. However, the institutional perspective

neglects certain fundamental issue of business strategy, such as why organisations subject to the same level of external institutional pressures perform differently (Prakash, 2000; Gunningham et al., 2003). Referenced from the reasoned action theory (Ajzen and Fishbein, 1980), we hypothesise that companies adopt heterogeneous sets of environmental practices also due to the individual interpretation of objective external pressures. The difference between 'objective' and 'perceived' pressures may explain the diverse responses of a company. Our model adds two internal organisational factors, namely orientation of environmental strategy and learning capacity, to jointly explain the proactive environmental practices at company level. This approach may reasonably complement the institutional theory as it views company characteristics as moderators to magnify or diminish the influence of externally institutional pressures. The determinant factors are identified as follows.

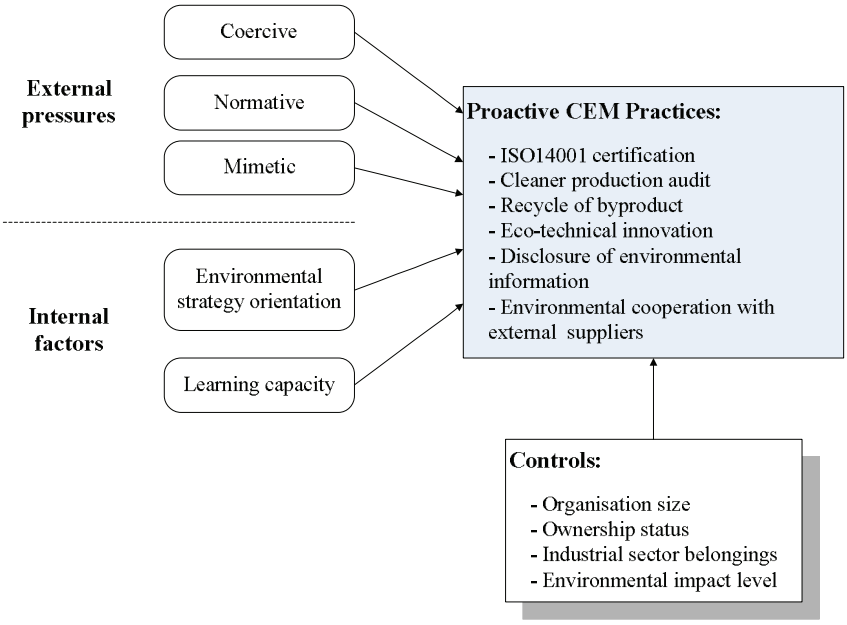

Fig.3.1: Analytical framework and determinant factors for proactive CEM.

2.1 Externally institutional pressures

In this analysis, we focus on the subset of institutional actors which are most likely to influence environmental practices at a plant level, including coercive pressure from the organisations holding mandatory power, normative pressure from the industrial association and the public, and mimetic pressure from the competitors in the same sector.

Coercive pressure:

The most obvious actors that influence the adoption of environmental practices are various government agencies. These agencies are authorised to promulgate and enforce regulations, and accordingly have coercive power over the related companies. Delmas (2002) found that governments play an important role in the adoption of certain voluntary environmental activities like the implementation of ISO 14001. The governments may give a clear message to encourage

proactive environmental actions by either providing some incentives or announcing in advance mandatory environmental requirements for the next phase. The coercive pressure from foreign countries or international organisations may also influence company environmental behaviors. Christmann and Taylor (2001) indicated that exporting manufacturers are more active in pursuing ISO14001 certification. In our analysis, the intensity of environmental enforcement and the export level of products are referred to as domestic and international coercive drives respectively.

Normative pressure:

Normative pressure results from norms defined by institutions like industrial associations. The public may impose normative pressure on companies via environmental activism or filing citizen's lawsuits. Previous studies found that a company's decision on environmental practices is influenced by the desire to manage its relationship with the public. A survey of ISO 14001 certified companies across 15 countries showed that one of the strongest motivating factors for the certification was the desire to be a good neighbour (Raines, 2002). Normative pressure also comes from professional networking such as industrial associations (King and Lenox, 2001). Although industrial associations still appear to be weak in China, their influence on corporate proactive environmental practices bears a test. Frequency of the public complaints and the influence of industrial associations are used to represent the normative pressures.

Mimetic pressure:

Besides governmental and public actors, companies may facilitate mimetic isomorphism. For instance, multinational companies are widely viewed as important agents in the diffusion of practices by transmitting techniques to their subsidiaries and other firms in the host countries (Arias and Guillen, 1998). Customer preferences on environmental issues are important and thus greatly affect decision-making. In order to keep a comparative competence, companies are likely to mimic the practices of leading companies in their sector. The overall level of environmental management of the industrial sector is therefore used to indicate the strength of mimetic pressure.

2.2 Internal factors

Two internal factors - orientation of environmental strategy and learning capacity - are added for a better understanding of why particular optional environmental strategies are chosen (Yang and Zhou, 2005).

Environmental strategy orientation:

The immediate antecedent to behaviour is behavioural intention and willingness. Awareness of problems and subjective social norms, in turn, affect the formation of behavioural willingness. Because a vast majority of companies in China are small and medium sized, the top managers

decide most of the operational issues. Their environmental willingness is more necessary for companies to be environmentally proactive since environmental initiatives require a higher managerial commitment than other operational things (Ramus and Steger, 2000). As the antecedent to willingness, awareness of environmental problems is selected as another variable for environmental strategy orientation.

Learning capacity:

The environmental performance improvement of a firm is a dynamic process highly related to the abilities of the firm's members (Hart, 1995)**.** A company's learning capacity can be used as an indicator to present its ability for practicing proactive environmental activities. The employee's ability for implementing new environmental approaches is usually enhanced by self-learning, professional education and job training. The education level of employees and the frequency of internal environmental training are adopted as proxies of learning capacity since the former is the basis for learning capacity, and the latter can promote capacity of environmental management (Yang and Zhou, 2005).

3. The study area - Changshu city

The survey was conducted in Changshu city of Jiangsu province, China, as indicated in Fig.3.2. This county-level city is located in front of the Yangtze River delta. It has a land area of 1,094 km^2 and a population of over one million. The total GDP of the city increased from USD 821.04 million in 1988 to USD 12.78 billion in 2007. The GDP per capita reached about USD 12,000 in 2007. Regarding the industrial structure, proportion of tertiary industry increased from 18.84% in 1988 to the current 39.05%, while the share of manufacturing industry remains stable at around 60% *(CSB, 2008)*.

As the life of people there improves, they call for better environmental qualities. The residents and media are increasingly concerned about the environmental performance of companies. Local government has explored certain innovative measures to encourage the public to act against industrial pollution. As examples, roundtable meetings, normally attended by residential delegates, company representatives and governmental officials, provide chances for achieving consensus on environmental issues through dialogues. The establishment of an environmental hotline helps the public to complain about bad environmental behaviour (Liu et al., 2008). With stricter supervisions by the government and the public, it becomes more difficult to commit environmental violations. Various environmental practices have been taken by the companies, including certain proactive efforts such as cleaner production audit, ISO 14001 certification and environmental management through supply chains. The better background of Changshu on environmental management provides us with the possibility to test the roles of identified factors on the proactive environmental behaviour of a company. In addition, Changshu has been

honored as National Garden City, National Model City for Environmental Protection, and National Ecological City due to its environmental achievements (CSEPB, 2009). The city's environmental protection status may represent the current situation of most China's developed areas.

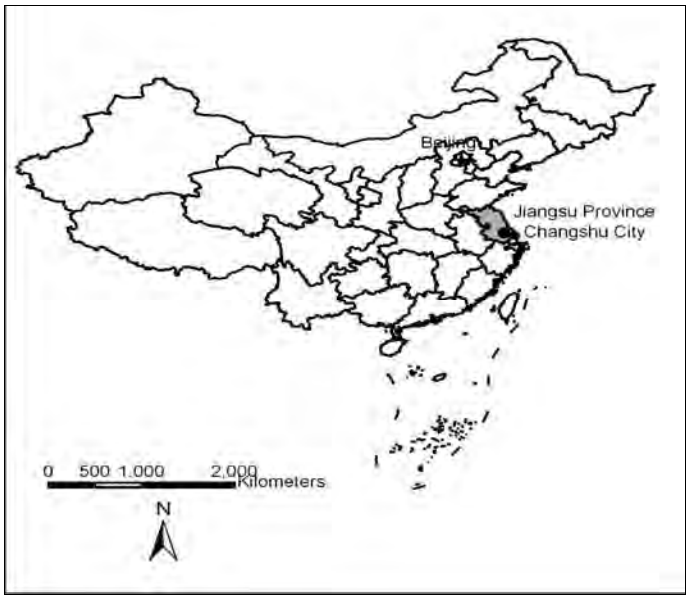

Fig.3.2: Geographical location of Changshu city.

4. Samples and data used for the analysis

The data of this study was collected by a questionnaire survey conducted in Changshu from April to September 2008. Based on a preliminary understanding of the contextual background of the study area, a questionnaire was prepared to monitor the proactive environmental behaviour and classified factors of companies. The questionnaire format consists of three major components: general information of the company; proactive environmental management behaviors such as whether the company passed ISO14001 certification; and the degree of pressures being felt by the company.

The survey targeted the managers to ask for their knowledge of environmental issues affecting their companies. Over a period of approximate six months, the survey was done in three steps. Six local government officials and thirty companies were contacted at the very beginning to clarify the status of CEM in the city. Then a tentative questionnaire was sent to 51 companies situated in an Economic Development Park to test its feasibility for response. The finalised questionnaire was then posted to 1300 companies on a list provided by the city's environmental protection bureau (EPB). A total of 132 companies responded, meaning a 10.2% response rate achieved. Amongst the respondents, 117 were confirmed to be valid. The distribution of usable samples by industrial sectors is listed in Table 3.1.

Table 3.1: Distribution of the surveyed samples and respondents by industrial sectors

Sector	Number of samples	Percentage	Number of respondents	Percentage
Paper	3	0.2	1	0.9
Textile, dyeing and clothing	367	28.3	14	12.0
Chemicals	237	18.2	30	25.6
Metals and non-metals	247	19.0	28	23.9
Machinery and equipments	116	8.9	9	7.7
Power generation	8	0.6	5	4.3
Others	322	24.8	30	25.6
In total	1300	100	117	100

5. Econometric approach

5.1 Econometric model

Adoption of proactive environmental behaviour is hypothesised to be jointly determined by the external and internal factors identified. The externally coercive, normative, and mimetic pressures are hereby indicated by vector ***C***, ***N*** and ***M***, respectively. Similarly, environmental strategy orientation is represented by a vector ***E*** and learning capacity is represented by a vector ***L***. Other company characteristics, such as size, ownership status, etc., are indicated by a vector ***Ch***, which may also influence the decision process of environmental issues. They are defined as control variables in the analysis. As stated, proactive environmental management level (EML_p) can be presented in a reduced-form as in Equation (3.1).

$$EML_p = f(C, N, M, E, L, Ch) \qquad \text{(Equation 3.1)}$$

5.2 Dependent variable

The EML_p is the dependent variable. It is difficult to measure the level of company environmental management since it does not necessarily equal the sum of environmental plans and tools. A feasible way is to list a series of adopted environmental management activities (EMAs), which could reflect the CEM level. For this analysis, the number of proactive EMAs under implementation is defined as the substitutive variable indicating a company's EML_p.

As listed in panel A of Table 3.2, six typical EMAs were selected as current proactive behaviours by Chinese companies. These practices are all beyond the requirements of existing mandatory regulations. Since the relative importance of each practice is difficult to quantify, the six practices are assumed to be equally contributing to company EML_p. A value of '1' is assigned to a practice if the firm has adopted it. Otherwise, a score of '0' is given. Each item of EMAs will obtain a score of '1'or '0'. The sum of the scores of the six practices is used to

represent company EML_p. A higher score reflects a higher level of proactive environmental efforts.

Table 3.2: Variable definition, proxies and valuation

Variable		Proxy	Valuation					
			0	1	2	3	4	5
Panel A: Dependent variable								
EML_p		ISO14001 certification						
		Cleaner production audit						
		Recycle of byproduct						
		Eco-technical innovation						
		Disclosure of environmental information						
		Environmental cooperation with external suppliers						
Panel B: Independent variables								
External pressures	Coercive	Intensity of environmental enforcement (REGULATION)						
		Export rate of the product (EXPORT)						
	Normative	Frequency of the public complaints (COMPLAINT)						
		Influence of the association of industrial sector (ASSOCIATION)						
	Mimetic	Level of sector environmental management (SECTORLEVEL)						
Internal factors	Environmental orientation	Awareness on environmental problems (AWARENESS)						
		Willingness to solve environmental problems (WILLINGNESS)						
	Learning capacity	Education level of the employees (EDUCATION)						
		Frequency of internal environmental training (TRAINING)						
Panel C: Control variables								
Characteristics of the company		Organisation size (SIZE)						
		Ownership status (OWNERSHIP)						
		Industrial sector (SECTOR)						
		Environmental impact level (ENVIMPACT)						

5.3 Independent variables

The independent variables ***C***, ***N***, ***M***, ***E*** and ***L*** individually represent coercive, normative and mimetic pressures, environmental strategy orientation and learning capacity. The proxies of these factors are listed in panel B of Table 3.2. Except the 'Intensity of environmental enforcement', the descriptions of the other independent variables were directly used as the survey items in the questionnaire. The level of effluent fee, which was frequently adopted by previous studies to represent non-compliance sanctions for Chinese companies, is used as a proxy indicating the 'Intensity of environmental enforcement' (Zhang et al, 2008). In our survey, companies were asked to judge the overall levels of their effluent fee charged by the government.

As expressed in panel B of Table 3.2, a five-level method was basically used for the valuation of independent variables. The companies were requested to give a value to measure the level,

strength or the agreement degree of each factor with '1' = very low; '2' = relatively low; '3' = moderate; '4' = relatively high; and, '5' = very high. The only exception is the export rate of a product, which used a four-level classification with '4' representing more than half of the products being exported; '3' having a 25-50% export ratio; '2' being a 10-25% export ratio; and '1' meaning an export ratio of less than 10%. This categorisation of the export rate is adopted to indicate the coercive power of international regulations since a company with a higher export level is more likely to be affected by international rules (Yang and Zhou, 2004).

5.4 Control variables

As indicated in panel C of Table 3.2, organisation size, ownership status, industrial sector, and environmental impact level are defined as control variables (represented by SIZE, OWNERSHIP, SECTOR and ENVIMPACT, respectively). For the valuation, size is divided into three categories by company turnover in 2007. Ownership consists of five types and the industrial sector is classified as having traditional and high-tech industries. The environmental impact level is rated on a scale of '1' to '5' with '5' being very strongly adverse and '1' being very slightly adverse impact.

5.5 Econometric model

According to the above explanations, the regression equation capturing the functional relationship between the EML_p and the listed variables can be constructed and expressed by equation (3.2), where ε represents the error term and β_0 is the constant.

$$\begin{aligned} EML_p = {} & \beta_0 + \beta_1 REGULATION + \beta_2 EXPORT + \beta_3 COMPLAINT \\ & + \beta_4 ASSOCIATION + \beta_5 SECTORLEVEL + \beta_6 AWARENESS \\ & + \beta_7 WILLINGNESS + \beta_8 EDUCATION + \beta_9 TRAINING + \beta_{10} SIZE \\ & + \beta_{11} OWNERSHIP + \beta_{12} SECTOR + \beta_{13} ENVIMPACT + \varepsilon \end{aligned} \tag{3.2}$$

6. Results and discussions

6.1 Statistical summary of the independent and control variables

Table 3.3 summarises the independent variables. It is indicated that most companies are aware of their environmental problems (with an average of 4.39) and express higher willingness to make efforts (averaged at 4.02). The internal environmental training is frequently carried out in the sampled companies although the average education level of the employees is low. The environmental enforcement intensity is moderately felt probably because the majority of companies have been in compliance. The sampled companies are not often complained about by the public such as neighbouring citizens.

Regarding the control variables, most of the samples are small and medium sized. Large

companies, with an annual turnover of more than CNY 300 million, account for 8.6% of the total. Small enterprises, whose annual turnovers are below CNY 30 million, share 47.6%, and the remaining 43.8% is medium enterprises. The ratios of collectively owned, private, wholly foreign-funded, joint venture and other types are 5.3%, 24.6%, 16.7%, 21.1%, and 32.5%, respectively. Nearly two-thirds of the samples are classified as traditional industry, while companies belonging to high-tech industry share one third. Fig.2.3 shows the environmental impact rated by the companies themselves. Most of companies regard their environmental impacts as slightly or very slightly adverse (with shares of 50.9% and 42.1%). Only 2.6% of them think they have very strongly adverse impact on the environment.

Table 3.3: Summarisation of the independent variables

Variables	Obs.	Mean	Std. dev.	Min.	Max.
REGULATION	109	3.29	0.72	1	5
EXPORT	101	2.15	1.24	1	4
COMPLAINT	117	1.53	0.68	1	3
ASSOCIATION	116	3.29	1.10	1	5
SECTORLEVEL	116	3.53	0.86	1	5
AWARENESS	115	4.39	0.62	3	5
WILLINGNESS	113	4.02	0.88	1	5
EDUCATION	107	1.93	1.01	1	5
TRAINING	117	4.16	0.82	2	5

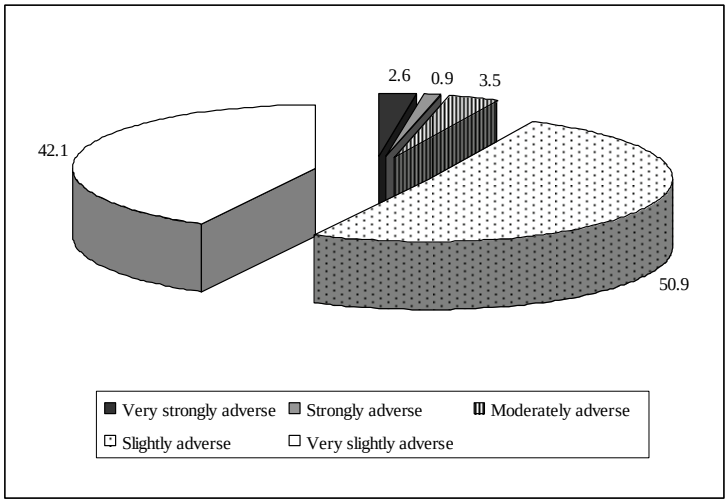

Fig.3.3: Distribution of environmental impact level (rated by the companies themselves, N=117).

6.2 Proactive environmental management behaviour

Fig.3.4 provides a summary of proactive environmental management practices adopted in the companies that responded to the survey. Recycling of byproducts is the most adopted practice (71.8%). Two-thirds of companies have cooperated with external suppliers on environmental issues to a certain degree, e.g., half of the companies expressed concern about the environmental

behaviour of their suppliers. Companies which passed ISO14001 certification and carried out a cleaner production audit have a relatively low ratio of 35.9% and 38.5%, respectively.

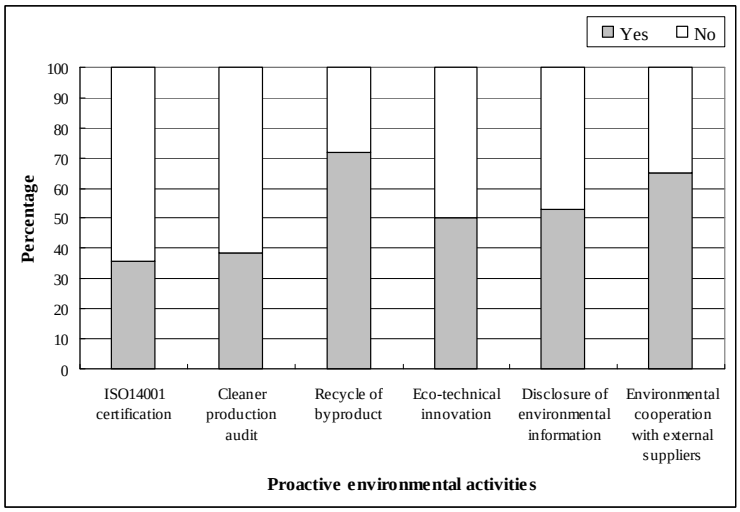

Fig.3.4: Distribution of proactive environmental activities (N=117).

Although more than half of the companies are disclosing environmental information in different ways, as indicated in Fig.3.5, it is easier for them to disclose subjective information like environmental goals and action plans. They are reluctant to share information on actual performances, such as pollution load and environmental-related difficulties. Fig.3.6 shows the distribution of the level of proactive CEM behaviour of the respondents. The average EML_p is 3.15 indicating a moderately lower level of the samples to adopt proactive environmental activities. Less than 10% of the 117 respondents are practicing all six kinds of environmental activities, whereas nearly 60% of them are just implementing three environmental activities or less.

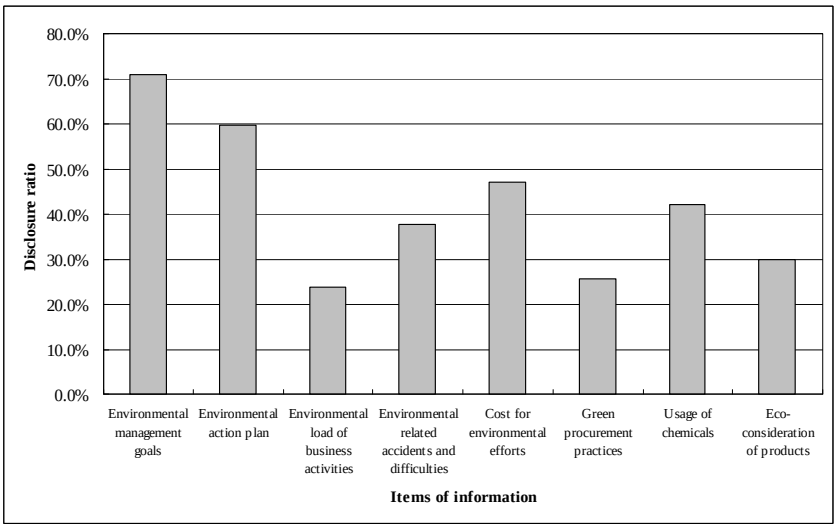

Fig.3.5: Disclosure ratio of environmental information items of the practicing enterprises (N=62).

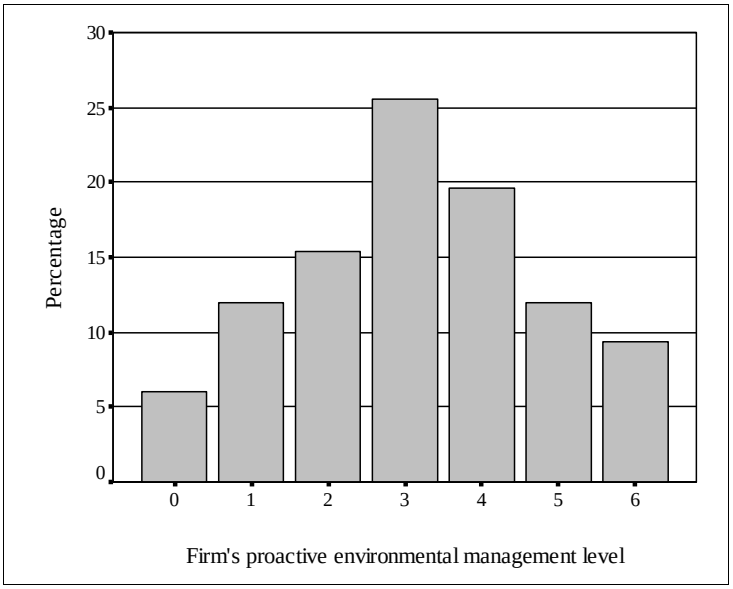

Fig.3.6: Distribution of firm's proactive environmental management level (N=117).

6.3 Multivariate analysis and discussions

As the dependent variable is in an ordinal measure, an ordered logistic regression was performed and the results are listed in Table 3.4. The robustness of the results was tested by repeating the regression with certain of the variables omitted. Three models were adopted. Model 1 is the case of omitting all the control variables. Model 2 is the case of adding three indicator variables for companies like SIZE, OWNERSHIP and SECTOR. Model 3 is the case of including all the variables discussed earlier. There are no obvious changes between the results of the three regressions. Due to data missing for some respondents, the total number of samples for econometric exercise is 74.

The results in Table 3.4 show that the intensity of environmental enforcement, as a major coercive pressure, has a limited positive effect on EML_p. This is probably because environmental violations become more and more difficult for the companies based in areas like Changshu city with a relatively developed economy. The companies there have learned to manage their relationship with the government by taking certain proactive environmental actions. No positive relationship was found between EML_p and the level of product export and the normative pressures. This is probably because the survey does not distinguish between export destinations and the type of exports for which proactive CEM would act as a screening device (Prakash and Potoski, 2006). This also indicates that the role of international regulations, public pressure and influence from industrial associations are still not significantly felt by the sampled companies. However, mimetic pressure is significantly affecting the EML_p. This interesting finding indicates that the companies are sensitive to market factors. Companies are quite anxious about losing their advantage if they cannot perform environmentally as well as

their competitors in the same sector. As expressed by Hoffman (1999), the different kinds of external drivers usually have certain linkages and one of them may be determinant at a specific stage. Milstein, et al. (2001) added that coercive pressures, followed by normative pressures, are normally more important at the beginning phase of the formulation of legitimacy. The mimetic driver will replace the previous two pressures to become a major force until the basic legitimacy has been formed. According to these viewpoints, this study provides the evidence that the companies in the study area have basically achieved environmental legitimacy.

Table 3.4: Ordered logistic regression result of the econometric model (N=74)

	Model 1		Model 2		Model 3	
	Coef.	P	Coef.	P	Coef.	P
REGULATION	0.52 (0.34)	0.125	0.64 (0.38)	0.091	0.64 (0.38)	0.091
EXPORT	0.19 (0.17)	0.265	0.10 (0.19)	0.598	0.1 (0.19)	0.595
COMPLAINT	0.49 (0.35)	0.157	0.52 (0.36)	0.146	0.52 (0.35)	0.146
ASSOCIATION	-0.06 (0.21)	0.761	-0.08 (0.25)	0.751	-0.08 (0.25)	0.753
SECTORLEVEL	0.74 (0.26)	0.004	0.73 (0.26)	0.006	0.73 (0.27)	0.006
AWARENESS	-0.20 (0.37)	0.589	-0.23 (0.40)	0.572	-0.23 (0.40)	0.567
WILLINGNESS	0.65 (0.33)	0.049	0.74 (0.34)	0.032	0.74 (0.35)	0.034
EDUCATION	0.41 (0.21)	0.054	0.36 (0.26)	0.168	0.36 (0.26)	0.169
TRAINING	1.10 (0.33)	0.001	1.06 (0.35)	0.003	1.06 (0.35)	0.003
ISIZE-2			0.33 (0.57)	0.561	0.35 (0.59)	0.559
ISIZE-3			0.31 (0.92)	0.734	0.33 (0.30)	0.726
IOWNERSHIP-3			0.14 (1.36)	0.92	0.11 (1.39)	0.935
IOWNERSHIP-4			-0.12 (1.58)	0.939	-0.13 (1.59)	0.934
IOWNERSHIP-5			0.14 (1.40)	0.923	0.12 (1.41)	0.933
ISECTOR-2			0.57 (0.56)	0.3	0.57 (0.56)	0.313
ENVIMPACT					0.03 (0.31)	0.93
L R chi	39.39***		42.05***		42.06***,	
Pseudo R^2	0.147		0.157		0.152	

Note: the data in the parenthesis is standard error.

The internal factors, like WILLINGNESS and TRAINING, appear to be obvious effects to EML_p. This shows that if a company views environmental issues as opportunities rather than threats, it is more possible to practice proactive environmental behaviour. The awareness on environmental problems and the education level of employees do not have a significant effect on EML_p in this analysis. In general, environmental awareness may be an important factor to engage the companies in environmental initiatives. It is a potential matter for the companies in this survey since almost all of the respondents (94.9%) have confirmed their clear understanding of self environmental conditions. The average educational level of employees is not significant probably because environmental management skills are mainly improved by internal training. The findings on internal factors in this study are different with some previous studies focusing

on institutional theory. They are not controversial since this study extends the application conditions for institutional theory. The internal factors do exist and may play significant roles for proactive environmental practices.

As indicated in Table 3.4, none of the control variables are significant to EML_p. This would be different from the results obtained by some scholars, who indicated that plant size, ownership status, industry sector and environmental management experience would somehow influence CEM (Zhang, et al., 2008; Dasgupta, et al., 1997; Arora and Cason, 1996). This difference may be due to a different definition of dependent variable in our analysis. This study only focuses on the proactive CEM practices while excluding those CEM activities in basic environmental compliance. One more possible reason is that this study only selected a small area for the survey. The respondents may have similar characteristics as defined by control variables.

6.4 The importance of the stakeholders

The companies were also asked to rate the importance of classified stakeholders by giving a score from '1' to '5' with '5' standing for the most important. Fig.3.7 shows the rating results. The internal top managers (scored 3.88 on average) and officials of environmental agencies (averagely scored 3.74) are the two most important stakeholders recognised by the samples for environmental practices. This result is somewhat consistent with the above statistical analysis, which identifies willingness to solve environmental problems as an effective driver for EML_p. The roles of industrial associations, environmental NGOs, mass media and the public are regarded as less important, which thus represents a weak normative pressure for companies in the current Chinese context.

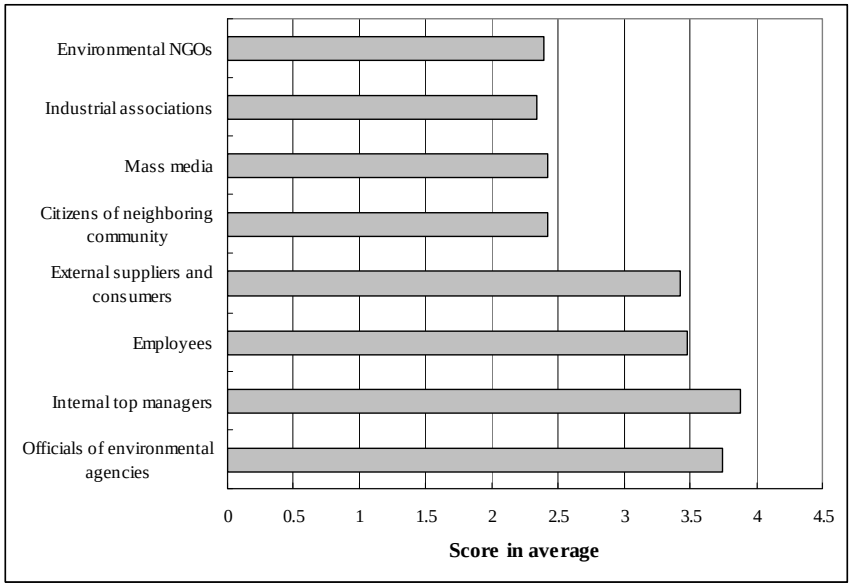

Fig.3.7: Relative importance of the stakeholders of companies for proactive CEM (N=117).

7. Brief summary

This survey sought to identify major driving factors for companies to take proactive environmental behaviour and conducted an empirical analysis in Changshu City of China. The defined drivers are partly supported by the econometric exercises, which recognised the overall environmental management performance at sector level, corporate willingness to solve environmental problems and frequently internal environmental training as significantly positive drivers. The EML_p does not seem to vary much in terms of characteristic factors like organisation size and ownership status. This argument necessitates future close observation of the relationship between company characteristics and proactive environmental behaviour in the Chinese context. The weak role of the general public and industrial associations confirmed by this study shows that Chinese environmentalism transformation is still at an early stage. These findings imply that Chinese environmental policymakers should continue to help the public to actively participate in environmental issues. More pipes should be created so that social actors have easier access to the corporate environmental information. The effective reactions of company stakeholders will generate pressures or incentives for companies to improve their environmental performances.

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Chapter 4: EID strategy of Chinese listed companies

1. Introduction

As an environmental management strategy to communicate with the stakeholders, corporate environmental information disclosure (EID) can play a pivotal role in the greening of corporate accountability (Sustainability/UNEP, 2002). Voluntary-based EID, which includes environmental reports published by companies, is generally un-audited in developing countries (Mathews and Perera, 1995). EID is of course in its infancy in China and environmental reporting to the public is predominantly non-mandatory (Guo, 2005). Nevertheless, a few Chinese domestic manufacturing giants, like PetroChina, Sinopec and Bao steel, regularly publish annual reports which cover sustainability or corporate social responsibility (CSR). Since 2001, it has been stipulated that companies applying to be listed must show their environment-related risks in the prospectus for Initial Public Offering (IPO). Given the potentials of EID in the greening of corporate accountability and the fact that environmental reporting is largely underdeveloped and unregulated in China, it is not clear what drives entities to disclose environmental information, especially on a voluntary basis.

In order to facilitate understanding on the mechanism of a company's environmental disclosure, we identify the factors that determine the disclosure level of corporate environmental information and to give an empirical observation on Chinese listed companies. The rationale for selecting listed companies as the target of the study is attributed to the following reasons: Chinese listed companies have relatively better institutional arrangement and economic performance; they are more capable of adopting proactive environmental management activities like disclosing environmental information; and due to heavier reliance on the financing from a wider range of investors, listed companies might make use of environmental information as a media for their stakeholders' management. One more reason is the ready availability of necessary data for quantitative analysis. We developed an analytical framework on the basis of stakeholder theory. The proposed hypotheses were then tested by using the data collected from the sampled companies.

2. Research hypotheses and analytical framework

The success of a company relies on the relationship management with its stakeholders as a whole. If a company believes that its external stakeholders are more concerned with environmental issues, it will be more motivated to disclose the environmental related information. Thus an overall hypothesis shall be stated as follows:

> *General Hypothesis: The power of a company's external stakeholders is associated with the company's environmental disclosure level.*

The potential external stakeholders may include primary and secondary stakeholders. The primary ones provide the company's resources and include the shareholders, creditors, customers and suppliers. The secondary or adversarial stakeholders, who have the capacity to mobilize public opinions in favor of or opposed to the company, consist of regulators, environmental groups and media. As it is not feasible to examine all these stakeholders, we limited the number of external stakeholders to those who are assumed to exert the strongest powers on the company. Consistent with Roberts (1992), this analysis chose representative external stakeholders of the listed companies, namely: (a) the government, having the ability to intervene via regulations; (b) the shareholders, who are principal provider of capital for the listed companies; and (c) the creditors, having the ability to provide economic power to the firm through debt provision.

In line with the above dimension and consistent with the general hypothesis, the analytical framework is indicated as Fig.4.1. Besides the external pressures from the stakeholders specified, company characteristic variables are considered as internal factors and defined as controls. The stakeholder-specific testable hypotheses can be explained below.

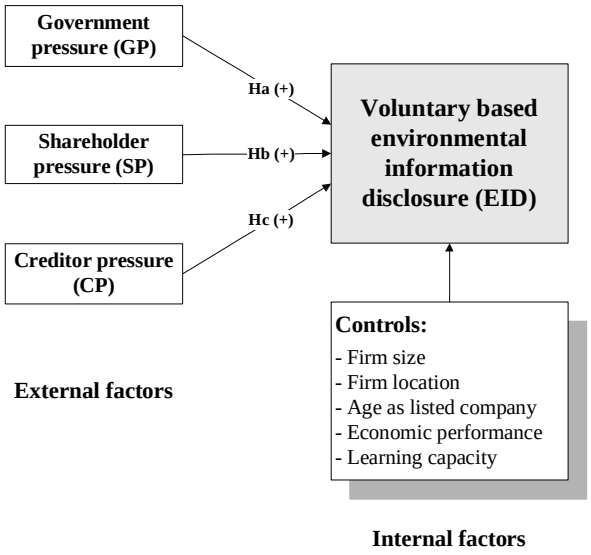

Fig.4.1: Analytical model and determinants of EID.

Ha: Government Power (GP)

The power of government as a stakeholder is manifested in its enforcement mechanisms. The company may use environmentally responsible activities to reduce the risk of governmental intrusions which may affect its value. Hence, the government is viewed as a powerful stakeholder. It is conceivable that companies belonging to highly environment-sensitive industries, like metals and chemicals, etc., will face more stringent regulation as they are more likely to damage the environment. Prior studies provide evidences that companies belonging to

environmentally sensitive industries (ESI) provide more environmental disclosures to minimise or avoid government sanctions, thus suggesting a positive relationship (Chan and Kent, 2003; Elijido-Ten, 2004). This generates the first hypothesis as:

Ha: Companies that belong to environmentally sensitive industries are more likely to disclose the environmental information than those in non-sensitive industries.

Hb: Shareholder Power (SP)

The power of shareholders may be measured by quantifying the degree of stock's ownership concentration. It appeals to intuition that companies with widely dispersed ownership are more likely to incorporate good environmental performance in their strategic planning to attract more investors. A number of researchers offered empirical support to the fact that the market incorporates corporate environmental performance in their assessment of covert environmental liabilities which investors consider in their stock valuation (Clarkson and Li, 2004; Hughes, 2000). The wider its stock dispersion was, the greater the likelihood that the company would disclose environmental information. This suggests the second hypothesis which may be expressed as:

Hb: A company's level of shareholder concentration is negatively associated with its environmental disclosure.

The level of stock ownership concentration is measured by the ratio of total equity possessed by the top 10 negotiable shareholders. The higher stock's concentration is, the lower the shareholder power (SP) which might be formed to encourage environmental disclosure. This data is available in the shareholding section of annual reports of the listed companies.

Hc: Creditor Power (CP)

The creditors' power depends upon the degree to which a company relies on debt financing (Roberts, 1992). Numerous studies suggest that the market considers environmental performances when evaluating environmental liabilities and the creditors will consider how risky the company is (Hughes, 2000; Cormier and Magnan, 1997). This was confirmed by a more recently published study which implies that: if a company relies too much on debt financing, it is more likely to strive to incorporate a proactive environmental strategy (Clarkson and Li, 2004). This creates the third hypothesis for this study:

Hc: A company's financial leverage is positively associated with its environmental disclosure.

The level financial leverage is adopted to present the creditor power (CP) in this study. Accordingly, the asset liability ratio (Debt/Asset) of the companies is sourced for the analysis.

3. Samples and the data

The samples and data were collected from Chinese listed companies in three steps. Initially, the complete namelist of the listed companies was downloaded from the information disclosure website (http://www.cninfo.com.cn/) specified by China Securities Regulatory Commission (CSRC). The list was sorted by industrial sectors and the volume of each company's registered capital. Out of every five companies on the sorted list, one company was selected randomly as a representative candidate. The second step was to search for such data as basic information regarding the candidate companies. The data, such as return of equity (ROE), stock's ownership concentration and asset liability ratio (D/A) in 2006, were also obtained from the economic evaluation database of Chinese listed companies on the same website. Since there is no usable index to indicate the EID level of Chinese companies, the environment-related information publicised by the sampled companies in 2006 were accessed from possible sources like annual reports, separate environmental (sustainability or CSR) reports, and the company website if there was one. We gave a subjective measurement to the quantity of the accessible environmental information since the actual environmental performance data was not available for checking the quality of the self-reported information. The value of different selected environmental information items was not differentiated in the coding process as there was no solid foundation available to do this. The quantification approach of EID level of the sampled companies, which is consistent with Hughes et al. (2001), will be explained later in detail. This formed the last step for data collection. Several samples, which are appointed as Special Treatment (ST) companies due to their continuous loss-making over two years, were excluded from this study. This is because the corresponding companies are under financially abnormal status and there are certain limitations on the ST stocks' exchange in China. Several other samples were deleted due to the lack of complete data for the statistical analysis. Overall, 175 usable samples were obtained. The sector distribution of samples is shown in Table 4.1.

Table 4.1: Distribution of the usable samples by industrial sectors

Sector	Number of samples	Percentage
Mining	6	3.4
Food & beverage	9	5.1
Textile & clothing	9	5.1
Paper	5	2.9
Petroleum, chemicals and plastics	28	16
Electronics	6	3.4
Metals & non-metals	26	14.9
Machinery & equipments	25	14.3
Pharmacy	15	8.6
Power generating	11	6.3
Others	35	20
In total	175	100

4. Econometric model and the variables

We assume that the company discloses environmental information based on pressure from external stakeholders and its characteristic factors (size, location, learning capacity, economic performance, etc.) identified in the analytical framework. The hypotheses were tested by using multiple regression models which employ ordinary least squares estimation. The econometric model is given in the equation below (4.1) and is estimated for the company's EID level (represented by the integrative disclosure index or the score of the defined individual environmental information items).

$$EID\ level = \beta_0 + \beta_1 GP + \beta_2 SP + \beta_3 CP + \beta_4 LC + \beta_5 AGE + \beta_6 PLACE + \beta_7 ROE + \beta_8 LSIZ + e \quad (4.1)$$

Where:

$EID\ level$: Environmental information disclosure level of company *i* at period *t*;

β_0 : Intercept;

GP : 1 for companies in environmentally sensitive industries; 0 otherwise;

SP : Percent of floating share of company *i* possessed by top 10 shareholders at period *t*;

CP : Asset liability ratio of company *i* at period *t*;

LC : Percent of the employees with college education level and above in the total;

AGE : Age since company *i* was listed in the stock market at period *t*;

$PLACE$: 1 for companies in eastern coastal region; 0 otherwise;

ROE : Return on equity of company i at period *t*;

$LSIZ$: Natural log of asset of company *i* at period *t*;

e : Error term.

Dependent variable

The dependent variable is a company's EID level. For a definition of environmental information items to indicate the EID level of the samples, reporting guidelines suggested by Global Reporting Initiative (GRI) and the 'Environmental Information Disclosure Measurement' issued by SEPA were reviewed and compared. The items, suggested by GRI guidelines, cover five major aspects and include 30 indicators from a product's lifecycle perspective. Only nine items are specified in SEPA's notification which is mainly concerned with the environmental impacts of manufacturing processes and the measures for pollution control. Being adaptive to the actual status of environmental management capacity and focus in China, six items are defined for evaluating the EID level of the samples. The core items in GRI guideline, items specified by SEPA and those selected for this study are listed in Table 4.2.

A technique known as 'indexing' was adopted to quantify the EID level (Wallace and Naser, 1995). A score was assigned first to each of the six environmental information items disclosed

by the company. The basic principle is: if no information was found for the item, a score of 1 was assigned. A score of 3 was assigned for the item with descriptive or incompletely quantitative data. And a score of 5 was given to the item with descriptive and quantitative data in details. For ease of analysis, the scores gained by each company were then converted into percentages of the highest possible score (30 for the five-point Likert scale method).

Table 4.2: Items selection for this study

Items specified in GRI guideline	
Aspects	Item examples
Materials, energy and water	EN1: Materials used by weight and volume; EN2: Percentage of materials that are recycled input materials; EN3: Direct energy consumption by primary energy source;
Biodiversity	EN11: Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas;
Emissions, effluents and waste	EN16: Total direct and indirect GHG emissions by weight; EN20: NO_x, SO_x and other significant air emissions by type and weight; EN21: Total water discharge by quality and destination; EN22: Total weight of waste by type and disposal method;
Products and services	EN27: Percentage of products sold and their packaging materials that are reclaimed by category;
Compliance	EN28: Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations.
Items specified by SEPA	
1. Company's environmental protection policies, yearly objectives and achievements;	
2. Yearly total consumption of resources;	
3. Company's environmental investment and development of environmental technologies;	
4. Type, quantity, concentration and destination of emissions and effluents;	
5. Construction and operation of environmental facilities;	
6. Disposal and treatment of the generated waste, the recycling and integrated utilisation of waste products;	
7. Voluntary agreement with environmental authority for performance improvement;	
8. Information on the activities for corporate social responsibility;	
9. Other environmental related information voluntarily disclosed by the company.	
Items selected in this study	
I1: Company's environmental protection policies, strategies and goals;	
I2: Consumption of energy, water and other resources;	
I3: Type, quantity and destination of emissions and effluents;	
I4. Construction and operation of environmental protection facilities;	
I5: Environmental investment and the cost for pollution control;	
I6. Other environmental related information.	

Independent variables

The independent variables GP, SP, CP represent the external powers affecting the EID level.

Through econometric practices, it is possible to determine how much each of these factors can explain the level of EID.

Government power (GP) is defined as a dummy variable representing the environmental sensitivity of the industry in which the company operates, e.g. 1 for companies belonging to Environmentally Sensitive Industries (ESI) and 0 for those belonging to non-ESI. The environmentally-sensitive industries in China include mining, thermal power, construction materials, pulp & paper products, metallurgy, petroleum, brewing, fermentation, textiles, pharmaceuticals, tanning and chemical industries (SEPA, 2003). The others are regarded as non-ESI. The percentage of floating stock possessed by the top 10 shareholders is used as the proxy of shareholder power (SP). It may be understood that the higher ratio of floating shares held by smaller group of owners, the lower pressure might be felt by the company from the shareholders. For creditor pressure (CP), the asset liability (Debt/Asset) is used as the proxy (Elijido-Ten, 2005).

Control variables

Size (LSIZ):

The literature suggests that larger companies are more likely to be under public scrutiny and are expected to have higher propensity on environmental disclosure. Larger companies are also capable of having superior resources for environmental efforts. Consistent with the prior studies including a control for the size factor in the model specification, LSIZ is defined as the natural log value of the company's net asset.

Age (AGE):

The variable AGE is included in the regression model as a control for the perceived stability of the company. AGE is the number of years since the company was listed in the Chinese Stock Market (e.g. Shanghai or Shenzhen Stock Exchange) as of the end of 2006.

Location (PLACE):

The company's location, expressed as PLACE, is defined as a dummy variable, i.e. 1 for companies located in the eastern coastal regions where the economy is relatively developed, and 0 for companies located in the Northeast, Middle and Western provinces of China where economic development is lower.

Learning capacity (LC):

The learning capacity of a company is suggested to be important for its dynamic improvement. The educational level of the employees may indicate the company's capacity to learn and implement new environmental management approaches. The percentage of the employees in total with educational experience of college and beyond is used to indicate the learning capacity of the samples.

Return of equity (ROE):

Given the costs involved in environmentally responsible activities, the economic performance of a company is an important factor in determining whether environmental issues will be a priority. Arguably in periods of low economic performance, economic objectives will be given more attention than environmental concerns. This study uses return on equity (ROE) to present the economic performance of the listed companies. The previous year's ROE was also collected for a robustness check to assess the slowing effects of economic performance to the EID level.

5. Results and discussions

5.1 Company EDI level

The distribution of the score assignment to the six individual environmental information items is indicated in Fig.4.2.

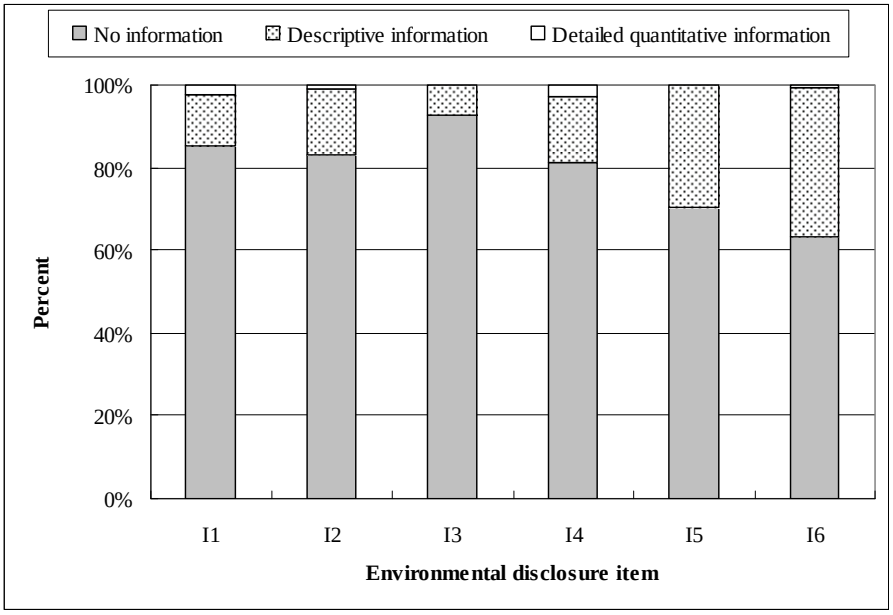

Fig.4.2: Results of environmental disclosure items.

Around 30% of the 175 sampled companies disclosed their investment for environment and pollution control cost in 2006. Nearly 37% of them described certain environmental efforts like ISO14001 certification and cleaner production auditing, etc. The companies appeared to be reluctant to show their impacts on the environment such as information on emission types, amount and destinations. Only 15% of the samples explained their environmental policies and objectives. This indicates that most Chinese listed companies still do not combine environmental factors into their business strategies.

The distribution of EDI level, presented as environmental disclosure index is expressed in Fig.4.3. Nearly 40% of the sampled companies did not show the public any environmental

related information. According to the evaluation result, the environmental information disclosed by Chinese listed companies is currently sparse.

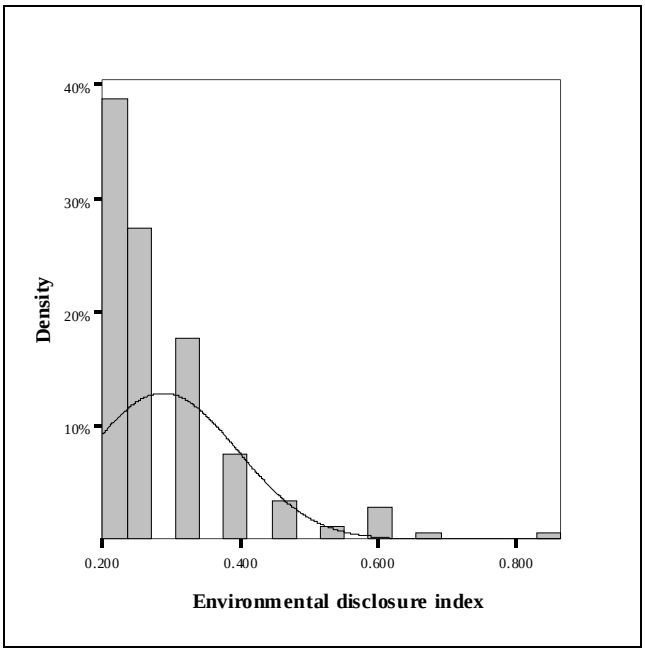

Fig.4.3: Distribution of environmental information disclosure index (EDI level)

(Z=0.816 in K-S test and could pass the normality test).

5.2 Descriptive statistics of the variables

Descriptive statistics of the variables (data of 2006) is shown in Table 4.3. Panel A is the dependent variable EDI level and other continuous variables whilst Panel B has the indicator independent and control variables. The dependent variable EDI level showed a minimum score of 0.200 and a maximum of 0.867 with a mean value of 0.288 indicating fairly insufficient disclosure of China's listed companies. Shareholder power (SP) has a minimum of 0.75%, a maximum of almost 94.5% and a mean of 10.1% suggesting that the samples have varying degrees of shareholder concentration. The creditor power (CP) has a wide range from a low of 8.8% to a high of 97.5%. The mean of 51.1% indicates that the majority of the sampled companies are highly credit geared. Result of ROE, as a measure of economic performance, indicates that the sampled companies have an average return of 9.0%. The age of listed companies ranges from a minimum of half a year to a maximum of 15 years, which means most of the Chinese listed companies are still young on the stock market. The mean of learning capacity (LC), with an average of 32.6%, shows that the majority of listed companies have employees with higher education levels.

Panel B shows that about half (52%) of the companies are categorised to be environmentally sensitive. By the locations of the samples, 54.9% of them come from the eastern coastal regions

with relatively developed economies. This also supports the well sample distribution when observing from the industrial sectors and geographical locations.

Table 4.3: Statistical summary of the variables

Panel A: Continuous variables					
Variable name	Obs.	Mean	Std. dev.	Min.	Max.
EID level	175	0.288	0.109	0.200	0.867
SP	175	0.101	0.114	0.0075	0.945
CP	175	0.511	0.18	0.088	0.975
LC	175	0.326	0.207	0.024	0.99
AGE	175	7.2	3.5	0.5	15
ROE	175	0.09	0.0711	0.0006	0.396
LSIZ	175	7.21	1.36	4.09	12.45
Panel B: Indicator variables					
Variable name	Obs.	No. of sample with 1	%	No. of sample with 0	%
GP	175	91	52.0	84	48.0
PLACE	175	96	54.9	79	45.1

5.3 Multivariate analysis and discussion for EID level

Ordinary least squares regression was performed on the dependent variable EID level against all the independent and control variables by using the data of 2006. The results are shown in Table 4.4. The model explains about 40.7% of the variation on EID level with significance at p=.000.

Table 4.4: Regression result for EID level by data of 2006

	β_0	***GP***	***SP***	***CP***	***LC***	***AGE***	***PLACE***	***ROE***	***LSIZ***
Coefficient	2.064E-02	0.102	-1.995E-02	2.751E-02	-2.928 E-02	-1.53 E-02	1.029 E-02	-6.608 E-04	3.007 E-02
t-statistic	0.533	7.196	-0.336	0.748	-0.823	-0.815	0.757	-0.007	5.471
p-value	0.595	0.000	0.737	0.455	0.412	0.416	0.450	0.995	0.000

R^2: 0.434; Adj. R^2: 0.407; F: 15.916; Sig.: 0.000

Hypothesis a (Ha) is strongly supported in the multivariate results with government power (GP) showing a significantly positive association with the EID level at p=0.000. More environmental disclosure may be expected from the companies that have higher environmental sensitivities. They tend to show environmental legitimacy to the government. This is consistent with the findings from an interview survey conducted by a previous study (Guo et al., 2007), i.e. that the primary contributing factor leading to corporate environmental disclosure in China is to raise the enterprise profile and to support the government policies.

Hypothesis b and c (Hb and Hc) are not supported. The shareholder power (SP) showed no significant association and the coefficient is negative, which means that the degree of shareholder dispersion has very slight and negative relationship with corporate environmental disclosure. Similarly, creditor power (CP) also showed no significant association. Despite the

fact that the majority of the listed companies are highly levered, implying that creditors represent a strong group to determine the company's business activities, CP still appears to be quite weak for the environmental disclosure. Although this finding may sound unusual, it is consistent with findings in an Australian environmental disclosure study (Chan and Kent, 2003). One possible reason driving this insignificant result could be the fact that the banks paid less attention to the company's environmental performance in the past. The green credit policy has only just been initiated in China (SEPA, 2007).

5.4 Multivariate analysis and discussion for the individual information items

In this study, the regression was also repeated by replacing the EID level in equation (3.1) with the score of each individual EID item as dependent variable. The results for item 1, 2 and 6 are not listed here since they have a significant relationship with GP and LSIZ, which is similar to the result for EID level in 3.5.3. The results of item 3 and 5 are listed in Panel A and B of Table 4.5 respectively, which indicate that the companies are selectively opening up their environmental information.

Table4.5: Regression result for the individual information item by data of 2006

Panel A: Item 3 (I3): Type, quantity and destination of emissions and effluents

	β_0	GP	SP	CP	LC	AGE	PLACE	ROE	LSIZ
Coefficient	0.365	0.256	-4.194E-02	-0.150	-0.111	6.741 E-03	0.213	-7.773E-02	8.462 E-02
t-statistic	1.613	3.084	-0.121	-0.700	-0.537	0.615	2.680	-0.139	2.636
p-value	0.109	0.002	0.904	0.485	0.592	0.540	0.008	0.890	0.009

R^2: 0.177; Adj. R^2: 0.137; F: 4.457; Sig.: 0.000

Panel B: Item 5 (I5): Environmental investment and the cost for pollution control

	β_0	GP	SP	CP	LC	AGE	PLACE	ROE	LSIZ
Coefficient	0.136	0.997	-0.767	0.351	0.213	-1.368E-02	-6.478E-02	1.731	0.104
t-statistic	0.395	7.861	-1.450	1.072	0.671	-0.817	-0.535	2.027	2.114
p-value	0.693	0.000	0.149	0.285	0.503	0.415	0.594	0.044	0.036

R^2: 0.368; Adj. R^2: 0.338; F: 12.106; Sig.: 0.000

Besides GP and LSIZ, the third defined item of environmental information also has positive relationship with the PLACE. This means that the listed companies operating in eastern coastal regions are more likely to disclose the emission data. This may attribute to the relative higher level of public environmental awareness in those regions. The polluters there are more willing to show the neighbouring communities that their emissions can meet according to national or local environmental standards. The fifth item of environmental information has positive relationship with ROE with significance at the 0.05 level, and has weakly positive relationship with CP. The better a company's economic performance, the more information on environmental investment and pollution control cost will be opened. SP appears in a weakly negative relationship with the score of this item, which means the stronger the shareholder

pressure, the company will be slightly more reluctant to show the environmental cost.

6. Brief summary

This analysis developed a stakeholder framework and discussed the environmental information disclosure behaviours of Chinese listed companies. The empirical results provide important insights into the determinants for the EID in China**.** Company environmental sensitivity and size are currently the major significant factors influencing their EID efforts. The economic performance is not significantly related to the environmental disclosure activities. At current stage, Chinese companies are providing the environmental information mainly to alleviate concerns from the government. As the pressure from other important stakeholders like shareholders and creditors, which appears to be weak at present, continues to grow, more companies will opt for opening more environmental information. To that end, the environmental awareness of social actors in China should be heavily promoted. Along with the increase in the stakeholders' concerns on corporate environmental behaviour, Chinese companies may become more proactive in showing their environmental information.

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Chapter 5: Functions of mandatory corporate EID program in China

1. Introduction

In China, due to the weakness of existing environmental legislative framework and enforcement capacity, many manufacturers appear to be far from environmentally benign. The national environmental agency is endeavouring to develop more innovative approaches that encourage companies to conduct better environmental management. Among which, giving the public easier access to environment-related information is expected to attract environmental concerns from more social actors, and to exert more pressures on the laggard enterprises or offer more incentives for the good ones (Pan, 2007). Mandatory disclosure requirements were found to help significant increases in the number of companies reporting and the level of information provided on environmental performance (Criado-Jimenez et al., 2008; Frost, 2007). The approach of mandatory rating and publicly disclosing a company's environmental performance was viewed to effectively reduce the pollutant emissions with lower costs (Pargal and Wheeler, 1996; Tietenberg and Wheeler, 2001). Prior research has addressed how the disclosure strategy affects the behaviour of the rated company's stakeholders such as investors and consumer perceptions (Curran and Moran, 2007; Sen and Bhattacharya, 2001). Much less research has focused on the responses of rated companies themselves to the rating result, a question central to management scholarship (Stephan, 2002).

A mandatory rating and disclosure system, which is similar to PROPER in Indonesia and was also funded by the World Bank, was initiated in China in 1998. The programme ranks environmental performance of industrial companies into five different colours, with two (Black and Red) denoting inferior performances, one (Yellow) denoting the compliance with national regulations but failure in certain aspects, and two (Blue and Green) denoting superior performance. According to the "Technical Guideline for Corporate Environmental Performance Rating and Disclosure", issued by SEPA, three groups of indicators are adopted: pollutant emissions, daily environmental maintenance, and social impacts. The programme's colour-coded ratings are generated by auditing a company's environmental performances. From 1999, pilot projects were carried out in Zhenjiang, Jiangsu Province, and Hohhot, Inner Mongolia. The primary results showed that the percentage of companies with superior performance (Green and Blue) has grown, the overall compliance ratio increased and companies in the worst category (Black) decreased (Wang et al., 2004). Afterwards, Jiangsu Province promoted province-wide implementation of this programme since 2001. The Chinese national government learned lessons from the pilot programme and expanded it to the other regions. The environmental rating and disclosure programme is expected to be able to provide incentives for a company to aim for continuous environmental improvement since it recognises three levels for

complying with environmental regulations. Even for those non-compliant companies, the programme rewards their efforts by recognising two levels of environmental performances. As of June of 2008, the number of companies participating in programme in Jiangsu Province increased to 16,464 from 1,059 in 2001. Nearly all the key polluting companies there have been covered by this programme.

In order to make clear to what extent the disclosure programme in China has worked for improving company environmental performance, we selected Changshu city in Jiangsu province as the study area and tried to identify the programme's functions by exploring two questions. One is what changes in environmental performances can be observed from the companies participating in the programme . The second is whether these changes could be attributed to the involvement of company stakeholders induced by the disclosure of the rating results. We conducted the analysis in two phases. At the first stage, a detailed database indicating the implementation of the disclosure programme in the study area was collected and statistically summarised. Based on the analytical framework established for identifying the potential functions of mandatory EID, a series of personal interviews were carried out to monitor the perceived and actual pressures felt by the companies participating in the programme. The collected information was used to estimate the strength of functions of the disclosure programme. By focusing on the responses of the rated companies, this analysis contributes to an in-depth understanding of roles of mandatory EID by expanding the scope of prior work to one more developing country's context. More importantly, it gives a richer theoretical development to explore the channels of mandatory EID for enhancing CEM. Our onsite hearings from the rated firms and empirical analysis provide meaningful implications for better design and scope of the growing practices of government-oriented disclosure programmes.

2. Analytical framework

Based on the potential functions of mandatory EID and adopted from Mahoney (1995), the analytical framework is depicted in Fig.5.1. The ultimate goal of a complementary environmental disclosure regime is to alter the company behaviour. Such disclosure regimes tend to rely on three functions, either separately or in combination, to influence environmental behavior: the reflexive, the deterrent, and the enhancement mechanisms. These mechanisms operate at various stages of the environmental disclosure process.

The **reflexive function** focuses on information asymmetries within a company that impair its ability to identify and respond to environmental issues. Lacking some mechanisms for the collection and processing of environmental information, the company will not be able to assess its compliance status and alter to improve environmental performance. A mandatory obligation to collect, process, submit and disclose environmental information of the company may

encourage it to become more aware of its internal operations and even self-critical of its environmental performance. This is the reflexive mechanism of environmental disclosure. In considering the reflexive mechanism, it is useful to distinguish between two kinds of noncompliance causes. One is structural failures such as poorly designed coordination between a company's organisational units. Another is the choice to engage in strategic noncompliance. The process-oriented requirements may assist in facilitating review-and-adjustment of internal operating procedures and therefore may be effective for the first type of noncompliance.

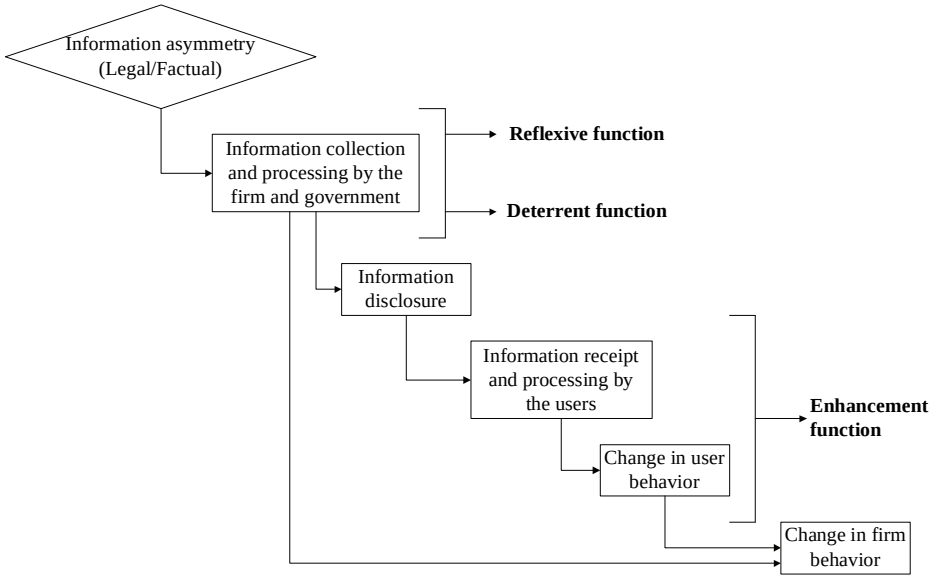

Fig.5.1: Functions of mandatory environmental disclosure.

The **enhancement function** of environmental disclosure focuses more directly on how the disclosure affects the behaviour of the recipient of information. This mechanism is premised upon the assumption that access to better quality information will enhance the reactions of the recipient. Environmental disclosure relying on the enhancement mechanism is widely used (Tietenberg, 1999). Most discussions of the enhancement mechanism focus on private party recipients, such as local communities, customers, shareholders, and nongovernmental organisations (NGOs) (Kleindorfer and Orts, 1998). The disclosure for private party strives to bring market pressures and public opinions to bear on company decision-making, thus altering company environmental behaviours without directly coercive government actions (Cohen, 2001). Meanwhile, information disclosure can improve the government's operations. For instance, once the regulator receives accurate and complete information about company environmental practices, it can adjust the enforcement activities to pursue violations in one plant or even within an entire sector that would be difficult to monitor. The strength of the enhancement mechanism is subject to two limitations. One is the accuracy of the disclosed information. The other is the capacity of the recipient to use the information in an effective way. There is surprisingly little discussion about these limitations in existing literatures.

The **deterrence function** acts as a bridge between the reflexive and enhancement mechanisms. The company anticipates the reaction of information recipients and alters its activities to avoid those reactions. The deterrence function fits well with classic rational choice theory of enforcement, in which individual companiesare regarded as rational actors seeking to maximize their preferences. The dominant preference of a company is profit maximisation or certain other measures of successes. In deciding whether to engage in a particular activity, the company will balance the relative costs and benefits of the action. The potential costs of the action include the third party's costs such as: a regulator penalties, the securities market adjusting share price, or the consumer reluctance to buy. Mandatory environmental disclosure may increases the deterrent value of third party costs by increasing the frequency and accuracy of monitoring.

3. Rating criteria of the EID program in Changshu

The rating and disclosure programme was started in 2002 in Changsu City. There were less than 40 companies participating in the programme at the beginning. The number soon increased to 267 by 2007. The programme implementation makes the social actors, like investors and creditors, to be more aware of company environmental performance. The environmental consciousness of the general public is also increased. During 2002 to 2006, the environmental performance rating criteria remained the same, as depicted in Fig.5.2.

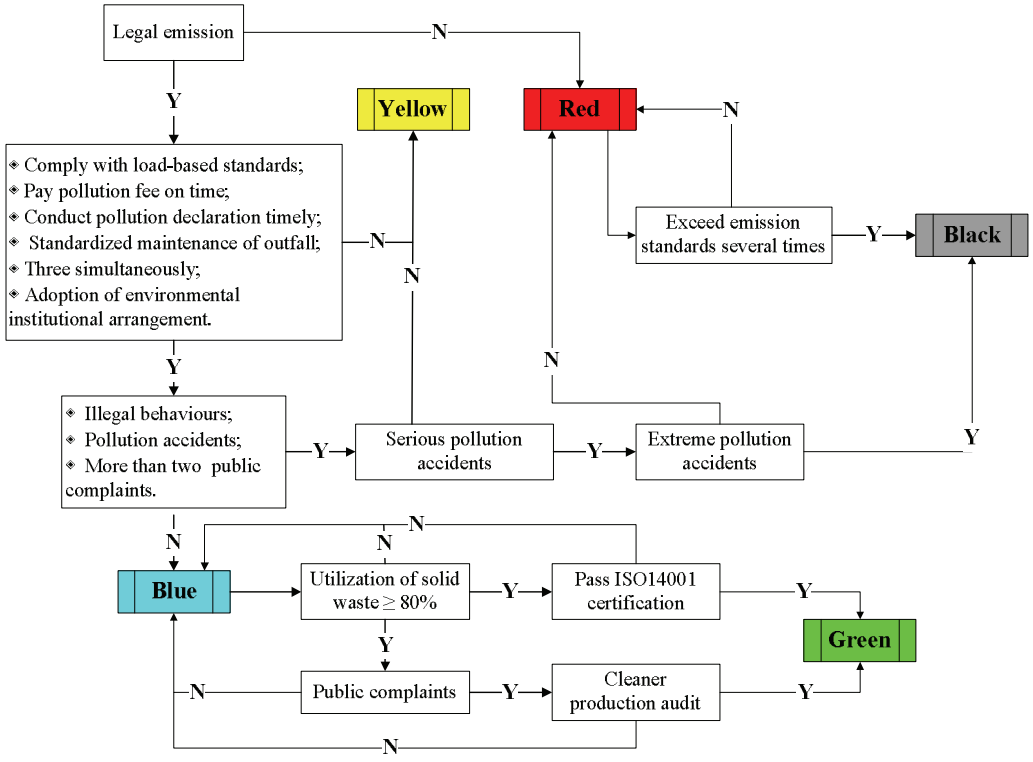

Fig.5.2: Rating criteria of the disclosure programme in Changshu during 2002-2006.

The rating scheme draws upon four principal sources of information related to the compmany: reports on pollution emissions; inspection documents on environmental management; records of public complaints, regulatory actions and penalties; and surveys which record the characteristics related to the rating of environmental performances. As the first step of the rating, the companies are classified by whether they comply with pollutant concentration standards. If a company exceeded the emission standard, it would be categorised as Red or Black. The company would be rated as Black if the frequency of over emission standards was higher than 50%. Otherwise, it would be Red. The company would be rated as Yellow if it could not satisfy any of the following requirements: 100% of hazardous waste disposal; complying with the load-based standards; no illegal environmental activity; no administrative penalty; no pollution accident. The company would be honored as Blue or Green only if it has no environmentally illegal behaviour. This implies that a Blue company has good environmental performance. Only a company which has effectively utilized more than 80% of its solid wastes, which has no public complaint and has passed national cleaner production audit or achieved ISO14001 certification, may be rated as Green. Therefore, whether a company has discharged pollutants legally or not is the most important indicator to distinguish between the rating results of environmental performances.

Since 2007, the rating criteria were revised in Changshu city. In summary, the standards were relaxed, especially for the requirement of pollutant emissions. For example, the previous criteria require the Yellow-rated companies to fully meet the emission standards. The revised criteria allow no more than two times of illegal emission records for the companies classified as Yellow. Even for the company to be rated Blue, one act of illegal emissions is acceptable according to the new criteria if the violation is not intentional and is stopped in a timely manner. The relaxation of the rating criteria may explain, to some degree, a much better rating result in 2007 than the previous years.

4. Stakeholders and their actions identified for the analysis

Civil society has noticeably acted as a second source of pressures for company environmental efforts. A well-ranked publication of company environmental performance is assumed to effectively assist public participation in the enforcement. Public disclosure provides the environmental information to all company stakeholders and puts pressure on them to control their emissions (Tietenberg, 1998). Unlike the government, whose actions are circumscribed by statutes and rules, civil society may exert pressure on company environmental management by various actions. As described in Table 5.1, four types of public intervention, which are common in Chinese current context, are considered for the function analysis of the disclosure programme. The No Action case is included, not only because it provides a base case of traditional models which do not cover civil society, but also because it serves as a reminder that the mere

widespread publication of data does not automatically translate into real reactions of civil society. The other interventions are carried out with the intention of having an overall positive effect for improving company environmental performance. Depending on who chooses what kind of interventions, the company will face a different objective function for decision-making.

Table 5.1: Types of optional public interventions

No.	Intervention	Description
1	No action	Receive the information, but do not react on it
2	Market pressure	Exerts direct pressure on company through markets
3	Complain to the governments	Complain bad performers to raise government's enforcement
4	Complain and market pressure	Combination of intervention 2 and 3

Mandatory EID enhances the dialogues between a company and its stakeholders. Stakeholder power takes the form of command of limited resources, for example, finance and labor, or the ability to legislate against a company and so on. External stakeholders include primary and secondary ones. The primary stakeholders provide the company with resources and may include the shareholders, creditors and business partners. The secondary or adversarial stakeholders, who have the capacity to affect public opinions in favour of or opposed to a company, consist of regulators, environmental NGOs and the media. As it is not feasible to examine the reactions of all the stakeholders to the disclosed environmental information, we limited the external stakeholders to those who may exert relatively stronger powers. Seven representative stakeholders, as listed in Table 5.2, were selected for the survey. Among which, four are primary stakeholders (investors, lenders, consumers and business partners), while the other three may be classified as secondary stakeholders (government, communities and NGOs).

Table5.2: Stakeholders and their holding powers

No.	Stakeholder	Holding power
1	Government	Increase the frequency of monitoring and enforcement
2	Neighboring communities	Raise complaints to increase government's enforcement or direct against
3	Environmental NGOs	Raise campaign to fight against the bad performers
4	Investors	Depreciate the bad performers and reduce investment to the companies
5	Lenders (Banks)	Depreciate the bad performers and cut or suspend the credits to them
6	Consumers	Boycott the products of the bad performers
7	Business partners	Decreased trust and opportunity reduction on business cooperation

5. Data used for the analysis

The usable data come from two sources. Aiming to have a preliminary understanding of the status of the disclosure programme implemented in the study area, company environmental

performance rating results, annual changes of the results and the determinant factors of the results were statistically summarised. The data come from an original database indicating environmental performances of participating companiesduring 2005-2007, which was provided by Changshu municipal EPB. However, the observable performance changes of the participating companies cannot represent the actual effects of the disclosure programme since the changes might be due to other policy interventions. The companiesin different industrial sectors may respond to the disclosure programme differently because of their individual characteristics. To have a deeper understanding of the actual roles of the programme, a series of interviews with selected participating companieswere conducted. The companies in dyeing and textiles and in the chemical sectors were chosen since they are representative sectors in the study area and account for more than half of the participating firms. Additionally, these two sectors have similar pattern of environmental management. The survey was carried out from December of 2008 to May of 2009. A total of 32 companies selected at random from the two sectors were approached, and all agreed to participate in our survey, sharing around one fourth of the total participating companies in the two sectors. The question list for onsite hearings consists of four major components: general information; affecting factors, external and internal, of environmental management; changes in environmental performance after participating in the disclosure programme; and the influence of the program on environmental behavioral changes. The interviewed companies are requested to give scores to their perceived pressures and actual reactions of the identified stakeholders based on disclosure of the rating results. The subjective judgments of the companies are used to estimate the functions of the disclosure programme for improving environmental performances.

6. Results and discussions

6.1 Rating results during 2005-2007

The industrial sector distribution of companies participating in the disclosure programme during 2005-2007, is summarised in Table 5.3.

Table 5.3: Distribution of the programme participating companies by industrial sectors during 2005-2007

Sector	2005		2006		2007	
	Number	Percentage	Number	Percentage	Number	Percentage
Dyeing and textile	90	43.9	107	43.1	101	37.8
Chemicals	33	16.1	37	14.9	43	16.1
Metal processing	20	9.8	22	8.9	35	13.1
Pulp and paper	7	3.4	7	2.8	3	1.0
Power plant	8	3.9	10	4.0	11	4.0
Sewage disposal plant	14	6.8	17	6.9	16	6.0
Others	33	16.1	48	19.4	59	22.0
In total	205	100.0	248	100.0	267	100.0

The total number of companieswas 205 in 2005, and increased to 248 in 2006 and 267 in 2007. Due to the obvious characteristics of industrial structure of Changshu, around 40% of the companies belong to the dyeing and textile industry. Chemicals and metal processing companies share the second and the third. The top three sectors accounted for nearly 70% in the total, which are regarded as major polluting sources in the study area.

The rating results of environmental performances of the participating companiesare statistically summarised in Table 4.4 for the period of 2005-2007. Among the 205 companies in 2005, none was rated as Black. Fifty one companies were rated as Red, which accounted for 24.9% of the total. The largest Yellow cluster consisted of 96 companies with a share of 46.8%. The number of Green companies was quite low. This indicates that the environmental performances of companies in Changshu city were not encouraging in 2005. Although most of the companies (around 75%) could basically meet the regulative requirements of pollutant emissions, nearly half of them had certain problems on daily environmental maintenance. The rating results for 2006 were similar to that of 2005 but showed some improvements. About 16% of the companies were rated as bad performers (Red and Black) while the better performers increased to 35.9% of the total. Within the 267 participating companies in 2007, most of them were rated Blue or Green. However, this cannot be viewed as the actual improvement of environmental performances due to the relaxation of rating criteria in 2007 as explained earlier.

Table 5.4: Statistical summary of rating results during 2005-2007

Rating result	2005		2006		2007	
	Number	Percentage	Number	Percentage	Number	Percentage
Green	7	3.4	10	4.0	13	4.9
Blue	51	24.9	78	31.4	215	80.5
Yellow	96	46.8	119	48.0	26	9.7
Red	51	24.9	33	13.3	6	2.3
Black	0	0	8	3.3	7	2.6
In total	205	100.0	248	100.0	267	100

6.2 Rating result changes between 2005 and 2006

Due to the different rating criteria used in 2007, this study only compares the disclosure results of 2005 and 2006 to directly observe the changes. There were 201 companies in Changshu who participated in the programmes in both years. Table 5.5 shows the changes of rating results. The numbers of companies with improved performances are listed in blue cells, and those with demoted performances are in grey cells. The numbers in white cells are those which maintained the same result over two years. About 56% of the participating companies maintained their rating unchanged, which indicates the relative stability of the rating programme. The participating companies tended to improve their performances (promoted: demoted = 51:38), leading to a better statistical result in 2006 than that of 2005. One more interesting finding of

our study was that those companies with lower ranks were more active in promoting their environmental performances. The ratio of companies which improved their ranks, was 46.9%, 28.7% and 2.0% respectively for the previous Red, Yellow and Blue rated companies.

Table 5.5: Changes of rating results of 2005 and 2006

Rating results of 2005	Rating results of 2006					In total
	Black	Red	Yellow	Blue	Green	
Black	0	0	0	0	0	0
Red	7	19	20	3	0	49
Yellow	0	7	60	27	0	94
Blue	0	0	21	29	1	51
Green	0	0	1	2	4	7
In total	7	26	102	61	5	201

6.3 Determinant factors of the rating results during 2005-2007

The factors determining the rating results during 2005-2007 are summarised in Table 5.6. For 2005 and 2006, only five items of the total 18 indicators defined in the rating criteria affected firms' final rating results. These items include: exceeding emission standards; public complaints; not paying emission fee in a timely manner; illegal environmental behaviours; and having no environmental certification required. This implies that companies in Changshu city are environmentally performing in a similar pattern. The same category of companies faced common problems of environmental management.

Table 5.6: Determinant factors of the rating results during 2005-2007

Determinant factor	2005			2006				2007			
	Blue	Yellow	Red	Blue	Yellow	Red	Black	Blue	Yellow	Red	Black
Exceeding emission standards			51			33	8	80	17	6	2
Public complaints	18	17		55	6			17	6		
Illegal environmental behavior		77			111				2		5
Not pay emission fee timely		2			2						
With no certifications	33			23				65			
Others								53	1		
In subtotal	51	96	51	78	119	33	8	215	26	6	7

Particularly in 2005, 51 companies were rated Red due to "exceeding emission standards". No Black company appeared since there was none having a frequency over the emission standards higher than 50%. Among the 96 Yellow companies, 77 were rated as such because of certain illegal environmental behaviors. Seventeen have been complained about by the public more than twice. The other two companies did not pay the pollution fee on time. The Blue companies were caused by two reasons. Within a total of 51 Blue companies, 33 have neither passed national cleaner production audit nor achieved ISO14001 certification. The remaining 18

companies had records of one occasion of public complaint.

In 2006, the determinant factor of all the Red and Black companies was the same: exceeding emission standards. The Red companies exceeded the standards only once while the Black ones emitted pollutants over standards several times. Similar to 2005, 111 out of 119 Yellow companies were rated because of their illegal environmental behaviors. Six received public complaints on more than two occasions. The remaining two failed to pay pollution fee on time. Twenty three Blue companies were rated due to not achieving the environmental audit and ISO14001 certification. The other 55 Blue companies received one public complaint. The determinant factors of Blue companies changed greatly in 2006 compared with 2005. Most of them (64.7%) were rated due to no environmental certifications in 2005 which is voluntary in the current Chinese context. However, 70.5% of Blue companies were rated because of public complaints in 2006.

Although the rating criteria were changed in 2007, the exceeding emission standard was still the main reason for the worst performing companies. All Red companies exceeded emission standards. Five out of the seven Black companies secretly discharged wastewater without necessary treatment. The reasons varied for those Blue companies which were not promoted to the Green category. Apart from exceeding emission standards, this might also be attributed to having not achieved ISO14001 certification or cleaner production audit, or having no award as a "national environmental-friendly company". Additionally, quite a few companies were rated Blue due to reasons such as not keeping their surroundings neat and in order.

6.4 Functions of the disclosure programme

Functions of the disclosure programme were analysed by using descriptive statistics of the data collected in our interviews. Among the companies surveyed, 25 belong to dyeing and textile industry, the other seven come from the chemical industry.

Table 4.7 summarises the three types of functions defined in the analytical framework. During the interviews with the selected companies, we intentionally asked them to separately judge their perceived pressures (deterrent function) and actual reactions (enhancement function) from the classified external stakeholders due to the rating and disclosure of their environmental performances. A score of 1 to 5 was given to each of the items with 1 being the weakest and 5 being the strongest. The perceived effects of the disclosure programme to the firms are listed in Panel A of Table 5.7. Panel B is the actual reactions from the distinguished stakeholders. Panel C shows the reflexive function of the programme evaluated by the companies themselves.

The deterrent function of the disclosure programme is not strongly evaluated by the participating companies. As indicated in Panel A, they did not think their external stakeholders would react seriously to the rating and disclosure results (averaging below 3.00). An exception

is for the local environmental bureaus. A moderate strength of response from the environmental bureaus was anticipated by the companies. Similar results are observed for the enhancement function, as listed in Panel B. After the disclosure of the rating results, the environmental bureaus and banks really acted at some degree (averaging at around 3.50). This may be partially because the Chinese government is practicing a green credit policy. The commercial banks share a company's environmental information with environmental agencies and are requested to strictly check and limit the loans to the worst environmental performers. However, companies did not feel very strong reactions from banks probably because this policy had only just been initiated and it is still not working effectively. The reflexive function was evaluated by using different items of a company's internal issues. The results listed in Panel C indicate that the disclosure programme does help the companies to become clearer about their environmental compliance status and proactively improve their environmental performances.

Table 5.7: Summary of functions of the disclosure programme

Function items	Obs.	Mean	Std.dev.	Min.	Max.
Panel A: Programme effects perceived by the companies					
a. Enhanced enforcement by environmental bureaus	32	3.22	1.13	1	5
b. Complaints and protest of neighboring communities	32	2.69	1.26	1	5
c. Complaints and boycotts from environmental NGOs	30	2.31	1.38	1	5
d. Boycotts of individual consumers	30	2.16	1.53	1	5
e. Decreased trust and cooperation of business partners	32	2.59	1.04	1	4
f. Reduced investment from the investors	31	2.38	1.39	1	5
g. Stricter checking or suspend of the loan from banks	29	2.94	1.64	1	5
Panel B: Actual pressure felt by the companies after the disclosure					
a. Enhanced enforcement by environmental bureaus	31	3.45	1.26	1	5
b. Complaints and protest of neighboring communities	31	2.68	1.40	1	5
c. Complaints and boycotts from environmental NGOs	30	2.19	1.30	1	5
d. Boycotts from individual consumers	30	2.19	1.33	1	5
e. Decreased trust and cooperation of business partners	32	2.94	1.29	1	5
f. Reduced investment from the investors	32	2.72	1.44	1	5
g. Stricter checking or suspend of the loan from banks	31	3.59	1.58	1	5
Panel C: Role of the programme to company's internal modifications					
a. Better processing of internal environmental information	31	3.19	0.95	1	4
b. More aware of the environmental compliance status	31	3.61	1.12	1	5
c. Better coordination of internal organisational units	31	3.26	1.12	1	5
d. More self critical of environmental performance	31	3.32	1.11	1	5
e. Making environmental efforts proactively	31	3.61	1.09	1	5

7. Brief summary

This analysis overviewed the development and implementation of corporate environmental

performance rating and disclosure programme in Changshu of Jiangsu Province, China. By using the detailed database provided by the programme implementer, municipal EPB, the rating results during 2005-2007 and the annual changes are statistically described. The improved rating results show that the participating companies were really making efforts to improve their environmental performances. Those with worse performance records would be more likely to improve their environmental performances in the following years. A common problem of the worst-rated companies was that they could not meet the national emission standards. The daily environmental maintenance was also not encouraging. Most of the companies were rated Yellow due to certain kind of illegal environmental behaviors which are not difficult to tackle.

Interviews with selected participating companies confirm that complying with environmental regulations is still a major objective of their environmental efforts although some of them have begun to be concerned with the relationship with other external stakeholders, such as banks and business partners. In spite of the unavoidable bias of using the subjective responses of the companies, the qualitative estimation provides an in-depth understanding of functional mechanisms of the disclosure programme. The reflexive function is relatively stronger than the deterrent and enhancement mechanisms. Communications with the local environmental bureau in the rating and disclosure process do assist the companies to be clearer of their actual status of environmental compliance. Due to the lack of incentives encouraging the reactions of external stakeholders other than the government, the disclosure programme has generated less pressure for enhancing environmental improvement. This implies that the disclosure programme could only work effectively in combination with other environmental tools. The pressure on the worst environmental performers would be actually generated only if the information receivers could react seriously.

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Chapter 6: Environmental activisms of company's neighbouring residents

1. Introduction

In recent years, the Chinese government has been trying to modify its environmental policy scheme. The basic philosophy of introducing alternative measures for industrial pollution abatement is to make use of the power of company stakeholders which could be translated into pressure for the polluter to pursue better environmental goals (Henriques and Sadorsky, 1996). From a traditional viewpoint, most literatures on industrial pollution control assume that government regulators act as sole agents for the public's environmental interest. On another hand, Coase (1960) and his followers highlighted the conditions under which the private agents might solve environmental problems by themselves. These two approaches shall be blended from an institutional perspective. The regulators are often ill-informed on pollution cases because monitoring is costly. The governments naturally solicit complaints from the public who are suffering because of the pollution. Meanwhile, the public can enhance their bargaining position during direct negotiations with the polluters by threatening to complain to the regulators. A combined method is particularly important for developing countries where monitoring resources are usually not sufficient.

Encouraging environmental participation of civil society requires an understanding of various types of situations of the policy-relevant characteristics. In general, there are two broad pollution types: product pollution and process pollution; and four specific settings: the household, the consumption, the employment and the community. From an economic viewpoint, the most complex setting involves situations where the polluter and victims have no formal contractual relationship and a large number of parties are included. The case of polluting companies and their neighbouring residents is a good example of this problem. As there is a clear purchase relationship for consumption-related pollution and a wage relationship for employment-related pollution, the community-polluter relationship is not mediated by any specific behavioural linkage. The case of residential community is a typical example for which the Coase theorem is problematic, not only because of the high bargaining costs but also due to the free-rider motive in a large number of cases (Kennedy et al., 1994).

The public environmental activism (EA) is promising but not encouraging currently in China. Different levels of environmental bureaus received about 100,000 letters complaining about noise, air and water pollution in 1997. This number increased rapidly and exceeded 600,000 up to 2006 (SEPA, 2006). It is disappointing that numerous claims cannot be resolved because the environmental participation rights of civil society are still not fully supported. The legislation does not clearly define the procedures for the public's involvement in environmental lawsuits.

As mentioned earlier, the public's environmental participation is recently expected to be enhanced by incorporating environmental disclosure strategies. However, the supply of environmental information can hardly satisfy the actual needs as the people in China are mainly informed by TV, the broadcast, newspapers and the internet which only provide limited and general environmental messages (CEAP, 2008). To date, there is little research monitoring the actual EA involvement of a company's neighbouring communities in China. It is not clear what factors are determining the residents' preference of using EA to fight against the pollutions. There are very limited discussions about how to encourage the residents' EA as a complementary strategy for the existing environmental policies.

In order to close the research gap mentioned above and help a comprehensive understanding of EA raised by company neighboring residents in China, we conducted a questionnaire survey for mainly discussing three topics as follows: a) current status of EA involvement of company neighboring residents; b) the predicting factors of resident's EA practices, and; c) the correlations between the identified determinant factors and resident's actual EA practices. Suzhou, a typical city of Jiangsu province in China, was selected as the study area. The urban residents living around industrial companies were personally interviewed to collect necessary data for the analysis.

2. Analytical framework

Based on the theory of reasoned action, Hirose (1995) presented a general determinant model for environment-friendly behaviour, in which the decision process leading to such an action was assumed to operate in two phases. At the first stage, the general attitude, 'goal intention', is formed, while 'behavioural intention', e.g., the intention to adopt a specific action, is formed as the second step. The following three types of perceptions of the environment were presented as determinant factors of 'goal intention': 'perception of environmental risk', a sense of crisis over environmental contamination; 'perception of responsibility', a sense of responsibility for the cause of environmental contamination; and 'perception of efficacy of action', the awareness that environmental problems could be tackled if appropriate actions were taken. Regarding determinants of 'behavioral intention', Hirose (1995) added 'feasibility assessment' for judging whether people have sufficient skills to act in a manner friendly to the environment; 'profit and cost assessment' for checking how personal profit and cost would change if people acted in an environment-friendly manner; and 'social norm assessment' for checking whether such actions satisfy the expectations of the reference group.

Modified from the general model of Hirose (1995), the analytical framework in this study is developed as depicted in Fig.6.1. This study focuses on EA practices of the residents living close to the polluting companies. Nine items of representative EA practices, which are common

in Chinese context, are selected to estimate the overall level of a resident's EA involvement. As an example, complaints by letter or phone call refer to the reporting of polluting cases by the residents to different levels of environmental protection bureaus either by posting a letter or giving a call by telephone directly. Besides the predictors of environmental behaviours in the model of Hirose (1995), perception of information and perception of government support are added as another two antecedents of behavioral intention since these two factors affect the resident's valuation of benefits and costs of EA participation. The demographic characteristics of the respondents, such as age, gender, education and income, are defined as control variables in this study.

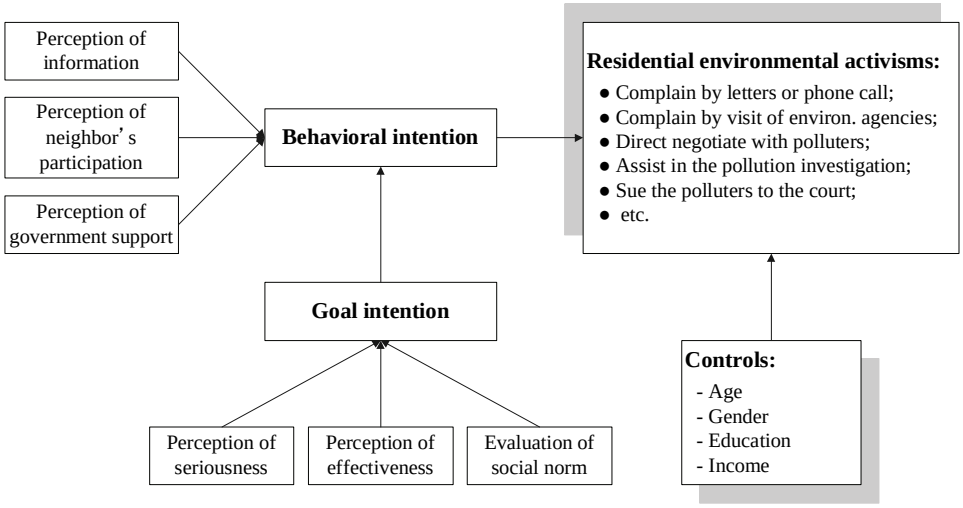


Fig.6.1: Overall analytical framework of this study.

3. Outline of the questionnaire survey and the samples

In order to obtain necessary data for the analysis, we conducted a questionnaire survey in August of 2009 in the study area: Suzhou city of Jiangsu province. Suzhou is located in the front of the Yangtze River delta where the economy has been relatively developed. A total of 343 valid responses were successfully obtained. The questionnaire format consists of four components: basic information of the interviewee; the sources and volume of corporate environmental information available for the residents; resident's EA practices and the degree of identified determinant factors, and; optional measurements for encouraging EA involvement of firm's neighboring residents.

The representation of the sampling was checked by observing the background information of the respondents. The distribution of demographic characteristics of the usable samples is listed in Table 6.1. Most of the respondents (79.6%) are 18-40 years old. Nearly 80% of them have received senior high school and undergraduate educations. The ratios of the respondents with different ages and education levels are some different with the structural distribution of the

population of the city as a whole. However, the individual income and gender of the respondents are evenly distributed. About half of the interviewees are male and another half is female. The samples with monthly income of CNY 1001-3000 account for 62.4% of the total.

Table 6.1: Distribution of the respondents by demographic characteristics

Variables	Options	Count	Percentage	Cumulative percentage
GENDER	Male	178	51.9	51.9
	Female	165	48.1	100.0
	Total	343	100.0	--
AGE	< 18	20	5.8	5.8
	18-30	234	68.2	74.0
	31-40	39	11.4	85.4
	41-60	37	10.8	96.2
	≥ 61	13	3.8	100.0
	Total	343	100.0	--
EDUCATION	Under junior high school	11	3.2	3.2
	Junior high school	56	16.3	19.5
	Senior high school	116	33.8	53.4
	Undergraduate degree	156	45.5	98.8
	Graduate degree	4	1.2	100.0
	Total	343	100.0	--
INCOME	≤ 1000	70	20.4	20.4
	1001-2000	122	35.6	56.0
	2001-3000	92	26.8	82.8
	3001-5000	42	12.2	95.0
	≥ 5001	17	5.0	100.0
	Total	343	100.0	--

4. Operationalisation of the variables

The comprehensiveness of the level of EA practices may be presented by a series of actual environmental activities against the polluters due to the difficulty of a direct measurement. As listed in Panel A of Table 6.2, nine items of EA are defined to estimate a person's level of EA engagement in current China, which are abbreviated as EA1 to EA9. The company's neighbouring residents may practice EA in a variety of forms. As the direct victims, they may request the polluters to stop the pollution activities by making complaints, or ask them to cover compensatory damage by direct negotiations, or sue the polluting cases in the courts, etc. (EA1 to EA6). As individual potential investors, the residents may refuse to buy shares in polluting companies (EA7) either for moral concerns or due to a belief that environmentally-benign companies will ultimately face fewer cleanup costs and will be more profitable. As general consumers, the residents may reject the products of companies with bad environmental performances (EA8).They may not consider the working opportunities in the polluting

companies (EA9). The interviewees were asked to check whether they have practiced each of these pre-defined items. A value '1' is given to the item if the answer is 'YES'. Otherwise, a score '0' is assigned. The sum of the score for each item was used to value a respondent's EA level. Thus each sample achieves an integral score between 0 and 9. The other variables, describing the predicting factors for EA level, are listed in Panel B of Table 2. A five-likert scale was used to measure the strength or the agreement degree of each factor with '1' = not at all; '2' = a little bit; '3' = moderate; '4' = relatively high; and, '5' = very high. The score of each factor was used to analyse their relationships defined in the analytical model.

Table 6.2: Definition and valuation of the variables in this study

Variable	Description of the item and its abbreviation	Valuation					
		0	1	2	3	4	5
Panel A: Items of environmental activisms							
EA level	Complain to environmental agencies by letters or phone call (EA1)						
	Directly visit environmental agencies for complaints (EA2)						
	Directly negotiate with polluting companies (EA3)						
	Arrange or participate in the protest against polluting companies (EA4)						
	Assist in the investigation of pollution (EA5)						
	Sue the polluting companies in the courts (EA6)						
	Refuse to buy the shares of the polluting companies (EA7)						
	Refuse the products of polluting companies (EA8)						
	Not apply the employment of and work in polluting companies (EA9)						
Panel B: Predicting variables							
Perception of seriousness	Recognition of surrounding environmental severity (SERIOUSNESS)						
Perception of effectiveness	Roles of personal efforts for better environment (EFFECTIVENESS)						
Evaluation of social norm	Social appreciation of environmental efforts (SOCIALNORM)						
Goal intention	Readiness of environmental efforts (GINTENTION)						
Perception of information	Availability of corporate environmental information (INFORMATION)						
Percept. of neighbour's participation	Degree of neighbour's environmental activism (NEIGHBOUR)						
Perception of government support	Degree of government support to environ. activism (GSUPPORT)						
Behavioral intention	Readiness of environmental activism against polluters (BINTENTION)						

5. Results and discussions

5.1 Overall level of resident's environmental activism

Fig.6.2 gives the distribution of EA level of the residents living close to the companies in the study area. In general, the resident's EA level is very low. A mean of 1.81 of EA level implies that the respondents have actually participated in less than two items of EA in average. People are reluctant to take protest actions against their neighbouring polluters. Less than 5% of the respondents (3.8%) have involved in more than five of the nine classified EA items. Most of them (66.2%) occasionally tried one or two kinds of EA in the past. Nearly 10% of the

respondents have no experience of acting against the polluting companies.

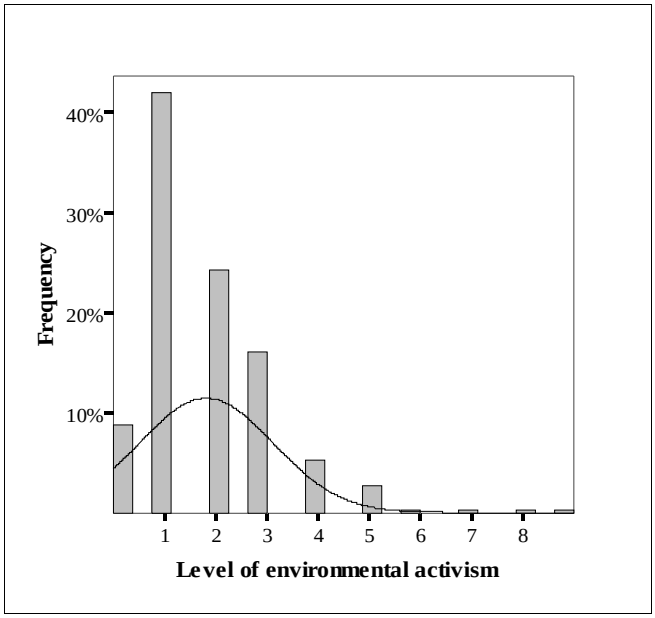


Fig.6.2: Distribution of overall level of resident's environmental activism

(Z=4.447 in K-S test and could pass the normality test).

Fig.6.3 further provides the occurring frequency of individual EA items. The people behave differently for different item of EA. Six items achieve very low frequencies of participations, with an answer of 'YES' being less than 20%. Two items of EA are practiced relatively better. Around half of the respondents (53.4%) prefer to reject the products of polluting companies. The samples who do not apply for the working opportunities in the polluting companies account for 40.5% of the total. Another item, which achieves a participation rate of 25.7%, is to send complaints to environmental agencies by letters or phone calls. The survey suggests that the residents prioritise the environmental protest activities under their own control, but are not willing to participate in time-consuming activities. As examples, only 5% of the respondents directly go to the environmental agencies to complain, or negotiate with the polluters for damage compensations, or sue the polluters in the courts.

5.2 Descriptive statistics of the predicting variables

A descriptive summary of the predicting variables defined in the analytical model is shown in Table 6.3. A mean of 2.90 for SERIOUSNESS indicates that the respondents recognise that their surrounding environment is not bad. A low score (averaging at 2.76) is given to the role of EA practices for keeping a better environment (EFFECTIVENESS). The residents believe that their environmental protest would be appreciated by the other people, with SOCIALNORM achieving an average of 3.64. Some barriers exist for the resident's EA practices. Little corporate environmental information is available as a low value is given to INFORMATION. A mean of 3.14 for GSUPPORT suggests a moderate government support to the resident's EA

practices. However, the respondents show higher goal and behavioral intentions to EA practices, with GINTENTION and BINTENTION achieving a mean of 4.13 and 3.89 respectively.

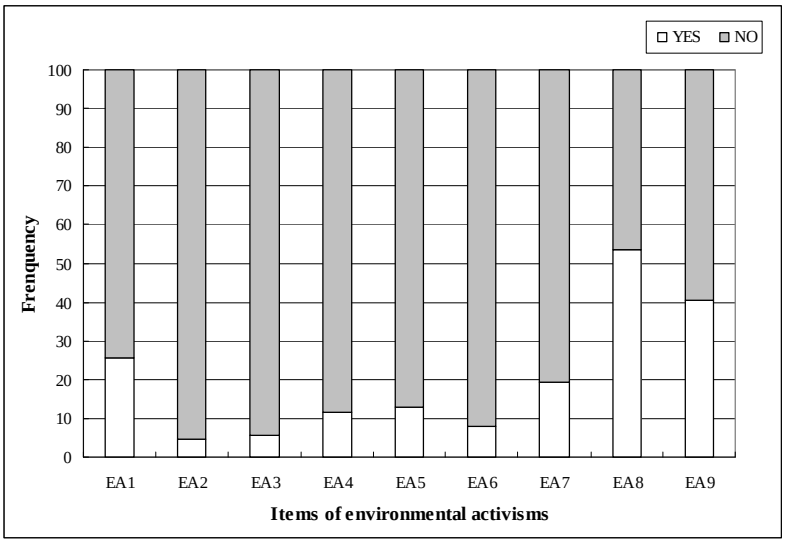


Fig.6.3: Frequency of resident's environmental activisms (N=343).

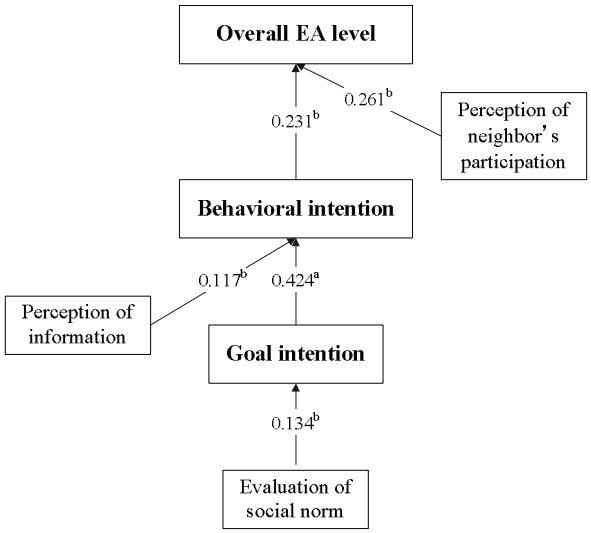
Table 6.3: Statistical summary of the predicting variables

Variable name	Obs.	Mean	Std. dev.	Min.	Max.
SERIOUSNESS	343	2.90	0.81	1	5
EFFECTIVENESS	343	2.76	0.98	1	5
SOCIALNORM	343	3.64	0.90	1	5
GINTENTION	343	4.13	0.89	1	5
INFORMATION	343	2.66	0.81	1	5
NEIGHBOUR	343	2.66	0.88	1	5
GSUPPORT	343	3.14	0.91	1	5
BINTENTION	343	3.89	0.91	1	5

5.3 Result of the path analysis

The model, described in section 2, is applied to figure out the cause and effect chains between the predicting variables and the level of EA by the path analysis. As the variables in this study are measured on a likert scale, a quantitative dataset is constructed by the questionnaire survey. The path coefficients are calculated out via various steps of multivariate regressions and depicted in Fig.6.4. The paths are excluded in the final model if the coefficients are not significantly over the 0.05 level. The direct effect of one variable to another may be observed from the weight given by the path coefficient, which indicates the relative change of a dependent variable for any change of the independent variable. The additional and indirect influences can be determined by multiplying the direct path coefficients for those indirect paths.

In the model, EA level is the variable at the end of the cause-effect chains.



Note: [a] significant at 0.01 level, 2-tailed; [b] significant at 0.05 level, 1-tailed.

Fig.6.4: Path diagram of the final model.

The empirical result shows that there are strong influences of certain attitudinal components on EA level, those represented by the two higher path coefficients emanating from 'goal intention' and 'behavioral intention'. There is, however, no direct influence on EA level of two attitudinal components in the original model, namely 'perception of seriousness' and 'perception of effectiveness'. Goal intention is significantly influenced by the variable of 'evaluation of social norm' (weighting at 0.134). The behavioral intention is significantly under the influence of two factors, 'goal intention' (with a coefficient of 0.424) and 'perception of information' (weighting at 0.117). This implies that providing corporate environmental information will greatly increase the resident's readiness to take EA practices. Besides the immediate antecedent - behavioural intention, perception of neighbour's participation greatly determines the level of EA (with a direct path coefficient of 0.261). The residents would like to act collectively against their neighbouring polluters.

5.4 Variances of environmental activisms by the control variables

In this study, we sorted the respondents into two categories using a cluster analysis, namely occasional and moderate participators of EA. Consistent with the results in section 5.1, most of the respondents (91.0%) are classified as occasional participators. The moderate participators share the rest 9.0%. Table 6.4 gives a summary of the demographic distribution of the samples by clusters with cluster 1 being occasional participators and cluster 2 being moderate participators.

There is very slight difference of EA involvements between male and female. A higher ratio of

males is categorised into the moderate group. People aged between 31-40 have a slightly higher tendency to participate in EA practices moderately. Individual income is slightly related to EA practices. In general, the residents are slightly more active in EA practices along with an increase of income. Probably due to the correlation between education level and personal income, education has a similar pattern in affecting EA level.

Table 6.4: Summary of environmental activisms by the control variables

Variables	Options		Cluster		Total
			1	2	
GENDER	Male	Count	156	22	178
		% within gender	87.6	12.4	100.0
	Female	Count	156	9	165
		% within gender	94.5	5.5	100.0
AGE	< 18	Count	18	2	20
		% within age	90.0	10.0	100.0
	18-30	Count	214	20	234
		% within age	91.5	8.5	100.0
	31-40	Count	37	2	39
		% within age	94.8	5.2	100.0
	41-60	Count	31	6	37
		% within age	83.8	16.2	100.0
	≥ 61	Count	12	1	13
		% within age	92.3	7.7	100.0
EDUCATION	Under junior high school	Count	9	2	11
		% within education	81.8	18.2	100.0
	Junior high school	Count	52	4	56
		% within education	92.9	7.1	100.0
	Senior high school	Count	107	9	116
		% within education	92.2	7.8	100.0
	Undergraduate degree	Count	140	16	156
		% within education	89.7	10.3	100.0
	Graduate degree	Count	4	0	4
		% within education	100.0	0	100.0
INCOME	≤ 1000	Count	60	10	70
		% within income	85.7	14.3	100.0
	1001-2000	Count	117	5	122
		% within income	95.9	4.1	100.0
	2001-3000	Count	79	13	92
		% within income	85.9	14.1	100.0
	3001-5000	Count	40	2	42
		% within income	95.2	4.8	100.0
	≥ 5001	Count	16	1	17
		% within income	94.1	5.9	100.0

5.5 Residents' access of corporate environmental information

It is assumed in this study that providing more environmental information of the companies would help residents' participation in EA practices. This hypothesis was confirmed in the path analysis of section 5.3. With aims to monitor the residents' perception of corporate

environmental information, additional questions were asked in our survey to monitor the respondents' information concerns and sources. The results are summarised in Table 6.5.

Table 6.5: Residents' perception of corporate environmental information (N=343)

Description of optional items	Percentage of the answers	
	YES	NO
Panel A: Corporate environmental information concerned by the respondents		
a. Company environmental management strategy and goals	25.7	74.3
b. Overall environmental management and compliance status	20.1	79.9
c. Consumption of resources and energy	25.9	74.1
d. Types and amounts of pollutant emissions	29.2	70.8
e. Impacts of pollutant emissions to surrounding environment	57.4	42.6
f. Risk of pollutant emissions to people's health	57.1	42.9
g. Construction and operation of pollution control facilities	12.5	87.5
h. Investment and cost for pollution control	13.4	86.6
i. Environmental activities in a voluntary manner	6.4	93.6
j. Environmental information related to the products	25.9	74.1
Panel B: The sources of corporate environmental information for the respondents		
a. Corporate environ. performance rating and disclosure program operated by local EPB	18.7	81.3
b. Onsite visit and direct observations	14.9	85.1
c. Public media such as television and newspapers	74.1	25.9
d. Corporate environmental information disclosed by NGOs	22.4	77.6
e. Website of local EPB (environmental protection bureau)	15.2	84.8
f. Website and annual environmental report of the companies	11.1	88.9
g. Interviews with the neighbours	39.4	60.6

Panel A of Table 6.5 shows the result of corporate environmental information concerned by the neighbouring residents of a company. The respondents obviously pay much higher attention to the impacts of pollutant emissions to surrounding environment and the risks to people's health, with both having similar and higher ratios of 'YES' answers (about 57%). Less than 30% of the residents would care about the other aspects of environmental performances of the companies. Panel B of Table 5.5 shows the sources for the residents to know the environmental information of their neighbouring polluters. Similar to the result of a previous survey (CEAP, 2006), 74.1% respondents obtain corporate environmental information via public media such as television, broadcasting and newspapers. Less than 20% respondents have the experience of obtaining environmental information from the government or directly from the companies. There is a large gap between the resident's environmental information concerns and what is available. The residents are reluctant to collect environmental information by personal visits and observations, with a ratio of 14.9% of 'YES' answers for this choice. Practically, the residents lack the ability to distinguish between nuisance emissions and those truly hazardous. Colorless or odorless eminssions, toxics and heavy metals may escape the notice of the residents.

5.6 Acceptability of residents to the cost of EA participation

During our survey, the willingness of residents to take the possible burdens for participation in EA practices was also asked. The result is depicted in Fig.6.5. Low cost is more acceptable for the residents. About 77.3% of the respondents would like to pay less than CNY100 for EA participation. If using the average wage of Suzhou city in 2008 as a converter, this result implies that nearly 80% of the respondents would spend less than half a day for EA participation, among which 16.6% of them would not take any burden at all for EA practices. Low willingness to pay in the study area confirms the marginal level of EA which often require large time inputs.

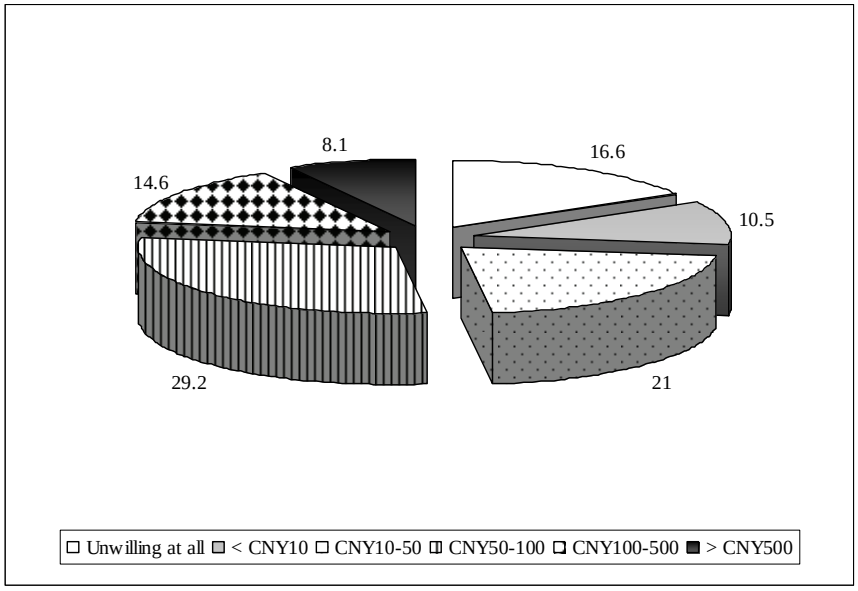


Fig.6.5: Percentage of the respondents by the amount of willing to pay (N=343).

6. Brief summary

This chapter develops an analytical model explaining EA practices of company's neighboring residents based on the reasoned action theory. The data collected by direct interviews with the residents of Suzhou city in Jiangsu province of China are used for the empirical analysis. This exploratory study not only provides descriptive summaries of people's involvement of EA practices, but also clarifies the cause and effect links between the identified predicting factors and EA level by multivariate regressions. It is indicated that the level of EA of the respondents is very marginal at the current phase. The evaluation of social norms greatly influences the formation of resident's goal intention to EA practices. Providing environmental information of the companies largely determines people's behavioural intention to EA practices. Besides the immediate antecedent - behavioural intention, perception of neighbour's participation greatly determines the level of EA. This implies that environmental information disclosure strategy will help increase the resident's readiness to participate in EA practices. But sufficient

environmental information access does not directly lead to resident's actual EA involvement. The government shall also responsively support people's EA efforts since successful environmental protests will greatly convince the residents to jointly act against their neighbouring polluters.

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Chapter 7: Green purchasing practices of urban consumers

1. Introduction

As is well known, environmental problems arise not only from the manufacturing processes but also from the consumption of products. The purchasing preferences of individual consumers dramatically determine the impact of society on the environment as a whole. The consumer's decision to buy environmentally friendly goods or services may directly contribute to the reversal of environmental deterioration. At the same time, the consumer's selection of green products can be translated into a powerful incentive for the companies to improve their environmental performances.

Some surveys have been recently conducted in China in order to clarify the public understanding of the concept of green consumption in overall. These surveys may be categorised either as a component of the National Environmental Education Program or an occasional activity for celebrating World Earth Day (CEAP, 2008; ACEF, 2009). As a representative empirical study in China, Zhang et al. (2007) interviewed about 300 people in Nanjing city, the capital of Jiangsu province, and analysed the relationship between household consumption behaviours (including purchasing activities) and the demographic characteristics of interviewees. However, it is not clear so far what variables are actually acting as the antecedents of green purchasing (GP) behaviours, and to what extent these predicting factors determine people's GP selections. With the aim of closing these research gaps, this analysis develops an overall analytical framework based on the reasoned action theory and discusses three major topics as follows: a) current level of urban residential involvement of GP practices; b) the factors affecting the individual's GP behaviours; and c) the relationship between the predicting factors and the level of actual GP behaviors. Suzhou, a typical city in Jiangsu province, China, was selected as the area for this empirical study. The urban residents living there were interviewed to collect necessary data for the analysis.

2. Analytical framework

The analytical framework in this study is constructed and depicted in Figure 6.1. This study only focuses on GP behaviours of the urban residents. Ten representative GP activities, which have been covered in earlier studies (Midori Aoyagi, 2001; Kim and Choi, 2005) and are also popular in current China, are selected to estimate the overall level of people's GP behaviors. As an example, purchase of energy-saving products refers to buying appliances with less energy use as a priority, such as high energy-efficient washing machines and air conditioners, etc. There are small modifications of the predicting variables in our framework if comparing with the original model of Hirose (1995). One is to integrate 'profit and cost assessment' into

'evaluation of feasibility' since the economic factor could be looked as one aspect of feasibility. This aggregation may ease the respondents to have rough valuations for this variable. Another is to add 'perception of information' as one more antecedent of behavioural intention. This is because a significantly positive role of information availability for intention formulation of residential recycling activities was confirmed in a previous study (Matsui et al., 2007). We also assumed that the knowledge of a product's environmental performance greatly affects the consumer's rational purchasing selection. The demographic characteristics of the respondents, such as age, gender, education and income, are defined as control variables.

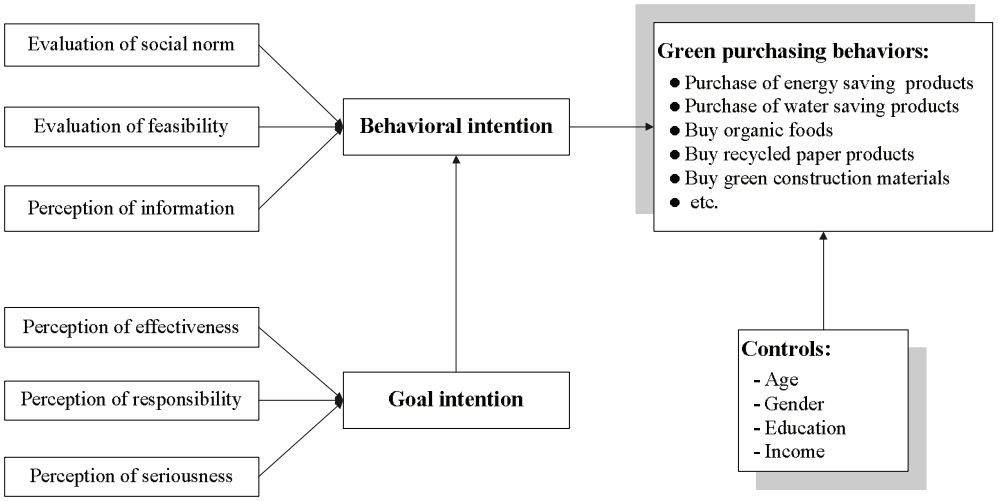


Fig.7.1: Overall analytical framework of this study.

3. Outline of the questionnaire survey and the samples

In order to obtain necessary data for the analysis, we conducted a questionnaire survey in August of 2009 in the study area: Suzhou city of Jiangsu province, China. Since it is not easy in China to collect questionnaires from the citizens by simply posting letters due to the low responses, this survey was carried out by direct interviews with urban residents. A total of 336 valid responses were successfully obtained. The questionnaire format consists of four components: basic information of the interviewee; awareness and actual activities of buying environment-friendly products or services; degree of the predicting factors of residential GP behaviours, and; optional measures enhancing people's GP engagements.

The accuracy of representation of the sampling was checked by observing the background information of the respondents. The distribution of demographic characteristics of the usable samples is listed in Table 7.1. Most respondents (81.9%) are 18-40 years old. More than 80% of them have received senior high school or undergraduate educations. The ratios of the respondents with different ages and education levels are some different from the structural distribution of the whole population of the city. Nevertheless, the individual income and gender

of the respondents are well and evenly distributed. About 60% of the interviewees are male and the remaining 40% are female. The samples with monthly income of CNY 1001-3000 account for 61.9% of the total.

Table 7.1: Distribution of the respondents by demographic characteristics

Variables	Options	Count	Percentage	Cumulative percentage
GENDER	Male	196	58.3	58.3
	Female	140	41.7	100.0
	Total	336	100.0	--
AGE	< 18	16	4.8	4.8
	18-30	223	66.4	71.2
	31-40	52	15.5	86.7
	41-60	17	5.0	91.7
	≥ 61	28	8.3	100.0
	Total	336	100.0	--
EDUCATION	Under junior high school	3	0.9	0.9
	Junior high school	46	13.7	14.6
	Senior high school	87	26.0	40.6
	Undergraduate degree	191	57.0	97.6
	Graduate degree	8	2.4	100.0
	Total	335	100.0	--
INCOME	≤ 1000	61	18.2	18.2
	1001-2000	113	33.6	51.8
	2001-3000	95	28.3	80.1
	3001-5000	43	12.8	92.9
	≥ 5001	24	7.1	100.0
	Total	336	100.0	--

4. Operationalisation of the variables

The comprehensiveness of overall level of GP behaviors may be presented by a series of actual purchasing activities due to the difficulty of a direct measurement. As listed in Panel A of Table 6.2, ten items of GP activities are selected to estimate a person's current level of GP engagement in China, which are abbreviated as GP1 to GP10. The interviewees were requested to check the activity list and indicate whether they have practiced each of these pre-identified items. A value '1' is given to the item if the answer is 'YES'. Otherwise, a score '0' is assigned. The sum score of each item was used to represent a respondent's overall GP level. Thus each sample achieves an integral score between 0 and 10. The variables, describing the determinant factors of GP level, are listed in Panel B of Table 2. In general, a five point likert-type scale was used to measure the strength level or agreement degree of each factor with '1' = not at all; '2' = relatively low; '3' = moderate; '4' = relatively high, and; '5' = very high. The only exception is for the variable of 'SERIOUSNESS'. The interviewee is asked to give an overall judgment to

the quality of surrounding environment with '1' = very bad; '2' = relatively bad; '3' = ordinary; '4' = relatively good, and; '5' = very good. The score of each factor was used to analyse their relationships defined in the analytical framework.

Table 7.2: Definition and valuation of the variables

Variable	Description of the item and its abbreviation	Valuation					
		0	1	2	3	4	5
Panel A: Green purchasing behaviors							
Overall GP level	Purchase of energy saving products (GP1)						
	Purchase of water saving products (GP2)						
	Purchase of products free of CFCs (GP3)						
	Purchase of recycled paper products (GP4)						
	Purchase of green or organic foods and vegetables (GP5)						
	Buy environmental-friendly building materials (GP6)						
	Buy green furniture for household use (GP7)						
	Purchase of other eco-products (GP8)						
	Participate in eco-tourisms (GP9)						
	Use my bag for shopping in the supermarket (GP10)						
Panel B: Predicting variables							
Perception of seriousness	Recognition of the severity of surrounding environment (SERIOUSNESS)						
Perception of responsibility	Degree of agreement on self responsibility (RESPONSIBILITY)						
Perception of effectiveness	Roles of GP behaviors for better environment (EFFECTIVENESS)						
Goal intention	Readiness of efforts for better environment (GINTENTION)						
Evaluation of feasibility	Difficulty for choosing green products or services (FEASIBILITY)						
Evaluation of social norm	Degree of environmental efforts affected by the neighbours (NEIGHBOUR)						
Perception of information	Understanding of the information of green products (INFORMATION)						
Behavioral intention	Readiness of GP activities for improving the environment (BINTENTION)						

5. Results and discussions

5.1 Overall level of GP behaviours

Fig.7.2 provides the distribution of GP behavioural level of urban residents in the study area. Overall, the level of GP behaviours is still very low. A mean of 3.94 of GP level implies that the respondents have actually practiced less than four items with the ten GP activities in average. People do not sufficiently care about the product's environmental performance when assessing their purchasing selections. Only 21.8% of the respondents practiced more than half of the ten pre-defined GP activities. Nearly half of them (47%) had seldom bought environment-friendly goods in the past. Fig.7.3 further gives the occurring frequency of individual GP behaviours. People behave quite differently depending on the practice of different GP activities. Seven items achieve relatively lower frequencies of practices, with answer of 'YES' being less than 40%. The other three items of GP behaviours are practiced better. Nearly 80% respondents have experience of buying high energy efficient appliances. About 60% of them once bought organic

foods and vegetables. The people with a habit of using their own bags in the supermarket account for more than 60% of the total. This result is consistent with the finding of a web-based survey documenting that many Chinese people (41.2%) buy green foods partially due to the care of their health (ACEF, 2009). A charging system for the use of plastic bags has been enacted since 1 June 2008 in China (GOSC, 2008). This policy limit may explain, to some degree, the higher ratio of using one's own bags for shopping found in this survey.

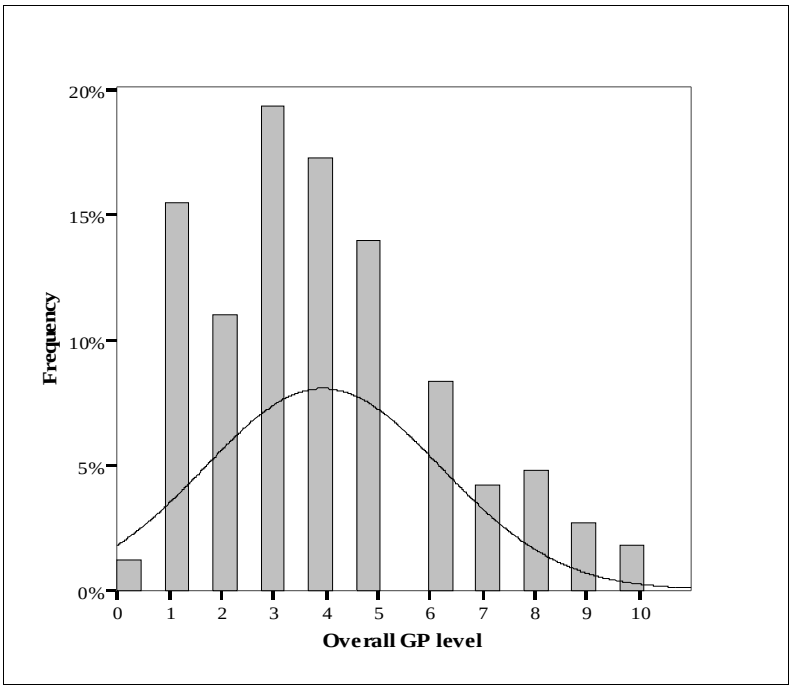


Fig.7.2: Distribution of overall level of green purchasing behaviours (Z=2.417 and could pass the normality test).

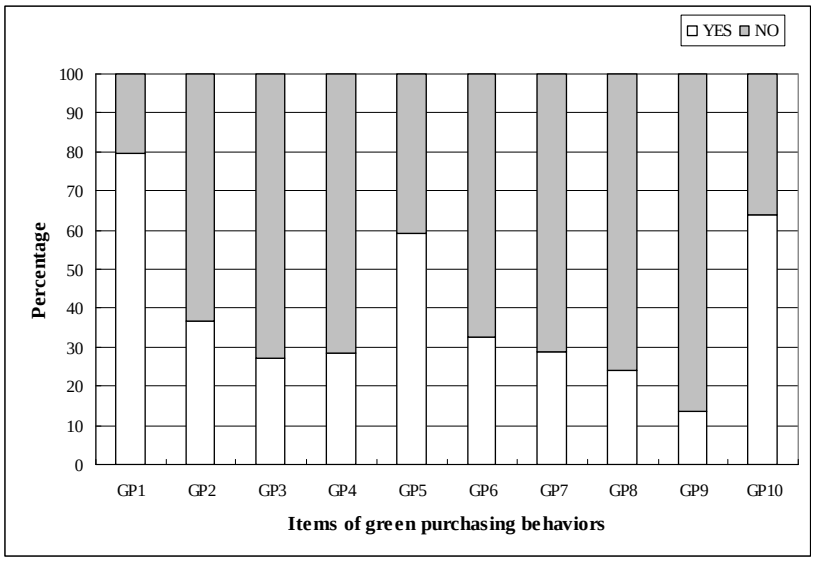


Fig.7.3: Frequency of individual green purchasing behaviours (N=336).

5.2 Descriptive statistics of the predicting factors

Descriptive summary of the predicting factors defined in the analytical framework is shown in Table 7.3. A mean of 2.86 for SERIOUSNESS indicates that the respondents view their surrounding environmental quality as being ordinary. The people highly value their responsibilities for a better environment (averaging at 4.35). A moderate score (averaging at 3.24) is presented to the role of GP efforts for maintaining a good environment (EFFECTIVENESS). Difficulties seem to exist for people to choose green products since the variable of FEASIBILITY only achieves a mean of 3.05. One barrier may be the availability of information on the environmental performance of green products as a low score is given to INFORMATION. The respondents express higher goal and behavioural intentions to GP behaviours, with GINTENTION and BINTENTION achieving a mean of 4.22 and 4.02 respectively. Our survey confirms the gap existing between people's environmental attitude and actual GP behaviours in China, which is similar to the result of Hughner et al. (2007).

Table 7.3: Statistical summary of the variables

Variable name	Obs.	Mean	Std. dev.	Min.	Max.
SERIOUSNESS	336	2.86	0.74	1	5
RESPONSIBILITY	336	4.35	0.73	1	5
EFFECTIVENESS	336	3.24	0.97	1	5
GINTENTION	336	4.22	0.68	1	5
FEASIBILITY	336	3.05	0.82	1	5
NEIGHBOUR	335	3.07	0.95	1	5
INFORMATION	336	3.01	0.68	1	5
BINTENTION	336	4.02	0.81	1	5

5.3 Factor analysis of GP items

An exploratory factor analysis was conducted on the ten items of GP activities to find if there are different dimensions of these behaviours. Four principal component factors are extracted. The first factor accounts for 26.4% of the variance in total and each of the other three factors accounts for about 10%. Together, the four factors account for 58.3% of variability of the original ten items. The rotated component matrix of the factor analysis is listed in Table 7.4. GP6 (buying green building materials) and GP7 (buying green furniture) are highly associated with factor 1; GP3 (purchase of products free of CFCs), GP4 (purchase of recycled paper products) and GP10 (using one's own bag for shopping in the supermarket) are highly associated with factor 2; GP5 (selection of organic foods) and GP9 (participation of eco-tourism) are obviously related to factor 3 and 4, respectively. However, the results for GP1 (purchase of energy-saving products) and GP2 (purchase of water-saving products) are not so clear since they have nearly equal loadings on factor 1 and 2.

According to the result of factor analysis, the four sets of constructs of GP activities may be

further explained and defined. GP6 and GP7 are mainly related to people's private living environment. GP3, GP4 and GP10 are the activities beneficial to the public environment. GP1 and GP2 are good for the public environment and also help the consumer to save money in most cases. GP5 is practiced usually due to people's increasing concern with food security. GP9 is an item specifically surveyed for the tourism issue. We therefore classified the GP items into four categories as defined in Table 7.5. Besides the overall GP level, the variables, representing the involvement level of the sub-category of GP items, are also used as dependent variables for the path analysis to observe their particular relationships with the predicting variables.

Table 7.4: Rotated component matrix of factor analysis of GP activities

GP activities	Component			
	1	2	3	4
GP6	0.788	--	0.243	--
GP7	0.736	--	0.185	0.207
GP2	0.466	0.380	-0.256	0.317
GP1	0.458	0.455	-0.165	-0.195
GP3	0.105	0.720	--	0.115
GP10	0.124	0.589	0.313	-0.157
GP4	-0.118	0.564	0.119	0.488
GP5	--	0.167	0.791	--
GP8	0.247	--	0.631	0.352
GP9	0.158	--	--	0.786

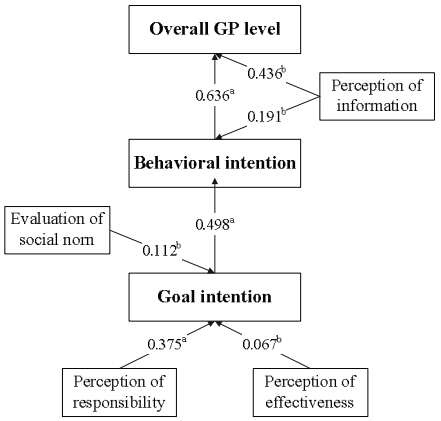
Table 7.5: Definition and valuation of the sub-category of GP items

Variable abbreviation	**Description of the sub-category**	**Valuation**
GP $_{Public}$	Practice level of GP items for public environment	Sum of the scores of GP1, GP2, GP3, GP4 and GP10
GP $_{Private}$	Practice level of GP items for private living environment	Sum of the scores of GP6 and GP7
GP $_{Food}$	Practice level of GP items for food security	Score of GP5
GP $_{Tourism}$	Practice level of eco-tourism	Score of GP9

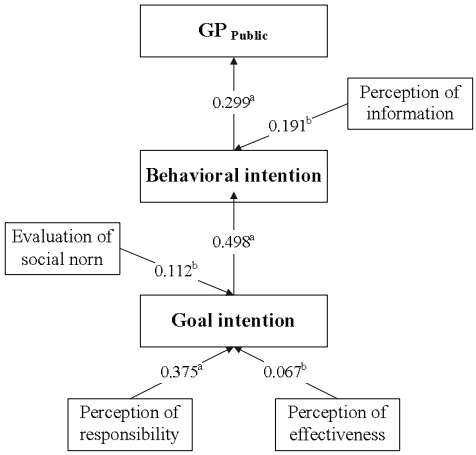
5.4 Result of the path analysis

The analytical framework, described in section 2, is applied to figure out the cause and effect chains between the predicting factors and the level of GP behaviours by a path analysis. As the variables in this study are measured in a likert scale, a quantitative dataset of them is constructed by the questionnaire survey and the path coefficients are calculated. Fig.7.4 (a), (b) and (c) depict path diagram of the final model for overall GP level, GP $_{public}$, and, GP $_{Private}$ and GP $_{Food}$ respectively. The final model for GP $_{Tourism}$ was omitted due to no significant results being observed.

(a):



(b):



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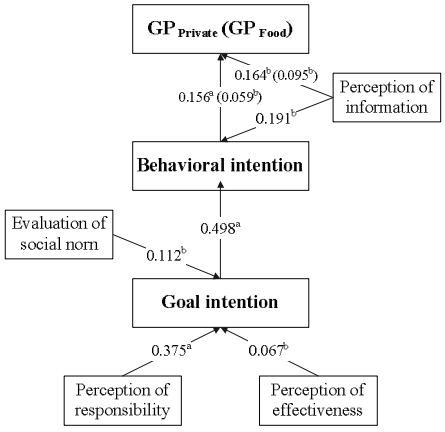

Note: [a] significant at 0.01 level, 2-tailed; [b] significant at 0.05 level, 1-tailed.

Fig.7.4: (a) Path diagram of the final model of overall GP level;

(b) Path diagram of the final model of GP_{Public};

(c) Path diagram of the final model of $GP_{Private}$ and GP_{Food}

(with the path coefficients for GP_{Food} in the parenthesis).

The path coefficients between the defined variables are derived from various steps of multivariate regression. The direct effect of one variable to another can be observed from the weight given by the path coefficient, which indicates the relative change in the dependent variable for any change of the independent variable. The additional and indirect influences can be determined by multiplying the direct path coefficients for those indirect paths. In the model, overall GP level or the sub-category of GP items is the variable at the end of the cause and effect chains. Within the original model in Fig.6.1, the causal connection is postulated between the identified environmental attitudes and GP behaviors. Each endogenous variable is supposed to have a direct or indirect effect on GP behaviours.

The empirical result shows that there are strong influences of certain attitudinal components on GP behaviours, those represented by the three higher values of path coefficients emanating from, 'perception of responsibility', 'goal intention' and 'behavioural intention'. There is, however, no direct influence on GP behaviours of two components, namely 'perception of seriousness' and 'evaluation of feasibility'. Environmental goal intention is significantly influenced by another two variables such as 'perception of effectiveness' and 'evaluation of social norm' (weighting at 0.067 and 0.112 respectively). The GP behavioural intention is significantly under the influence of two factors, namely 'goal intention' (with a coefficient of 0.498) and 'perception of information' (weighting at 0.191). Besides the immediately antecedent, 'behavioural intention', 'perception of information' greatly determines the overall level of GP behaviors (with a direct path coefficient of 0.436). This implies that by improving 'perception of responsibility' of the people towards better environment will strongly increase the readiness to participate in GP activities. In general, our findings are consistent with the results of most previous studies documenting that consumer's ecological concerns and attitudes have significant influence on the intention to buy green products, and in turn, affect the actual GP efforts (e.g. Dobson, 2007; Mostafa, 2006; Sihombing, 2007).

An additional interesting finding of this study is that perception of product's environmental information ('INFORMATION') plays different roles to different categories of GP activities. As indicated in Figure 5(b) and (c), there is no significant relationship between 'INFORMATION' and GP items for the public environmental improvement (GP_{Public}). Whereas, significantly positive correlations were observed between 'INFORMATION' and GP items for better private environment ($GP_{Private}$) and food security (GP_{Food}) as well. This implies that people's altruistic GP activities are mainly determined by the immediately intentional factor. However, the consumers are more cautious to the GP practices with egoism. Their better understanding of environmental information of related products would greatly assist them in actual GP involvements.

5.5 Variances of GP behaviours by the control variables

We conducted a K-Means cluster analysis and sorted the respondents into three groups, namely occasional, moderate and active participators of GP behaviours. The final centre of cluster analysis of the occasional group is '1'. The centre of the moderate and active participating groups is '4' and '8' respectively. Consistent with the result in section 5.1, most respondents (58.9%) are classified as moderate participators. The active and occasional participators account for 13.4% and 22.7% of the total respectively. Table 7.6 provides the statistical summary of the demographic distribution of the samples by the clusters with cluster 1 being occasional participators and cluster 2 referring to moderate participators.

Table 7.6: Summary of green purchasing behaviours by the control variables

Variables	Options		Cluster			Total
			1	2	3	
GENDER	Male	Count	57	120	19	196
		% within gender	29.1	61.2	9.7	100.0
	Female	Count	36	78	26	140
		% within gender	25.7	55.7	18.6	100.0
AGE	< 18	Count	7	8	1	16
		% within age	43.8	50.0	6.2	100.0
	18-30	Count	64	134	25	223
		% within age	28.7	60.1	11.2	100.0
	31-40	Count	9	34	9	52
		% within age	17.3	65.4	17.3	100.0
	41-60	Count	5	8	4	17
		% within age	29.4	47.1	23.5	100.0
	≥ 61	Count	8	14	6	28
		% within age	28.6	50.0	21.4	100.0
EDUCATION	Under junior high	Count	1	2	0	3
	school	% within education	33.3	66.7	0	100.0
	Junior high school	Count	20	23	3	46
		% within education	43.5	50.0	6.5	100.0
	Senior high school	Count	20	54	13	87
		% within education	23.0	62.1	14.9	100.0
	Undergraduate degree	Count	48	115	28	191
		% within education	25.1	60.2	14.7	100.0
	Graduate degree	Count	3	4	1	8
		% within education	37.5	50.0	12.5	100.0
INCOME	≤ 1000	Count	21	36	4	61
		% within income	34.4	59.0	6.6	100.0
	1001-2000	Count	33	67	13	113
		% within income	29.2	59.3	11.5	100.0
	2001-3000	Count	23	60	12	95
		% within income	24.2	63.2	12.6	100.0
	3001-5000	Count	11	17	15	43
		% within income	25.6	39.5	34.9	100.0
	≥ 5001	Count	5	18	1	24
		% within income	20.8	75.0	4.2	100.0

There is some difference of GP involvement between male and female. Slightly higher

percentages of females are categorised into the active and moderate participator groups. This shows that females show more concern about environmental issues by adopting GP practices. People aged between 18 and 40 have a tendency to perform GP activities moderately, while those over the age of 40 behave either actively or occasionally in GP activities. Individual income is significantly related to GP behaviours. In general, people are more active in GP behaviours along with an increase of income. An exception is that relatively rich people (with monthly income no less than CNY 5,001) are less active in buying green products. Most of them (75%) are sorted into the moderate cluster. Probably due to a strong linkage between education level and personal income, education has a similar pattern in affecting GP behaviours. Higher education does not always generate environment-friendly behaviours. This finding is similar to that of Zhang et al. (2007).

5.6 Perception of the information on green products

We assumed earlier that providing sufficient and accurate information on green products would help with better participation of GP behaviours. This assumption has been basically confirmed in the path analysis. With the aim of simultaneously monitoring people's actual perception of environmental information on green products, several additional questions were asked in our questionnaire survey. The result is summarised in Table 7.7.

Table 7.7: Perception of the information on green products (N=336)

Description of optional items	**Percentage of the answers**	
	YES	NO
Panel A: Awareness of existing logos of green products		
a. China Environmental Labeling (Type Ⅰ)	26.8	73.2
b. China Environmental Labeling (Type Ⅱ)	22.0	78.0
c. China Environmental Labeling (Type Ⅲ)	10.4	89.6
d. China Energy Conservation Certification	28.0	72.0
e. Recyclables	63.4	36.6
f. Green Building Materials	11.9	88.1
g. Green Foods	65.2	34.8
h. China Energy Efficiency Label	39.6	60.4
Panel B: Green product related information concerned by the respondents		
a. Logo of green product certification	64.6	35.4
b. Categories and amounts of hazardous materials in the product	39.5	60.5
c. Water saving index of the product	28.3	71.7
d. Package materials of the product	23.2	76.8
e. Collection and recycling of the used product and packages	29.5	70.5
f. Pollutant emissions in product manufacturing processes	24.7	75.3
g. Energy efficiency of the product	47.3	52.7
h. Resource consumption for the product manufacturing	29.5	70.5
i. Whether the product could be reused	43.5	56.5

In China, there are eight popular logos indicating a product being environmentally preferable. We listed all the logos in the questionnaire format and asked the interviewees whether they have seen them or not in daily life. As listed in Panel A of Table 7.7, people's awareness of these logos is limited. China Environmental Labeling (Type Ⅰ), for which the corresponding certification was started in 1994, only achieves a ratio of 26.8% of recognitions. The majority of people (65.2%) know the logo for green food products, confirming that consumers are particularly concerned about the product's information with relevance to health. The logo for Recyclables obtains another high recognition probably because it popularly appears on products and packages.

In the survey, we also listed nine items of product-related environmental information and requested the interviewees to pick up those that they are interested in while purchasing a product. Panel B of Table 7.7 describes the results. Most people (64.6%) would like to check whether the product has successfully achieved certifications of green products. Nearly half of them (47.3%) look at the detailed indicators documenting the product's energy efficiency. Another two items gathering higher attention are categories and amount of hazardous materials in the product (39.5%), and whether the product could be reutilised or not (43.5%). On the other hand, less than 30% of the respondents are interested in environmental information on pollutant emissions during the product manufacturing process and the resources consumed for the production.

6. Brief summary

This chapter develops an analytical framework explaining people's GP behaviours based on the TRA. The data collected by direct interviews with urban residents of Suzhou city in Jiangsu province of China are used for the empirical analysis. The exploratory study provides a descriptive summary of people's involvement of GP behaviours, and also clarifies the cause and effect linkages between the identified predicting factors and GP level by multivariate regressions. It is indicated that the current level of GP behaviors of the respondents is still marginal. The environmental attitude, specifically the self-responsibility for better environment, greatly influences the formation of intention to GP practices. Providing sufficient information on green products largely helps people's actual GP involvements. These findings provide essential implications for policy-makers. Environmental education should be enhanced to increase the public's awareness and responsibility of environmental problems. More efforts should be taken for the dissemination of green products by providing concise and accurate information to assist the individual consumers in practicing GP activities.

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Chapter 8: Determinant factors of GSCM of companies in China

1. Introduction

Out of all business operations, manufacturing processes are viewed to have the most impact on the environment, in the forms of pollutants generation, ecosystem disruption and depletion of natural resources (Fiksel, 1996). The pressures and drivers accompanying globalisation have encouraged manufacturers in developing economies like China to improve their environmental performances (Zhu and Sarkis, 2006). Accordingly, environmental concerns gradually become part of overall corporate culture and, in turn, help reengineer the development strategies of corporations (Madu et al., 2002). CEM is moving from pollution control and risk management towards product life-cycle management and industrial ecology. In recent years, CEM has evolved to include certain boundary-spanning activities like green procurement, product stewardship and reverse logistics, etc. (Snir, 2001; Prahinski and Kocabasoglu, 2006). These practices are related to supply chain management, which needs various interactions between the core manufacturers and the other entities along the supply chain, either the upstream suppliers or downstream customers.

The rapid economic growth of China has greatly relied on the extensive expansion of manufacturing industries which provide resource-intensive but cheap goods for foreign markets. The regulative requirements in developed economies, such as the familiar EU waste electrical and electronic equipment (WEEE) directive and the Restriction of Hazardous Substances (RoHS) directive, have forced electronics makers in China to respond actively by practicing certain GSCM activities. The relatively high position of Chinese manufacturers in the global supply chain offers the possibility and an ideal setting for exploring their actual GSCM practices. Zhu et al. (2008) studied the emergent GSCM practices at company level in the Chinese context, and found that GSCM is still a new concept for Chinese companies as they change their environmental efforts from internal improvement to the whole supply chains. Regarding the determinant factors for GSCM practices, the previous study mainly focused on a company's internal issues such as the importance of learning oriented programmes and support of top managers. The pressures from external stakeholders bear further investigations due to their importance to a company's environmental behaviours according to the institutional theory (Zhu et al., 2008). Further studies employing both external pressures and internal factors would give a more comprehensive understanding of the relationships between GSCM practices and the determinant factors. A broader coverage of determinant factors may provide the possibility to empirically test the linkage of institutional theory to internal management theories. As the previous study was conducted in some northern cities of China (Zhu et al., 2008), it would be necessary to conduct additional surveys of the companies based in the other geographical areas,

such as the southern Yangtze River delta which is a representative economic zone in China.

In order to close the research gap described above, we identified the external pressures which determine the level of company GSCM practices while using internal factors as the mediators. The selection of the Yangtze River delta close to Shanghai as the study area is due to its relatively developed economy compared with other regions of China. The improved background of CEM provided the possibility of monitoring GSCM activities there. Two topics are mainly discussed: a) Current status of GSCM practices of the companies in the study area, and; b) Determinant factors, external and internal, predicting the level of involvement of GSCM practices.

2. Analytical framework and research hypotheses

Fig.8.1 depicts the overall analytical framework, in which the relationships between the determinant factors and company GSCM activities are discussed.

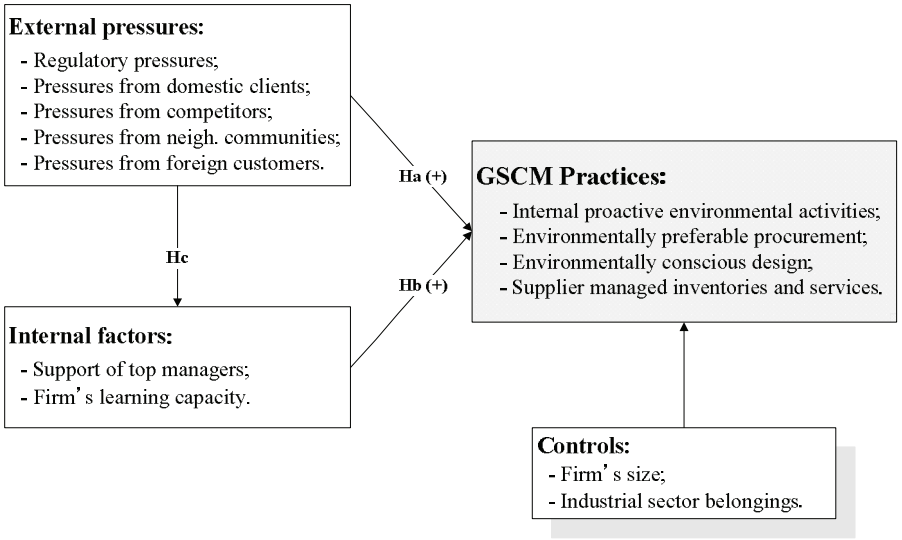

Fig.8.1: Overall analytical framework of this study.

Ha: external pressures

The importance of external factors, recognised by the institutional sociology (DiMaggio and Powell, 1983), is borrowed to illustrate the complementary nature of the factors for Chinese companies to adopt GSCM practices at the early stage of environmental policy transformation. Besides the requirements of governmental regulations, the domestic and foreign clients, competitors and neighbouring communities may exert pressures on the companies (Hall, 2000). These external pressures have jointly prompted the companies to become more aware of their environmental problems and to practice certain GSCM activities (Sarkis, 1998; Hervani et al., 2005). Customer expectations have become the most important external pressures (Doonan et

al., 2005). To achieve sustainable solutions and business goals, the environmental properties of products and services have to satisfy customer demands (Zhu and Sarkis, 2006). Communities refer to those who are not necessarily involved in the business partnership directly but have knowledge of local companies (Nelson et al., 1999). The community perspectives shall be adequately represented as they may influence a company's decision-making process (Kearney, 2004). It has been indicated that communities have the ability to influence the social reputation of a company (Henriques and Sadorsky, 1996). According to Zhu and Sarkis (2006), Hall (2000) and Sarkis (1998), external pressures are believed to be the important factors affecting GSCM practices. This generates the first integrative hypothesis of this study as:

Ha: companies that face higher pressures from external stakeholders are more likely to adopt GSCM practices.

Hb: internal factors

As is well known, the institutional theory neglects certain fundamental issues of business strategy, such as why organisations subject to the same level of external pressures perform differently (Prakash, 2000; Gunningham et al., 2003). It is argued that companies adopt heterogeneous sets of environmental practices due to their individual interpretations of the objective pressures from the outside. The difference between the 'objective' and 'perceived' pressures may lead to diverse responses. Therefore, the analytical model adds two internal organisational factors, namely support of top managers and company learning capacity, to jointly explain GSCM practices.

Management support of top managers is critical for the introduction and implementation of innovations in an organisation, especially on EMS (environmental management system) (Daily and Huang, 2001). Top management support can affect the success of new initiatives by facilitating employee involvement or by promoting a cultural shift of the company, etc. Previous research suggests that cross-functional programmes need the support from senior management, and indicates that top management support is associated with the success of environmentally preferable purchasing (Carter et al., 1998). As GSCM is a broad-based organisational endeavour, it has the potential to benefit from top management support. Meanwhile, learning capacity is viewed as especially important in a resource-based framework. GSCM practices are amenable to the benefits derived from learning since they are human resource-intensive and greatly rely on tacit skill development by employee involvement, team work and shared expertise (Hart, 1995). The capacity for implementing innovative environmental approaches is normally enhanced by employee self-learning, professional education and job training. The education level of employees and the frequency of internally environmental training are often used as proxies of learning capacity. The above discussions suggest two sub-hypotheses on internal factors which may be expressed as Hb1 and Hb2:

Hb1: a company's level of GSCM practices is positively associated with the support of top managers.

Hb2: a company's level of GSCM practices is positively associated with the company's learning capacity.

Hc: the linkage of external and internal factors

As discussed above, the addition of internal factors reasonably complements the institutional theory and a company's internal factors may be viewed as mediators to adjust the influences of outside pressures. A company will be unlikely to implement GSCM activities if it does not have the necessary capacities no matter what pressures it faces. This provides one more hypothesis on the relationship of external pressures and internal factors in determining a firm's GSCM practices in this study, which may be documented as:

Hc: the relationships between a company's external pressures and adoption of GSCM are mediated by the internal factors.

3. Samples and data collection

The data of this study was collected by a questionnaire survey conducted in the region of the Yangtze River delta during April and May of 2009. Two small areas in the delta were selected for the survey. One is Taichang, a county-level city in Jiangsu Province. Another is Kangqiao industrial park based in Shanghai. Developed from traditional environmental policies, local environmental agencies have tried some innovative measures for improving CEM by encouraging the public's involvement against industrial pollutions. With aims to reduce the compliance cost and maintain financial value, companies there have adopted some proactive environmental practices. According to the overviewed literatures and preliminary understandings on the contextual background of the study area, a questionnaire was developed to measure GSCM practices, determinant factors and organisational performances. The questionnaire format consists of four major components: general company information; GSCM activities such as environmentally preferable procurement; the degree of external pressures felt; and evaluations of environmental and economic performances.

The environmental managers were chosen as focal points in the survey to answer the questions concerning GSCM issues in their companies. Due to the large scope of GSCM activities, the environmental manager discussed matters with the purchasing manager and production manager as necessary. Over a period of approximate two months, the survey was conducted in two phases. At the first stage, local government officials, and seven companies were communicated with in order to test the validation and answering feasibility of the survey document. The questions are listed in a concise but accurate manner to avoid misunderstanding of the respondents. The finalised format was sent to 210 companies on a name list provided by the

local environmental protection bureaus (EPBs). A total of 165 respondents were confirmed to be useful for the analysis, meaning a relatively high 78.6% of valid response rate due to the coordination of local EPBs. The distribution of usable respondents by industrial sectors is listed in Table 8.1. As expected, the samples from the sectors of machinery manufacturing, chemicals and textile and dyeing account for half of the total, which are the representative industries in the study area.

Table 8.1: Distribution of the usable respondents by industrial sectors

Sector	Number of samples	Percentage
Paper	5	3.0
Textile and dyeing	19	11.5
Chemicals	24	14.6
Plastics and rubber	7	4.3
Metals	5	3.0
Machinery and equipment manufacturing	35	21.2
Electronics	6	3.6
Automobile	13	7.9
Printing	3	1.8
Construction	5	3.0
Others	43	26.1
In total	165	100.0

4. Operationalisation of the variables

Dependent variable

The dependent variable in this study is L_{GSCM}. A company's L_{GSCM} may be presented by a series of practical activities since it is difficult to directly measure the degree of GSCM involvement. Twelve GSCM activities were identified to estimate a company's overall level of GSCM practices in current Chinese context, as listed in Panel A of Table 8.2 and abbreviated as GA1 to GA12.

We addresses the GSCM practices as proactive environmental efforts in the manufacturing phase by excluding the end-of-pipe pollution control measurements and reverse logistic management of used products. Four categories of GSCM practices, represented by C1 to C4 respectively, are included: internally proactive environmental activities (C1); environmentally preferable procurement (C2); environmentally conscious design (C3); and, supplier managed inventories and services (C4) (Walton et al., 2000; Carter et al., 2000; Zsidisin and Hendrick, 1998). Achieving ISO14001 certification, implementation of cleaner production auditing and reutilisation of byproducts and other waste are chosen as internal proactive environmental activities. A company's procurement strategies have strong impacts on the upstream producers on the supply chain, as an example, by buying the materials free of toxicities (Sarkis, 2003). In

this study, four items of activities are defined as environmentally preferable procurement: requiring the suppliers to offer cleaner products, evaluating suppliers' environmental performances, providing education and technical assistance to suppliers, and providing education for internal procurement staff. Environmentally-conscious design primarily focuses on technological improvements of products and processes to mitigate environmental impacts. Three items of activities, namely working closely with suppliers in product design, reducing waste in cooperation with suppliers and providing product related environmental information for customers, are selected to assess the environmentally-conscious design of companies. The last type of GSCM practices is supplier managed inventories and services which are found in chemical industries. Certain chemical companies commissioned their inventory management to the providers of raw materials due to the higher potential risks and fruitful management experiences of the suppliers (PPRC, 2002). Since many chemical companies are located in the study area, two items are included to represent a firm's GSCM activities in this aspect. One is to entrust suppliers to manage company inventories. Another is to offer inventory management services for the clients.

The companies were requested to present a five-point Likert scale to each item of the twelve activities. The scales are defined as: '1' = not considering the activity at all; '2' = planning to consider; '3' = considering currently; '4' = partially implementing; and '5' = implementing successfully. The average score of all the twelve items was used to represent the company's L_{GSCM}. Similarly, average score of the items of each GSCM category was used as the level of practice of that category.

Independent variables

The determinant factors to adopt GSCM activities include external pressures and internal factors. As listed in Panel B of Table 8.2, five external pressures and three internal factors are classified. In a similar way, a five-point Likert scale was used to measure the importance, strength or degree of each factor: '1' = not at all; '2' = to some degree; '3' = moderate; '4' = relatively high; and, '5' = very high. The score of each factor was used to estimate their relationships with L_{GSCM}. An only exception is for FCLIENT (pressure from foreign customers). Export ratios were used as the proxy for this variable. It is assumed that the higher a company's export ratio was, the higher pressure from foreign markets would be felt. The export ratios were classified into four levels in the questionnaire format with consideration of easier responses from the surveyed companies.

Control variables

Two more variables are introduced into the analytical framework as the controls. One is company size and another is industrial sector affiliation. The existing literature suggests that larger companies are more likely to be under the public scrutiny and are expected to have higher

propensity to innovative environmental practices (Hettige et al., 1996). Larger companies are also capable of having superior resources for environmental activities. Companies with higher environmental sensitivity are more willing to improve their environmental performances. Panel C of Table 8.2 lists the valuation methods of control variables. A natural log of the turnover in 2008 was used to represent a company's size. Industrial sector affiliation is classified into two types, with '1' referring to environmentally sensitive industries (ESI) and '0' being the non-ESI. ESI in China include mining, thermal power, construction materials, pulp & paper products, metallurgy, petroleum, brewery, ferment, textiles, pharmacy, tanning and chemical industries (SEPA, 2003). The others are classified as non-ESI.

Table 8.2: Definition and valuation of GSCM activities, the determinant factors and the controls

Variable		Description of the proxy	Valuation					
			0	1	2	3	4	5
Panel A: GSCM activities								
L_{GSCM}	Internal proactive environmental management (C1)	Achieving ISO14001 certification (GA1)						
		Cleaner production auditing (GA2)						
		Reutilisation of byproducts and other wastes (GA3)						
	Environmentally preferable procurement (C2)	Require the suppliers to offer cleaner products (GA4)						
		Evaluate environmental performances of suppliers (GA5)						
		Provide education & technical assistance for suppliers (GA6)						
		Environmental education for internal purchasing staffs (GA7)						
	Environmentally conscious design (C3)	Work closely with suppliers in product design (GA8)						
		Work with suppliers on waste minimisation (GA9)						
		Provide environmental information of products (GA10)						
	Supplier managed inventories (C4)	Entrust suppliers to manage some of inventories (GA11)						
		Offer inventory management services for clients (GA12)						
Panel B: Determinant factors								
External pressures	REGULATORY	Pressure of environmental regulations						
	DCLIENT	Importance of domestic client's environmental expectation						
	COMPETITOR	Importance of competitors' green strategies						
	COMMUNITY	Pressure of complaints of neighbouring communities						
	FCLIENT	Pressure of foreign customer's environmental expectation						
Internal factors	TSUPPORT	Degree of support from company's top managers						
	EDUCATION	Education level of the employees						
	TRAINING	Frequency of internally environmental training						
Panel C: Control variables								
Characteristics of the companies		Company size (LSIZ)	Natural log of company's turnover					
		Industrial sector affiliation (SECTOR)						

5. Results and discussions

5.1 GSCM practices of the companies

An exploratory factor analysis was performed on the twelve GSCM items to find if there are

different dimensions of these activities. Two factors are extracted. However, the first factor accounts for 49.9% of the variance in total and the second only accounts for 11.6%. The rotated component matrix of the factor analysis is listed in Table 8.3. All the items of external GSCM practices (GA4 to GA12) are highly associated with factor 1. The results for internally proactive environmental activities (GA1, GA2 and GA3) are not clear since they have nearly equal loadings on both factors. The factor analysis result provides a rationality of using the average score of all the classified GSCM items (L_{GSCM}) as the dependent variable for the regressions.

Table 8.3: Rotated component matrix of factor analysis of GSCM items

GSCM items	Component	
	1	2
GA11	0.814	-0.119
GA12	0.803	-0.107
GA10	0.779	--
GA5	0.767	0.273
GA9	0.749	-0.271
GA6	0.747	--
GA7	0.730	0.321
GA8	0.725	-0.303
GA4	0.691	0.207
GA1	0.578	0.492
GA2	0.490	0.622
GA3	0.500	0.583

Table 8.4 gives a statistical summary of scores of the defined GSCM activities. In general, it can be concluded that Chinese companies are still at a very preliminary stage for GSCM practices. The surveyed companies have started to implement internally proactive CEM to some degree. Most of them plan to think about or are considering the environmental activities which would be jointly practiced with external actors on the supply chain. Slight improvement was observed in this study if compared with a previous survey conducted in north China by Zhu and Sarkis (2006). This change may be attributed to the different location of the study areas. As described earlier, the region for this study has a relatively developed economy, and the companies there may be performing better on the environment than those in other areas.

The surveyed companies react differently to the classified GSCM activities. Fig.8.2 provides details of the score distribution of GCSM activities practiced by the respondents. Many companies are implementing certain proactive internal CEM practices. Nearly 70% of the surveyed companies are reutilising byproducts and other generated wastes at some degree. Around half of them are making efforts to achieve ISO14001 certification and are pursuing cleaner production audit. The companies are selective to those GSCM activities requiring cooperation with external actors on the supply chain. About 70% of the respondents are asking their upstream suppliers to provide cleaner materials or products to avoid possible environmental risks. Around 50% of companies arrange internally environmental education for

their procurement staffs and work closely with their suppliers for waste minimization. Another item of GSCM activity practiced relatively better is to provide product-related environmental information for the clients. However, most of the companies do not supply technical assistance to their suppliers. About 65% have not taken any action for environmentally-conscious design together with the suppliers. In summary, GSCM activities are obviously due to individual business needs and benefits from the company's own perspectives. GSCM is still a new concept for most Chinese companies. More time is needed for them to recognise the importance of strategic cooperation with the other members on the supply chain. In-depth GSCM practices within a wider scope would be adopted if companies could unite as a group with a shared strategy on business and environment issues.

Table 8.4: Statistical summary of GSCM activities of the surveyed companies

Categories and items of GSCM activities	Obs.	Mean	Std. dev.	Min.	Max.
Internal proactive environmental activities (C1)	158	3.60	1.07	1	5
GA1	159	3.41	1.49	1	5
GA2	160	3.51	1.35	1	5
GA3	160	3.93	1.14	1	5
Environmentally preferable procurement (C2)	159	3.38	1.01	1	5
GA4	160	3.84	1.16	1	5
GA5	159	3.47	1.19	1	5
GA6	160	2.76	1.27	1	5
GA7	162	3.48	1.27	1	5
Environmentally-conscious design (C3)	153	3.32	1.04	1	5
GA8	159	2.93	1.30	1	5
GA9	159	3.45	1.22	1	5
GA10	156	3.54	1.27	1	5
Supplier managed inventories and services (C4)	157	3.11	1.23	1	5
GA11	158	3.10	1.24	1	5
GA12	158	3.12	1.33	1	5
Overall level of GSCM practices (L_{GSCM})	148	3.39	0.91	1	5

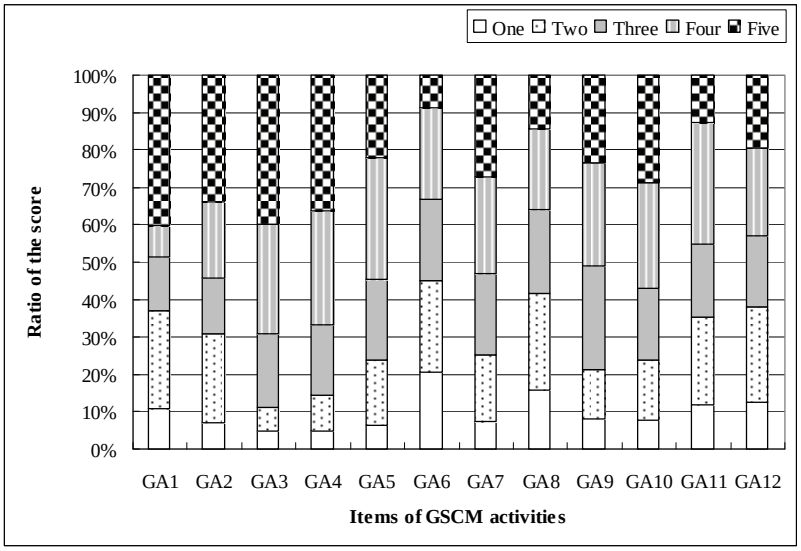

Fig.8.2: Distribution of the scores of GSCM activities.

5.2 Descriptive statistics of the other variables

Table 8.5 summarises the variables describing the determinant factors of GSCM activities. Companies gave higher scores to pressures from external stakeholders. Among the external pressures, regulative requirements and domestic client's environmental expectations are viewed as highly important, reaching an average of 4.41 and 4.29 respectively. Keeping up with competitors in the same sector is also regarded as an important factor (averaging at 4.08). The sampled companies usually carry out internal environmental training at a frequency of 2 or 3 times a year. The education level of employees is relatively low probably because most of the firms belong to traditionally labour-intensive industries. An average score of 2.87 is presented to top manager's support, which implies that managers do not care much about GSCM efforts. This finding shows a fact that the managers of Chinese companies are not seriously considering environmental activities out of basic compliance.

Table 8.5: Statistical summary of the determinant factors

Variables and abbreviations		Obs.	Mean	Std. dev.	Min.	Max.
External pressures	REGULATORY	156	4.41	0.75	1	5
	DCLIENT	156	4.29	0.86	1	5
	COMPETITOR	152	4.08	0.85	1	5
	COMMUNITY	162	3.88	1.73	1	5
	FCLIENT	150	2.46	1.27	1	4
Internal factors	TSUPPORT	159	2.87	1.35	1	5
	EDUCATION	160	3.30	1.03	1	5
	TRAINING	159	4.15	0.75	1	5

Regarding the control variables indicating company characteristics, most of the samples are small and medium-sized. Large companies, with an annual turnover of more than CNY 300 million (CNY: Chinese currency Yuan), only account for 7.4% of the total. Small enterprises, which have less than 300 employees or yearly sales of less than CNY 30 million, have a share of 64.2%. The remaining 28.4% are medium-sized companies. According to the classification criteria of Chinese national environmental authority, half of the samples are categorised as ESI (49.1%). The other half is non-ESI. Most of the respondents (71.4%) process raw materials or produce components for downstream manufacturers.

5.3 The relationship between L_{GSCM} and the determinant factors

Standard multiple regressions were performed with L_{GSCM} as the dependent variable and each of the determinant factors and controls as independent variables. The results are listed in Table 8.6. The result indicates that Hypothesis a (Ha) is supported in general. Among the external pressures, DCLIENT and COMPETITOR are significantly and positively associated with L_{GSCM} at p=0.000. This implies that domestic clients' environmental preferences and competitors' green strategies for differentiation are major external drivers for firms to adopt GSCM activities.

One more external factor which has slightly positive correlation with L_{GSCM}, significant at $p<0.01$, is REGULATORY. Government regulations were believed to be dominated forces for CEM in the past since a company's environmental strategies are imposed coercively via environmental sanctions (Delmas, 2002). However, this study classified GSCM practices as those beyond of basically environmental compliances. The governmental requirements may become relatively minor factor for the adoption of GSCM practices. No significant associations are found between the other two external pressures, COMMUNITY and FCLIENT, and L_{GSCM}. The surveyed companies highly valued the pressure from their neighbouring communities. However, community pressure cannot account for a company's GSCM efforts probably because the communities mainly complain the environmental illegal cases of companies rather than require proactive efforts such as GSCM practices. The pressure from foreign clients is not strongly felt by manufacturers in the current phase.

Table 8.6: Regression results for L_{GSCM} and each of the determinant factors

Variables entered	Coefficient	t-Statistic	P-Value	Variables entered	Coefficient	t-Statistic	P-Value
a) REGULATORY				***b) DCLIENT***			
β_0	0.497	0.851	0.397	β_0	0.439	0.896	0.372
REGULATORY	0.266	2.760	0.007	DCLIENT	0.342	3.890	0.000
LSIZ	0.176	4.856	0.000	LSIZ	0.147	4.172	0.000
SECTOR	0.293	1.960	0.052	SECTOR	0.322	2.210	0.029
F-Value		9.673		F-Value		12.583	
R^2 (adjusted)		0.169		R^2 (adjusted)		0.214	
c) COMPETITOR				***d) COMMUNITY***			
β_0	0.409	0.859	0.392	β_0	1.507	3.117	0.002
COMPETITOR	0.356	4.224	0.000	COMMUNITY	0.041	0.840	0.402
LSIZ	0.155	4.457	0.000	LSIZ	0.177	4.452	0.000
SECTOR	0.258	1.772	0.079	SECTOR	0.260	1.680	0.095
F-Value		13.382		F-Value		7.112	
R^2 (adjusted)		0.226		R^2 (adjusted)		0.123	
e) FCLIENT				***f) TSUPPORT***			
β_0	1.804	4.026	0.000	β_0	1.803	4.695	0.000
FCLIENT	0.033	0.544	0.588	TSUPPORT	-0.021	-0.341	0.734
LSIZ	0.156	3.959	0.000	LSIZ	0.167	4.018	0.000
SECTOR	0.253	1.573	0.118	SECTOR	0.278	1.765	0.080
F-Value		5.281		F-Value		6.188	
R^2 (adjusted)		0.097		R^2 (adjusted)		0.109	
g) EDUCATION				***h) TRAINING***			
β_0	0.708	1.846	0.067	β_0	-0.310	-0.726	0.469
EDUCATION	0.374	5.721	0.000	TRAINING	0.597	7.001	0.000
LSIZ	0.151	4.592	0.000	LSIZ	0.128	4.031	0.000
SECTOR	0.178	1.299	0.196	SECTOR	0.126	0.955	0.342
F-Value		18.884		F-Value		26.249	
R^2 (adjusted)		0.294		R^2 (adjusted)		0.370	

Regarding the internal factors, Hypothesis b1 (Hb1) is not supported. The support of top managers is not found to be significantly associated with a company's L_{GSCM} in this survey, which is in contrast with the result of Carter et al. (1998). Nevertheless, Hypothesis b2 (Hb2) is fully confirmed. The two variables representing learning capacity, education level of employees (EDUCATION) and frequency of internal environmental training (TRAINING), are significantly and positively associated with L_{GSCM} at p=0.000. This result is identical with Zhu et al. (2008), which confirm a hypothesis that the extent of GSCM practice engaged in by Chinese companies is positively related to the level of organisational learning capacity.

5.4 Mediating function of internal factors

The regression result of L_{GSCM} and the determinant factors confirms the causal chains existing between each of the three external pressures (REGULATORY, DCLIENT and COMPETITOR) and two internal factors (EDUCATION and TRAINING) with L_{GSCM} respectively. Significant relationships are also found between each of the three external pressures and each of the internal factors. The regression results to show their significant correlations are listed in Table 8.7.

Table 8.7: Regression results of internal factors and external pressures with significances to L_{GSCM}

Variables entered	Coefficient	t-Statistic	P-Value	Coefficient	t-Statistic	P-Value
	a) EDUCATION as dependent variable			*b) TRAINING as dependent variable*		
β_0	2.131	4.409	0.000	2.014	6.196	0.000
REGULATORY	0.268	2.479	0.014	0.483	6.667	0.000
F-Value		6.145			44.445	
R^2 (adjusted)		0.033			0.222	
β_0	1.503	3.806	0.000	2.451	8.689	0.000
DCLIENT	0.421	4.671	0.000	0.396	6.144	0.000
F-Value		21.819			37.748	
R^2 (adjusted)		.0120			0.195	
β_0	2.125	5.280	0.000	2.727	9.751	0.000
COMPETITOR	0.288	2.982	0.003	0.350	5.216	0.000
F-Value		8.894			27.211	
R^2 (adjusted)		0.050			0.150	

A third condition has to be met in order to confirm the mediating function of internal factors as hypothesised in this study. The significant relations between the external pressures and L_{GSCM} shall be strongly reduced if controlling the internal factors. We tested Hypothesis c (Hc) by repeating the OLS regressions in three steps. In step 1, L_{GSCM} is individually regressed against each of the three external pressures which have significant relations with L_{GSCM}. In step 2, each of the three pressures and EDUCATION, as an internal factor, jointly enter into the regressions as independent variables. In a similar way, step 3 is carried out by substituting the variable of EDUCATION by TRAINING. The regression results are listed in Table 7.8.

Table 8.8: Regression results of L_{GSCM} for mediating function test

Variable entered	Step 1			Step 2			Step 3		
	Coefficient	t-Statistic	P-Value	Coefficient	t-Statistic	P-Value	Coefficient	t-Statistic	P-Value
a) REGULATORY as the independent variable									
β_0	2.331	5.126	0.000	1.502	3.358	0.001	0.747	1.699	0.092
REGULATORY	0.241	2.367	0.019	0.146	1.540	0.126	-8.783E-02	-0.895	0.372
EDUCATION				0.375	5.338	0.000			
TRAINING							0.728	7.580	0.000
F-Value		5.601			17.416			32.931	
R^2 (adjusted)		0.031			0.189			0.312	
b) DCLIENT as the independent variable									
β_0	1.637	4.237	0.000	1.077	2.813	0.006	9.139E-02	0.220	0.826
DCLIENT	0.407	4.619	0.000	0.286	3.319	0.001	0.174	2.206	0.045
EDUCATION				0325	4.634	0.000			
TRAINING							0.612	6.622	0.000
F-Value		21.331			22.731			35.351	
R^2 (adjusted)		0.124			0.236			0.328	
c) COMPETITOPR as the independent variable									
β_0	1.675	4.776	0.000	0.978	2.787	0.006	0.100	0.251	0.802
COMPETITOR	0.423	5.031	0.000	0.319	4.010	0.000	0.226	2.811	0.006
EDUCATION				0.338	5.101	0.000			
TRAINING							0.570	6.342	0.000
F-Value		25.314			27.949			36.265	
R^2 (adjusted)		0.147			0.279			0.337	

The mediation function of internal factors does happen and Hc is supported. In the case of introducing the internal factors into regressions, the significances of external pressures to L_{GSCM} are all reduced obviously or even taken away completely. This implies that the low level of GSCM involvement of Chinese companies could be fundamentally attributed to the lack of necessary internal capacities for GSCM practices. The strong pressures from external stakeholders do not necessarily lead to GSCM in reality. More specifically, REGULATORY is completely mediated by the two internal factors while DCLIENT and COMPETITOR are only partially mediated. The adoption of GSCM practices of Chinese companies is probably more responsive to the non-coercive and competitive factors such as pressures from the domestic clients and leading companies in the same sector. This interesting finding also confirms that governmental regulations in China do not play an active role in encouraging industrial practices in GSCM. In addition, the greater reduction of significances in step 3 than that of step 2 demonstrates that the variable of TRAINING is indeed as potent as a mediator. The internal environmental training of related employees may strongly enhance a company's capacity to deal with the external pressures by taking proactive environmental management such as GSCM practices.

6. Brief summary

We explore the determinant factors of GSCM activities adopted by the firms based in the Yangtze River delta. The surveyed companies perform relatively better on GSCM practices if comparing with the samples of a previous survey in China (Zhu et al., 2008). Nevertheless, the overall level of GSCM does not change fundamentally. A company's environmental efforts in cooperation with external members of the supply chain are quite marginal. Among a larger range of determinant factors of GSCM activities classified in this study, external pressures from regulatory, domestic clients and competitors are significantly and positively associated with L_{GSCM}. A company's learning capacity determines L_{GSCM} as an internal factor. The support of top managers is less influential to GSCM activities. An interesting finding is that the internal factors are greatly mediating the influences of external pressures. This result provides essential implications for Chinese policy-makers. More interactions should be created to facilitate the concerns of external stakeholders which may translate into pressures for efforts in GSCM practices. It is necessary to enhance understanding of the advantages of GSCM as an innovative strategy of CEM. The dissemination of good cases shall be an effective approach since it helps the increase capacities to practically involve in GSCM practices.

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Chapter 9: Case studies of GSCM practices in China

1. Introduction

As summarised in chapter 7, the result of our questionnaire survey is similar to that of Zhu et al. (2008) in overall. The level of GSCM does not change fundamentally. The company's environmental efforts in cooperation with external members of the supply chain are still quite marginal. Nevertheless, we did find that certain companies have actually practiced GSCM activities. In order to identify those GSCM practices in more details and give an evaluation of their corresponding effectiveness, we selected several typical companies based in the study area and carried out in-depth analyses by various case studies. The GSCM opportunities of focal companies were also identified from future perspective. This kind of empirical study may show the good cases of GSCM activities and would be useful for promoting GSCM in China by the diffusion of successful practices.

2. Focal companies for case studies

Three companies were selected for case analysis, namely Shanghai GKN Drive Shaft Co., Ltd., Taicang Zhenhui Chemical Fiber Co., Ltd., Nine Dragons Paper Industries (Taicang) Co., Ltd., which are abbreviated as SDS, Zhenhui and Nine Dragons respectively. SDS is a manufacturer of automotive components based in Shanghai Kangqiao Industrial Park. Zhenhui is a chemical fiber company and Nine Dragons is a paper-making plant, both situated in Taicang City of Jiangsu Province. The background data of the three companies is listed in Table 9.1.

Table 9.1: Background information of the three target companies

Information item	SDS	Zhenhui	Nine Dragons
Time of establishment	May, 1988	July, 2002	April, 2002
Location	Shanghai Kangqiao Industrial Park	Taichang city, Jiangsu Province	Taichang city, Jiangsu Province
Ownership	Joint venture	Private, domestic	Private, fully foreign funded
Number of employees	1,747	1,100	2,200
Major products	Auto constant velocity sideshafts (CVS), propshafts and others	Polyester chips, polyester pre-oriented yarn (POY), polyester fully drawn yarn (FDY), polyester DTY, etc.	Corrugated paper, corrugated cardboard and kraft linerboard
Production capacity in 2008	4 million pieces of CVS and 0.6 million propshafts	30,000 tons of polyester chips, 140,000 tons of POY& FDY	3 million tons of corrugated paper
Annual sales	2.1 billion CNY (2008)	1.85 billion CNY (2008)	3.3 billion CNY (2007)

3. Major supply chain relationships of target companies

3.1 Major supply chain relationships of SDS

Major supply chain relationships of SDS are depicted in Fig.9.1. Raw and supplemental materials of SDS mainly come from the domestic suppliers. As examples, different types of

steel are bought from Shanghai Fifth Steel Works of Baosteel Group. Whereas, lubricating oil and grease are imported from Germany. The cooperation parts purchased by SDS mainly include different types of besides-star wheel from Shanghai Automotive Forging Factory, dust caps from the 1st Branch Factory of Hualing Mechanical Works, different types of clamps from Oetiker Industries Tianjin Ltd., steel balls from Shanghai Bearing Works, etc. The products at SDS are CVS, propshafts, industrial shafts, universal joint drive shaft assembly and other automotive components. Downstream customers are major domestic car-makers including Shanghai-Volkswagen (SVW), SGM, FAW-Volkswagen (FAW-VW), Chery, Dongfeng Honda, Nissan, B-BMW, BJC, HN-Mazda and Guangzhou Honda. SDS's main customers, SVW, FAW-VW and SGM, have a large share of domestic car market in China. These automobile makers have already practiced strict management on the design, manufacturing, parts supply, sales service process, with relatively mature GSCM practice on new product development, manufacturing and materials management, pollution control, and energy saving.

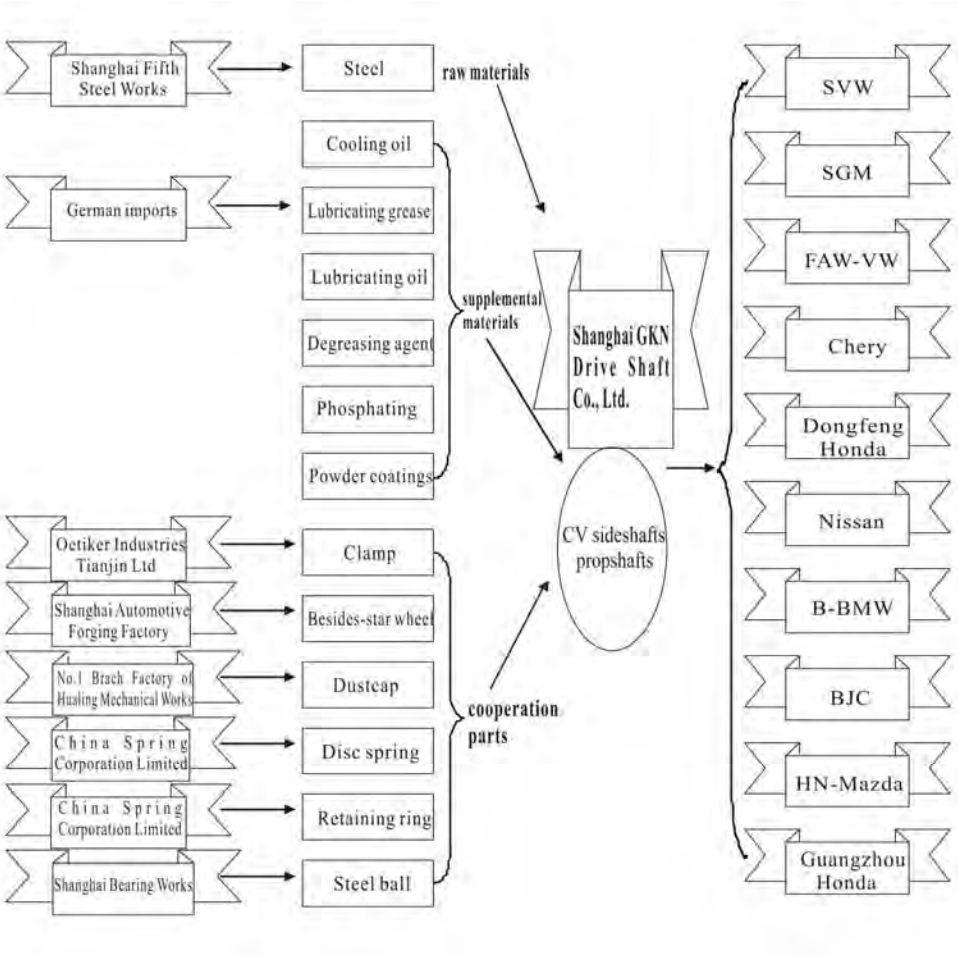

Fig.9.1: Main supply chain relationships of SDS.

3.2 Major supply chain relationships of Zhenhui

Main supply chain relationship of Zhenhui is described in Fig.9.2. Major raw and supplemental

materials include purified terephthalic acid (PTA), ethylene glycol (EG), and the major accessories include JN-D301 POY oil, JN-D202 FDY oil, TiO_2, antimony triacetate (catalyst), liquid heat medium and so on. The raw material PTA is mainly imported from multinational companies and domestic supplier as Ningbo Mitsubishi. The products of Zhenhui are various types of polyester chips, polyester pre-oriented yarn (POY), low elastic polyester filament (DTY), polyester fully drawn yarn (FDY). Most of the clients are small and medium enterprises and a third party is responsible for logistics between the company and the dock.

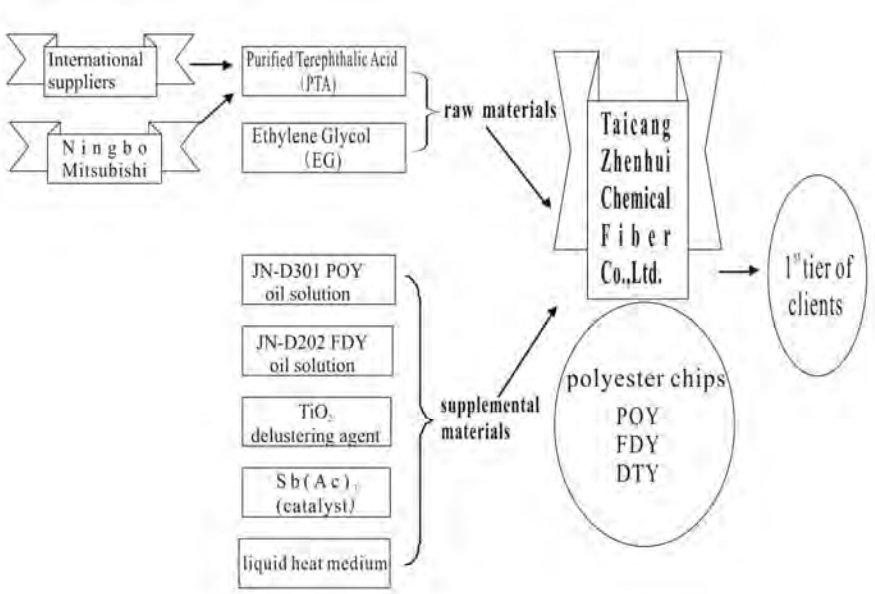

Fig.9.2: Main supply chain relationships of Zhenhui.

3.3 Major supply chain relationships of Nine Dragons

As described in Fig.9.3, the main raw materials of Nine Dragons are imported waste paper and unbleached softwood pulp, 70% of them are from Europe and the U.S., Japan, the rest 30% are from the East of China. The main foreign supplier of raw materials is America Chung Nam, Inc., which is the parent company of Nine Dragons. The main domestic supplier is Jiangsu Renewable Resources Co., Ltd. The supplemental materials purchased by the company are dispersed rosin size, chemical additives for papermaking, industrial oxidized starch, polyester wire mesh, blankets, dry nets, etc. The company's major products are 126-250 g/m^2 corrugated cardboard and kraft linerboard. Products of Nine Dragons are all for the domestic market. Its customers are mainly located in eastern China as well as Hubei, Shandong and other areas of China. Moreover, the fixed customers account for 80%, and its indirect customers are mainly home electronic appliance companies, such as Asus, Foxconn and Samsung, etc.

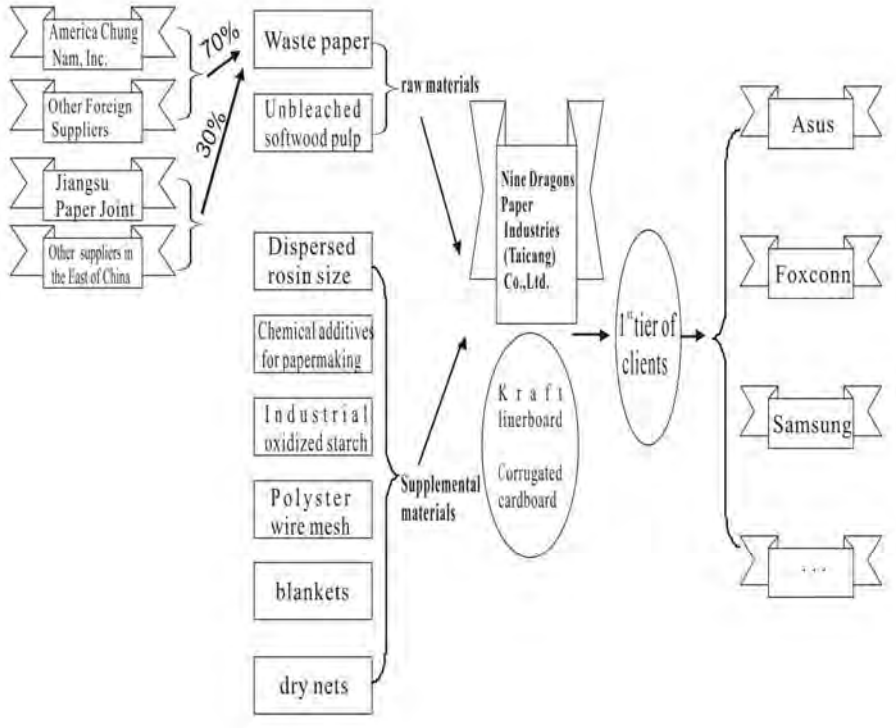

Fig.9.3: Main supply chain relationships of Nine Dragons.

4. Practices, effectiveness and opportunities of GSCM of target companies

4.1 The case of SDS

4.1.1 GSCM practices of SDS and their effects

After its establishment in 1988, SDS has carried out variously internal proactive environmental management. SDS passed ISO14001 certification in 2001 and set up a department to take responsibility of the company's environmental management in 2002. The company conducted several environmental impact assessments for the replenishment projects with aims to increase the production capacity. In 2004, SDS set up a leading group on environment, safety and occupational health with a full-time engineer and several part-time environmental staff.

Two initiatives stand out as typical GSCM practices of SDS in recent years. One is the "SAIC-35% Energy Saving Plan" launched by its holding company, Shanghai Automotive Industry Corporation (SAIC). Another is the "SGM-Greening the Supply Chain Project" implemented by a major client, Shanghai General Motors (SGM). In a strict sense, the former is an internal activity enhancing resource efficiency of the group. On 5 August 2007, SAIC issued the goal of energy saving, to reduce the comprehensive energy use per CNY10,000 of output by 35% based on 2005 level by the end of 2010. Regarding the second initiative, SGM launched the "SGM-Greening the Supply Chain Project" in January of 2008. SDS followed the energy saving plan of SAIC and formally participated in the GSCM project of SCM by taking the

following actions.

Energy saving activities based on "SAIC-35% Energy Saving Plan"

The energy saving efforts of SDS can be divided into two stages. The first phase is up to 2007 and mainly includes occasional energy saving activities. Since 2008, external pressures propelled the company to create a detailed energy saving plan. The efforts for energy saving under "SAIC-35% Energy Saving Plan" are listed in Table 9.2. The activities include managerial measures and technological upgrading. During January to May of 2009, SDS put forward 48 initiatives on energy saving, among which 43 (around 90%) have been completed to satisfy the goal of energy saving set by SAIC. As SDS has to invest in new energy-efficient equipments and processes, it needs to train the employees to establish adequate capacity for the implementation of an energy saving plan. All such activities have cost SDS a great deal. Meanwhile, the energy saving programmes saved money in terms of reducing the cost of electricity and raw materials and waste disposal expenses. As energy saving and emission reduction are current focus of environmental policy of central and local governments, better environmental performance earns more credit and subsidies from the government.

As the Chinese shareholder, SAIC performs the role of monitoring energy saving efforts of SDS. For instance, SDS is required to keep in pace with the environmental policies of the head corporation and to report its comprehensive energy use. In 2008, SAIC delivered experts to properly train SDS employees on energy management. Table 9.3 exhibits the achievements of energy saving efforts of SDS. Based on the fixed price of 2005, the comprehensive energy use per CNY 10,000 of output has declined by 13.9%, 27.7% and 28.9% in 2006, 2007 and 2008, respectively, if comparing with that of 2005.

From the beginning of 2008, SDS outlined specific plans for further energy saving in response to the "SAIC-35% Energy Saving Plan". A new round of better performances can be observed in the first half of 2009. Table 9.4 shows the changes. During January to May, 2009, the company total energy use indicated a decrease of 7.8%, and the energy use for producing per set of CVS decreased by 4.1%.

Activities involving in "SGM - Greening the Supply Chain Project"

SDS participated in "SGM - Greening the Supply Chain Project" as an important supplier of SCM. The detailed activities and corresponding achievements in 2008 are listed in Table 8.5. Main GSCM practices cooperated by SDS include: participation in environmental training of the suppliers provided by SGM experts; preparation of an action plan for GSCM practices; review of the plan and onsite guidance to the suppliers by SGM experts; implementation of the examined plans by SDS; implementation information sharing by SDS; and, performance evaluation and feed back by SGM. In 2008, SDS implemented three action plans: water balance,

energy audits, and saponification instead of spraying oil before cold sizing to reach zero emission of washing liquid. While the total investment of the three actions was CNY 0.41million, its gross benefit was CNY 0.7135 million due to the energy efficiency improvement, water saving as well as waste reduction. Therefore, SDS got CNY 0.3035 million net profit. Meanwhile, the environmental benefit was significant, including a reduction of 904.4 tons of CO_2 emissions, 50.1 thousands tons of wastewater, 12 tons of solid waste, and a saving of 562,417 kWh of electricity, 19 tons of coal and 50,100 tons of water annually.

Table 9.2: Approach, focus and activities of energy saving of SDS during 2008 to June of 2009

Approach	Focus	Activities
Managerial measure	Establishment of energy saving institution and plans, training and education	◆ Establishment of energy management team with senior executives in charge; ◆ Three levels of energy management network: company, factory and workshop; ◆ Amendment of company's "Resource and Energy Management Procedure", establishment of energy management files based on ISO14001; ◆ Qualification certificate is required for energy management members, regular training of the management team; ◆ Training of related staffs by SAIC, Shanghai Energy Monitor Center and Shanghai Energy Conservation Center in 2008; ◆ Electromechanical energy saving training of related workers in 2009; ◆ Monthly check of energy saving and emission reduction; ◆ Monthly meeting on energy saving, announcement of results of the monthly check, setting up of monthly energy initiatives.
Structural modification	Adjustment of equipment, product and energy structure	◆ Restructuring energy use, phase-out of low-efficient coal-boiler and phase-in of high-efficient oil-fired boiler; ◆ Replacement of precision forging equipment instead of hot forging equipment; ◆ Rational arrangement of production in the second half of 2008 during the market recession in order to improve energy efficiency.
Technological upgrading	Identification and implementation of feasible projects	◆ Adjustment of fan controller in the cooling tower. The fans are operated based on water temperature instead of keeping continuous running; ◆ Improvement of continuous carburizing furnace; ◆ Improvement of air-cooling control; ◆ Improvement of flow gate control, updating and shut down of automatic flow gate and hoister; ◆ Residual heat reuse of air compressor by heating the washing water through heat exchanger, subsequently cooling down by fans; ◆ Upgrading the coal-boiler by oil-fired boiler; ◆ Upgrading electricity meters, reuse of reclaimed water.

Table 9.3: Comprehensive energy use of SDS (with fixed price of 2005)

Items	2005	2006	2007	2008	2010
Output value (CNY 10,000)	132,616	184,228	243,296	230,479	--
Comprehensive energy use (tce)	25,831	30,914	34,272	31,922	--
Energy use per CNY 10,000 output	0.195	0.168	0.141	0.139	--
Goal of energy use per CNY 10,000 output	0.2	0.175	0.151	0.127	0.127
Growth rate of output value	--	38.9%	83.5%	73.8%	--
Growth rate of energy use	--	19.7%	32.7%	23.6%	--
Decline rate of energy use per CNY 10,000 output	--	13.9%	27.7%	28.9%	35%

Table 9.4: The change of energy performance of SDS in the first half of 2009

Indicator	January-May 2008	January-May 2009	Decrease rate (%)
Energy use (tce)	7,468	6,886	7.8
Output of CVS (in 10,000)	220.5	212.1	3.8
Average energy use (tce/10,000 CVS)	33.9	32.5	4.1

Table 9.5: The practices of SDS involving in "SGM Green Supply Chain Project"

Project No.		1	2	3	In total
Content	Action plan	Water balance project of Zhoupu plant	Energy audit	Saponification instead of spraying oil before cold sizing	
	Action content	Searching water saving potentials in the plant	Increasing processing ability of CC inside wheel in P6 furnace	Saponification instead of spraying oil before cold sizing	
Implementation	Department on duty	Planning department	Heat treatment workshop	Forging workshop	
	Start time	April, 2008	May, 2008	May, 2008	
	Finish time	September, 2008	September, 2008	December, 2008	
Economical performance	Investment (CNY)	60,000	0	350,000	410,000
	Raw materials saving (CNY/year)	--	--	170,000	170,000
	Energy saving (CNY/year)	--	330,000	21,280	351,280
	Water saving (CNY/year)	127,215	--	1,542	128,757
	Waste charge saving (CNY/year)	51,480	--	12,000	63,480
	Total saving (CNY/year)	178,695	330,000	204,822	713,517
	Investment recovery period	4 months	--	16 months	--
Environmental performance	CO_2 reduction (ton/year)	--	562.4	342	904.4
	Energy saving	--	562,417 kWh/year	19 tons coal per year	--
	Water saving (ton/year)	49,500	--	600	50,100
	Solid waste reduction (ton/year)	--	--	--	12
	Waste liquid mitigation (ton/year)	49,500	--	600	50,100

4.1.2 Further GSCM opportunities of SDS

GSCM practices of SDS shall be improved further, particularly in internally proactive environmental management, the collaboration with various suppliers for developing environment-friendly products and improving management as a whole. The GSCM activities to be implemented further include: implementation of cleaner production audit; to reclaim the metal, wooden and cardboard boxes and other containers; to reclaim the byproducts; and, to collaborate with the suppliers to purchase the environment-friendly products.

Although SDS is not on the list of the compulsory cleaner production audit, it still has potential to save energy and reduce emissions. Implementation of a cleaner production audit can help the company carry out environmental management systemically. Currently, the containers for transporting the products of SDS are all for single use and the reclaiming system has not yet been established. Since the containers have high angular rigidity and are hard to deform, it is possible to reuse them. The company could collaborate with their clients for reclaiming these containers and reusing them. The main product of SDS is the automotive transmission shaft

which is made from steel. The byproducts like scraps and used products can be recycled as rolled steel. SDS should collaborate with the downstream car assembler in recycling the vehicle parts and reuse them for reproduction. In addition, SDS is the terminal client of many lubricants and parts makers. From this viewpoint, SDS could collaborate with the relevant suppliers and use its influence for actions such as requiring green products from the suppliers, setting standards and evaluating environmental behaviours of suppliers, providing environmental training or technical assistance for suppliers, etc.

4.2 The case study of Zhenhui

4.2.1 Internal GSCM practices of Zhenhui and their effects

In December 2004, Zhenhui established its environmental management system by setting up a leading group with the company manager as the head of group, and assigning a few environmental protection staffs. Zhenhui passed ISO14001 certification in 2006. GSCM practices of Zhenhui focused on internally proactive environmental management activities like cleaner production audit and energy audit.

In April 2007, Zhenhui started its work of cleaner production audit. In September, 2007, "Cleaner Production Audit Report of Zhenhui" was finalised. In the same year, Zhenhui carried out several technological upgrading projects, including renewal of boiler auxiliary equipment, air compressor modification of elasticising plant and reuse of the reclaimed water. The detailed activities of Zhenhui during cleaner production audit are listed in Table 9.6.

In March, 2008, Zhenhui finished its report of energy audit and proposed several energy saving advices such as introduction of circulating pump and modification of air compressor. In November 2009, Zhenhui applied as a pilot company of developing circular economy initiated by local government. The contents of energy audit are listed in Table 9.7, which include energy management and consumption status, energy consumption structure, energy measurement and statistics, etc. The significant part is the audit on energy management status, potential analysis of energy saving and technological upgrading proposals.

There are five major technological reconstruction projects for energy saving and emission reduction in Zhenhui. The first one is to reuse the reclaimed water. This project uses the domestically advanced wastewater treatment equipment, which is the first water reclamation equipment in the domestic textile industry. Water reused per day amounts to 600 m^3, which can save CNY 504,900 in water fees and 50.91 tce of energy. This project started in January and ended in July of 2007. The total investment was about CNY 609,000. The second project is to reuse the exhaust gases. The advanced and packed stripping tower was adopted. The residual gas is sent to be burned in the coal stove, which reduces air pollutant emissions and saves energy. The third one is to reuse residual heat. This project applied refrigeration technology in

which atmospheric steam is utilised as the heat source. As a result, the operational cost decreased. Finally there are two electricity-saving projects. One is to upgrade the air compressors to be frequency convertible. According to the demand of different plants, two air compressors and related pipe system were added. This can save 1.0512 million kWh of electricity, equivalent to 378.43 tce, and CNY 0.5359 million in charges. The total investment was CNY 1 million. The other one is to optimise the pump system by using a highly efficient pump to replace the pump with surplus capacity. Automatic control system was also installed.

Table 9.6: Cleaner production activities and their effects at Zhenhui

Time	April-July, 2007
Contents and procedures	***Planning and Organization*:** Zhenhui established a team for cleaner production in May, prepared the audit plan and arranged training by inviting external experts. ***Pre-Assessment to find cleaner production potentials:*** Define filament process as audit focus; formulate cleaner production objectives and measures; encourage the employees to propose reasonable suggestions, as a result, more than 100 advices were collected and 32 programmes were created. ***Assessment:*** Material flow analysis and identification of waste sources. ***Programs screening:*** 20 feasible programmes with no or low-cost and 3 medium or high-cost programmes were selected. ***Program implementation:*** Allocation of funding and implementation department; assessment of implementation effect. ***Continued cleaner production:*** Establishment of organisation; keeping cleaner production working group; incorporating cleaner production management into daily management, establishing incentives; making sustainable cleaner production plan. ***Experience:*** Education and training the staff is the premise, leader's support is the guarantee; staff's involvement is the base; field works is essential; cleaner production audit can improve the level of environmental management dramatically.
Specific programmes	***20 low-cost programmes***: Like substituting cooling water by desalinated water; construction of sealing walls for coal storage space; waste separation and recovery and so on. ***2 medium-cost programmes:*** Replenishment of air blower in spinning plant; substituting linisher component by sand cup. ***1 high-cost programme:*** Reuse of the reclaimed water.
Effects	Based on an incomplete statistics, the value from coal, energy, material and water saving, and reduction of wastewater and solid waste reached 9.4373 million CNY in 2007. From January to August 2007, the wastewater discharge was 108,300 tons, declined by 42.57% when comparing with the same period of 2006. Since July 12, 2008, the daily sewage discharge reduced to 13 tons and COD concentration was 14mg/L with a great decrease from 30mg/L in previous year. Waste silk per ton of product was 8.79Kg, which is better than the level 3 in Cleaner Production Technical Guideline of fiber industry.

Zhenhui achieved good economic and environmental performances by the end of 2008 due to above mentioned internally proactive environmental efforts, which are shown in Table 9.8. Zhenhui is a chemical fiber producer consuming large amount of energy and generating heavy pollutions. Due to the cleaner production audit in 2007, Zhenhui achieved at least CNY 9.4373 million economic benefits from the consumption reduction of water, electricity, coal, raw materials and the decrease of wastewater discharge and waste silk. Due to the technological upgrading projects, Zhenhui saves 965.89 tce of energy, 0.198 million m^3 of water, and CNY 4.5005 million of costs per year. The comprehensive energy use per unit of industrial added

value appeared a sharp decline during 2005-2007 but then a slight increase in 2008. As for the emission indicators, they are stable during 2005 to 2007, and an obvious improvement in 2007-2008. The emission of COD and wastewater exceeding emission standard were typical indicators. Before 2008, the wastewater discharge amount exceeding emission standard was 0.215 million tons, while this data decreased to 0.0135 million tons in 2008 due to the construction of new water purification facility. The emission of SO_2 also experienced a sharp decrease.

Table 9.7: Energy audit results of Zhenhui

Energy management institution	Current situation	The leading group of energy management consists of the general manager, the deputy general manager and department leaders. Daily working team is founded under the leading group. The part-time energy managers are equipped from the top to down. Personal responsibility of energy management is also clarified.
Energy management system	Current situation	An energy management system has been made, including "Energy procurement and approval system", "Energy management standards", "Energy management system of measuring instruments", "Energy measurement and statistical management system", "Electricity conservation regulation" and "Assessment methods of raw, supplementary materials and energy use", etc.
	Problems	Further improvement is needed.
	Suggestions	With the increasing concern from the government, the company should collect new regulations and modify its related management system.
Energy measurement	Current situation	The total energy input and output measuring instruments are 100% equipped; the rate of meters for sub energy using equipments is 77.5%, and the average rate is 22%.
	Problems	The rate of measuring instruments for the second and third level energy using equipments is low. The company is lack of measuring instrument for the use of coal, steam and large electric facilities, which makes the detailed data collection to be difficult.
	Suggestions	The existing measuring instruments should be managed based on "Equipment and general management rule of measuring instruments for energy using unit", The files of measuring instrument shall be established.
Energy statistics management	Current situation	The energy consumption is reported by each sectors, the financial department counts the energy purchase, use and inventory quarterly and regularly sends the data to parent company and local statistics agency.
Energy quota management	Current situation	"Assessment methods of raw, supplementary materials and energy use 2007"and "Quota assessment in elasticizer department 2007" was formulated.
	Problems	Assessment items and basic data are not accurate and complete.
	Suggestions	To equip with measuring instruments and improve the monitoring methods; to specify the indicators for products, main processes and equipments.
Technological progress of energy saving	Current situation	Several technological improvements have been made in 2007, including application of frequency convertor, reasonable choice of air pressure for elasticizing, etc. The total investment is CNY 9.399 million. They can save 965.89 tce, 0.198 million m^3 water, and CNY 4.5005 million of cost annually.
Education of energy saving	Current situation	"Staff education and training system" was set up; energy saving education is promoted; the newsletter is utilized to promote publicity and awareness; advanced departments and individuals are awarded.
Summary		The management institution and system have been established, but need further improvement. The measuring instruments of main facilities need to be equipped. Energy statistics shall be improved for better quota management.

Table 9.8: Energy use per CNY 10,000 of output of Zhenhui

Year	2005	2006	2007	2008
Sales revenue (million CNY)	1,156.87	1,667.96	2,022.86	1,849.56
Gross industrial output value (million CNY)	1,200.65	1,673.71	2,077.63	1,850.32
Comprehensive energy use (tce)	20,051	29,457	36,413	42,382
Comprehensive energy use per unit of gross industrial output value (tce/ million CNY)	16.7	17.6	17.5	22.9

4.2.2 Other GSCM activities of Zhenhui

Zhenhui constructed the elasticiser industrial park in its area which is equipped with 100 sets of high-speed elasticiser. Most of companies in this park are small household workshops which are downstream customers of Zhenhui. Zhenhui provided workshops, financial guarantees and even environmental service such as sewage collection and treatment for them. A certain degree of a mutual symbiotic relationship is formulated between Zhenhui and these customers. Environmental management activities of Zhenhui, which were carried out in recent years, may influence these small companies in the future.

4.2.3 Further GSCM opportunities in Zhenhui

The key environmental management activities that Zhenhui plans to accomplish in the next stage are further energy saving and emission reduction, which contain two aspects. One is to install energy measuring instruments in equipments with high energy use such as circulating pump, water pumps, air compressor, cooling tower blower, freezer etc., to strengthen the daily management for optimising the operational processes. Another is to continue to identify energy saving potentials and implement the programmes for energy saving.

The GSCM activities of Zhenhui as so far mainly focus on internal energy saving and emission reduction. This may be attributed to the characteristics of the company which is a raw material manufacturer with relatively heavy pollution intensity. Since the downstream customers are small companies and rely on Zhenhui for capital, working place and infrastructure, they lack power in shaping the supply chain relationships. However, Zhenhui really implemented a series of internally environmental management activities since 2006 and has accumulated rich experiences. This is a good start to further GSCM practices jointly with its upstream suppliers and downstream customers. As examples, Zhenhui may require green products from the suppliers, set standards and evaluate environmental behaviours of suppliers, providing environmental trainings or technical assistance for suppliers, etc. The Research & Development Center of Zhenhui is recognized as the technology centre of the fibre industry in Jiangsu Province. In the future, this centre can play an active role in collaborating with suppliers and customers to develop green products.

4.3 The case of Nine Dragons

4.3.1 GSCM practices of Nine Dragons and their effects

Nine Dragons is a fully foreign-owned enterprise with high energy use and pollution intensity, which makes it sensitive to the change of macro environmental policy. Nine Dragons strives to abide by national and local environmental regulations, industrial and environmental standards. Nine Dragons established pollution control facilities from its beginning. The initial investment for environmental protection was USD 20 million, 12.7% of the total investment. By the end of 2007, its total environmental investment reached CNY 300 million. Now, the green area of the factory is up to 300,000 m^2. During 2003 to 2006, Nine Dragons passed ISO14001 certification, OHSAS (Occupation, Health and Security Administration System) certification and China Environmental Label certification. Along with the institutional framework being concerned, Nine Dragons established a Department of Environmental Protection and Resource Recycling, with 300 staff led by the general and department managers. It also set up the Supervision and Management Council consisting of six members with duties of daily patrolling within the company. In addition, Nine Dragons addresses environmental trainings of employees and managers. There are three levels of internal environmental training: company level, workshop level and team level. The company level training targets all department managers and external specialists are invited as the trainers, usually once a quarter. The workshop level training is arranged by the Department of Environmental Protection and Resource Recycling, usually once a month. The team level training is frequently conducted for all the related workers. Nine Dragons has constructed a standard library and updates the books and journals annually.

The GSCM efforts at Nine Dragons focus on internally proactive environmental management, mainly including technological upgrading for pollution control and energy audit. The environmental requirements in China have become stricter in recent years. In 2006, Nine Dragons was once put on the blacklist of implementing energy saving plan by Jiangsu Province. After that, the company made a series of efforts to improve its environmental management.

In March 2007, Nine Dragons invested CNY 60 million to reconstruct its wastewater treatment plant by using the efficient IC (Internal circulation) reactor imported from the Netherlands, which can convert organic matters to granular sludge and methane gas by metabolism. The company also introduced a water reclamation system which can recycle 36,000 tons of water per day, and increase the ratio of water reuse up to 47%. Upon completion of these reconstruction projects, the company treated 1.7235 million tons of wastewater in 2008. The average concentration COD was cut off from 80mg/L in 2007 to 46.2mg/L, and a total of 582.5 tons of COD was reduced. A total of 5.405 million tons of water was reused, and 249.7 tons of COD was reduced through water reclamation. The total reduction of COD was 832.2 tons in 2008. Nine Dragons won the provincial award due to the high ratio of water reclamation in 2008.

In 2009, Nine Dragons conducted a project to conduct recollection and reuse of residual heat

from the paper-making line. The company, together with Finland TM, developed and utilised a heat recovery system to save the energy resulting from excessive high temperature of steam discharged in the process of paper-drying. This system cost CNY 23.06 million for equipment installation. In a packaging product line with a capacity of around 1 million tons per year, 180,259 tons of steam is used for heating ultra-clean water for pulp making and clean water for paper-making. By the introduction of this system, the production line can save 22,172 tce of energy per year, equal to CNY 17.74 million, assuming the coal price to be CNY 800/t.

The other technological upgrading of Nine Dragons included cooling tower construction to recycle the cooling water. The water used in high quality paper-making process is returned to produce the low quality paper. The waste is burnt for heat by circulating fluidised bed technology if it cannot be recycled. The residual of the burned waste is used to make the chopping block for forklifts. Thus the solid waste of the company almost achieved zero emissions.

As shown in Table 9.9, the contents of the energy audit at Nine Dragons are similar to that of Zhenhui and focus on the identification of energy management status, energy saving potential and technological modifications. According to the analysis of energy saving potentials, Nine Dragons should draw attention to basic institutions and management of equipment operations. Six proposals of energy saving and technological modification were put forward, including reconstruction of pump in boiler house, reconstruction of pulp pump, reusing the heat of exhaust vapors, etc. The total investment of the six proposals is estimated to be CNY 16.4 million. These projects may save 37,176 tce of energy, reduce 29.978 tons of CO_2 and 738.28 tons of SO_2.

During 2004 to 2007, almost all environmental indicators, including the amount of coal use, fresh water consumption, COD and ammonia nitrogen emissions, were on a decreasing trend, especially in 2007. The reason was that the production capacity was expanding continuously during 2004 to 2006. However, several technological reconstruction projects described above were put into practice in 2007 and received obvious achievements. The details are expressed in Table 8.10. As the result, Nine Dragons received several awards on energy saving and CNY 10 million financial subsidies as well.

Regarding the external GSCM practices, Nine Dragons interacts with its downstream customers, mainly the packing enterprises. They supervise each other on environmental management. Nine Dragons categorises its clients based on certain indicators including environmental factors. The Department of Environmental Protection and Resource Recycling has set up a waste paper recovery unit to collect waste paper from downstream customers as raw materials for production. Most waste paper as raw materials for Nine Dragons originates from the U.S., EU and Japan, where generally have strict inspection procedures for the export of recyclables. When waste paper enters into China, it is inspected by customs and by the commercial agency as well. The

containers must be disinfected 24 hours before being opened for testing. Nine Dragons holds a supplier conference once a year, mainly to exchange information on material supply, environmental management and so on. Therefore, we can infer that Nine Dragons has started the second stage of GSCM practices, such as 'environmentally preferable purchasing', 'evaluation and selection of upstream suppliers'. Some activities concerning the third stage have been practiced like 'environmentally conscious design and manufacturing', 'eco-design in cooperation with suppliers'. For example, Nine Dragons required suppliers to provide environment-friendly products, set standard for suppliers' environmental behaviours and evaluate them, conduct researches for developing environment-friendly products such as the 80g/m^2 light cardboard with suppliers, reduced packing waste in cooperation with suppliers, etc.

Table 9.9: The contents of energy audit of Nine Dragons

Energy management institutions	Current status	Energy management framework has been set up from the top to departments. There are employees working on energy management.
	Problems	Weak in systematic arrangement. Energy managers have not attended to provincial trainings and did not achieve certifications. There is no specific staff responsible for energy management at workshop level.
	Suggestions	To specify responsible persons at workshop and process level based on current framework. Department of energy management should equip portable energy monitoring instruments to identify further energy saving potentials. Extensive training shall be carried out to promote awareness of the staffs.
Energy management system	Current status	Water, electricity, steam, coal, gas and raw materials are in the range of energy and resource management.
	Problems	Lack of systematic energy management system, including energy procurement and assessment, energy financial management, energy production management, energy measuring instruments, energy use evaluation and rewards, and energy managers and operators' training system.
	Suggestions	To reinforce the trainings and information sharing on energy saving
Energy measurement management	Current status	Measurement systems cover coal, electricity, heating power, water and steam
	Problems	No measuring system of cooling water and compressed air; No measurement of main energy consuming equipments; The ratio of measuring instruments is 42.15%, with the ratio in good condition being 94.27%; difficult to subdivide the quota for quantitative assessment.
	Suggestions	To improve the rate of measuring equipments for main electric equipments and processes; enhance the patrol and verification of the meters.
Energy statistics management	Current status	Primary statistics was established; data and records are processed electronically.
	Problems	Data recording and analysis are incomplete; no record for related parameters and basic management needs to be strengthened; No systematic statistic analysis; in particular, the material flow analysis is not developed.
	Suggestions	To establish detailed and classified formats for energy use statistics of each process; to find out the reason of excessive energy use for improvement by comparing the energy consumption index.
Energy quota management	Current status	Quota management is practiced in some departments but has not reached team level.
	Problems	No statistical data at the process level due to the product varieties and measuring problems; The main index of energy use is rough and cannot reflect the actual performance of working procedures, major energy consuming and energy transformation devices.
	Suggestions	To establish quota management for all processes, develop statistical analysis of energy use and establish the indicator for assessment; to establish material flow analysis system, reward and penalty system, introduce the energy evaluation into the company management system.

Table 9.10: Environmental performance changes of Nine Dragons

Year		2007	2006	2005	2004
Total sales (in CNY billion CNY)		1.665	2.649	1.706	0.98
Air pollution index	Coal use (10,000 t)	31.82	109.48	46.94	23.3
	Exhaust gas (billion m^3)	2.546	9.853	4.225	2.09
	SO_2 (t)	51.6	1916.0	267.5	183.2
	NO_x (t)	549	5474	--	--
	Soot (t)	11.3	396	353	17.5
Water pollution index	Industrial water use (million t)	11.96	58.70	--	--
	Fresh water use (million t)	6.10	16.00	8.20	3.90
	Wastewater treatment amount (million t)	2.83	16.00	--	--
	Wastewater amount below emission standard (million t)	2.83	16.00	8.20	3.90
	COD (t)	11.4	1600	82	38.5
	NH_4-N (t)	--	7.6	7.6	3.6
Industrial solid waste (million t)		0.1438	0.2235	0.2033	0.0751

4.3.2 Further GSCM opportunities of Nine Dragons

At the current phase, GSCM practices of Nine Dragons focuses on internal environmental management activities. According to the energy audit report of Nine Dragons, there are many problems with energy management. Besides reinforcing technological upgrading and pollution control of wastewater, exhaust gas and solid wastes, carrying out the suggestions proposed during the energy audit is an important task in the near future. Moreover, cleaner production audit needs to be considered. Nine Dragons has put the second and even the third stage of GSCM activities into practice. Promoting these activities continuously is critical for improving its environmental management.

5. Brief summary

This study conducted case analyses of GSCM practices of three target companies, namely SDS, Zhenhui and Nine Dragons. It is confirmed that the GSCM practice level of multinational, joint venture and foreign-funded companies is higher than domestic ones. This implies a close relationship between company size, ownership and the level of GSCM, which is consistent with the finding from our questionnaire survey. Although obvious improvements of economic and environmental performances are observed in the three cases, their environmental efforts basically focused on energy saving and emission reduction, and failed to substantially penetrate into the advanced stage of GSCM practices. This research showed us the possible way forward for promoting GSCM practices in China. The currently mandatory environmental policies are effective at certain degree in enhancing a company's environmental management, like in the cases of Zhenhui and Nine Dragons. However, compared with government policy-driven cases, the market actor-driven model is more sustainable for GSCM activities as it is based on mutual support and communication among the core companies, suppliers and customers, and can extend the green ideology through the supply chain rapidly. Besides regulative enforcement, the

government shall provide more support which is usually neglected. Large state-owned companies, as the leading policy practitioners, should play a more active role in GSCM diffusion.

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Section Ⅲ

CEM Policy Studies in India

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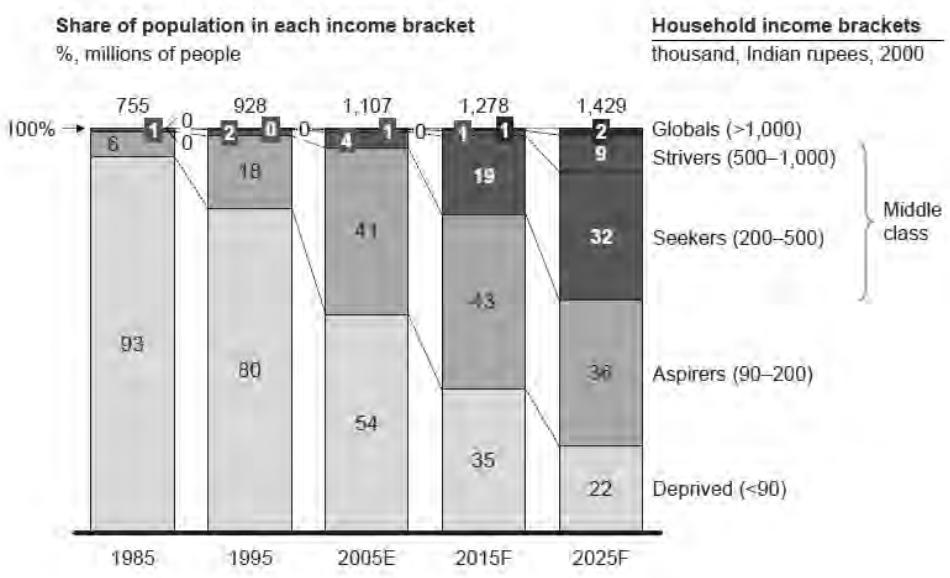
Chapter 10: CEM policy studies in India

1. Country profile

India, as the seventh largest country in the world, occupies 3.29 million km^2 (2.4% of the world's land area) and, as of 2005-2006, supports 1.12 billion people (over 15% of the world's population). India's population, which is growing at the rate of 1.5% a year, is expected to exceed that of China by 2020. The country's median age is 25, one of the lowest among the large economies. Although urbanisation is rapid in major cities, about 72% of population still lives in rural areas and is dependent on agriculture for livelihood. India is also home to one of the largest middle class populations in the world, which is expected to increase in size even more as a result of the country's rapid economic growth (Fig.10.1).



Note: Figures are rounded to the nearest integer and may not add up to 100%.
Source: McKinsey Global Institute, 2007

Fig.10.1: Emergence of middle class in India.

India's economy has grown rapidly in the last few years as a consequence of the paradigmatic shift in economic policies in 1991. New policies sought to integrate India's economy with that of the rest of the world. Over the last few years, the impact of the new policies has become visible through the increasing growth rates as well as the success of Indian entrepreneurs abroad, the most notable examples being the success of the Indian software and pharmaceutical industries. India's annual growth in the first four decades after her independence was around 3.0 – 3.5%, whereas GDP growth in recent years has been around 8.5 – 9.0%. Although India is currently the world's 12th largest economy (and the third largest in Asia behind Japan and China) with a total GDP of around USD 1 trillion, some have predicted that by 2050 India will be the third largest economy in the world after China and the US (Datamonitor, 2005; McKinsey Global Institute, 2007). Services, manufacturing and agriculture account for 55%, 27% and 18% of GDP respectively (Fig.10.2). Nearly two-thirds of the population still depends on agriculture for its livelihood. Recent reforms have encourage inflow of foreign direct

investment, which has risen significantly in recent years, contributing to USD 255 billion in foreign exchange reserves in 2005 (RBI, 2005).

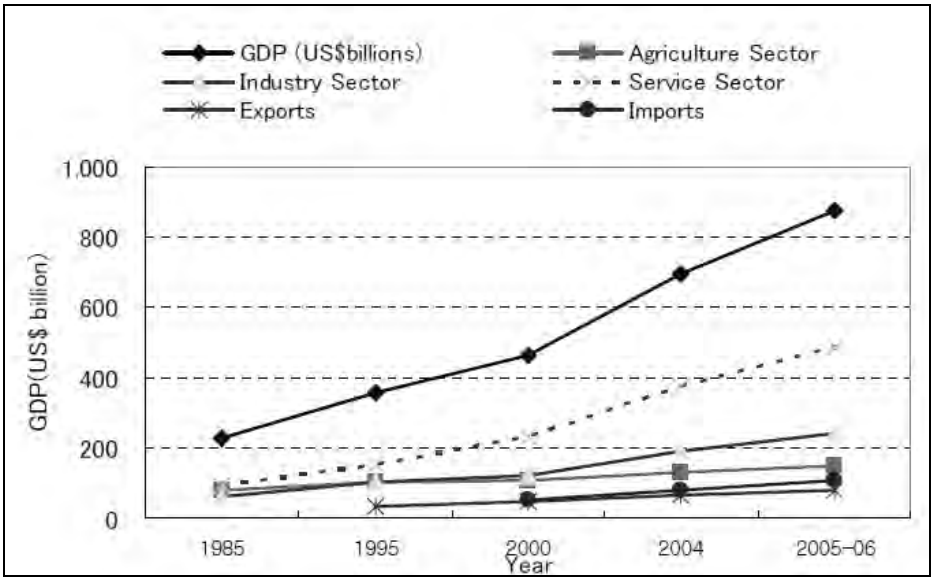


Fig.10.2: Economic performance of India in recent years.

The country has abundant resources, such as coal and iron ore, to support industrial growth. Major industrial products are textiles, jute, processed food, steel, machinery, transport equipment, cement, aluminum, fertilisers, mining products, petroleum, chemicals and computer software, which accounted for 27% of GDP in 2006. Exports of engineering goods, petroleum products, precious stones, cotton apparel and fabrics, gems and jewelry, handicrafts and tea accounted for USD 127 billion in FY2006-2007. Wheat, rice, coarse grains, oilseeds, sugar, cotton, jute and tea are the main agricultural products. Software exports accounted for USD 22 billion in FY2006-2007. India's major trade partners are Japan, the USA, the European Union and Russia. Imports of petroleum, machinery and transport equipment, electronic goods, edible oils, fertilisers, chemicals, gold, textiles and iron and steel accounted for USD 192 billion in 2006.

2. Industrial portfolio

2.1. Major industries

Growth in India's economy is led by the robust performance of the industrial sector. Impressive growth in manufacturing (at an average rate of 7% over one decade), reflects growth trends within the electronics and information technology, textiles, automobiles, pharmaceutical and basic chemicals industries (Table 10.1). This economic boom has also led into an increase in investments and activities in the construction, mining, and iron and steel sectors. However, although the manufacturing sector in India shows promising growth, India's competitive position in terms of cost may not be comparable with that of China at the moment.

By size, companies in India are classified as micro, small, medium and large. They are then divided into the public and private sectors.

Table 10.1: Growth trends in selected manufacturing sector

	Growth Rate (%)		Relative Contribution (%) [*1]	
	2002-03	2003-04	2002-03	2003-04
Manufacturing Sector	6.0	7.4	15.6[*2]	15.8[*2]
Food Products	11.0	-0.5	18.4	-0.7
Metal products and parts	6.4	3.7	3.1	1.5
Transport equipment and parts	14.6	17.0	14.3	14.8
Rubber, plastic, petroleum and coal products	5.5	4.4	6.5	4.3
Non-metallic mineral products	5.1	3.7	6.0	3.5
Basic chemicals and products	3.7	8.6	11.6	21.7
Machinery and equipment	1.6	15.8	3.6	28.5
Basic metal and alloy industries	9.3	9.1	13.1	10.8
Cotton textiles	-2.7	-3.1	-2.2	-1.9
Other manufacturing industries	0.0	7.7	0.0	3.2

*1: Signifies ratio of the change in index of respective industry groups to the change in overall index adjusted for the weight of the relevant industry group.
*2: Manufacturing sector's contribution to GDP.
Source: TATA Services, 2005.

2.2. Public enterprises

Until 1999, the industrial scene in India was dominated by public enterprises, which were owned and controlled by the central and state governments (Table 10.2). Public enterprises still continue to be a major employer. As of 31 March 2003, there are nearly 240 central public sector enterprises which are making a significant contribution to the growth and competitiveness of the Indian economy. They are engaged in the manufacture and production of goods such as steel, fertilisers, heavy engineering products, transportation equipment, drugs and pharmaceuticals, petro-chemicals, cement and textiles; the mining of coal and minerals; the extraction and refining of crude oil; and the rendering of services like trading and marketing, transportation, contract and construction, finance, telecommunication, tourism and consulting. Investment in central public enterprises has grown appreciably over the years. From an investment of INR 290 million in five enterprises in 1951, investment rose to INR 1354.45 billion in 246 enterprises by March 1992 and to INR 3334.75 billion in 240 enterprises by March 2005.

Public sector companies have been nurseries of technology and expertise, both managerial and technical. They have built up the strength of the nation in various areas such as agriculture, defense, space research, nuclear programmes, heavy engineering and infrastructure. Besides driving key segments of the economy, public sector companies have begun to excite stock markets after liberalisation.

Table 10.2: Growth and contribution of public sector companies in India

Sector	Units	Public sector production	
		2001-02	2002-03
Coal	million tonnes	312.5	325.4
Lignite	million tonnes	23.5	26.0
Petroleum	million tonnes	125.7	129.7
Finished steel	million tonnes	10.0	11.0
Aluminum	thousand tonnes	231.7	244.7
Primary lead	thousand tonnes	37.8	-
Zinc	thousand tonnes	176.3	-
Nitrogenous fertiliser	thousand tonnes	2880.0	2854.0
Phosphatic fertiliser	thousand tonnes	479.0	307.0

Source: TATA Services, 2005.

2.3. Private sector enterprises

Private sector companies, now accounting for over 85% of industrial production, continue to play a pioneering role in the development of the Indian economy (Table 10.3) and have a number of achievements to their credit. Private corporations in India have largely triggered the recent boom in the economy, and private investment in industry has exceeded government investment. Although the public sector investment continues to surpass outstanding private sector investments in mining, electricity services and irrigation, the recent developments show that private investment could soon exceed public investment in these areas as well. The private sector has now come of age and has developed considerable entrepreneurial, managerial, technological, financial and marketing strength.

Table 10.3: Company type by ownership

Main Characteristics	Factories No.	Employment (1,000)	Fixed Capital	Gross Output	Value Added
			In 10 million Rs.		
Public/Private sector					
Public sector	14947	3430	338648	619979	100096
Co-operative Society	2048	309	9079	30926	4263
Wholly Private	110634	3965	82369	308683	39171
Others	920	46	1864	2868	722
Total	128549	7750	431960	960456	144302
% Distribution					
Public sector	11.6	44.3	78.4	64.4	69.4
Joint sector	1.6	4.0	2.1	3.2	3.0
Wholly private	86.1	51.2	19.1	32.1	27.1
Others	0.7	0.6	0.4	0.3	0.5
Total	100.0	100.0	100.0	100.0	100.0

Source: TATA Services, 2005.

2.4. Micro, small and medium enterprises

The private sector covers not only organised industries, but also small scale industries. The micro and small enterprises constitute an important segment of the Indian economy, accounting for around 39% of the country's manufacturing output and 34% of its exports in 2004-2005. They provide employment to around 29.5 million people in both rural and urban areas of the country. In view of the growing importance of Micro, Small and Medium Enterprises (MSMEs)

and the constant need to upgrade the technology they use, the government revised the definition of types of company within the Small Scale Industry (SSI) sector through the Micro, Small and Medium Enterprises Development Act, 2006. The key differences between micro, small, medium and large enterprises are summarised in Table 10.4. They differ in terms of investment, employment, production capacity and environmental impact.

As per the Act, in the manufacturing sector an enterprise with up to INR 50 million of investment in plant and machinery is deemed a small enterprise, and an enterprise with up to INR 100 million of investment is defined as a medium enterprise. In the service sector, an enterprise with up to INR 20 million of investment in equipment is classified as a small enterprise, and one with up to INR 50 million of investment is classified as a medium enterprise.

As shown in Table 10.5, the growth of MSMEs is currently being propelled by fresh investments in heavy industries, which depend on MSMEs as their suppliers. The contribution to exports by MSMEs has also been significant in the wake of an increase in manufacturing activity and the increasing prominence of service sector companies.

Table 10.4: Key parameters of Indian enterprises by size

	Micro	Small	Medium	Large
Investments in plant and machinery	up to INR 2.5 million	up to INR 10 million to INR 50 million	up to INR 100 million	above INR 100 million
Employment	less than 5	less than 100	less than 200	above 500
Production	tiny	small	medium	large
Technology	primitive	obsolete	intermediate	advanced
Brands	Nil	rarely	few	many
Organisation	proprietary	proprietary / partnership	partnership / public limited	public limited
Management	direct	semi-professional	organised	professional
Gestation	nil	short	medium	long
Profits	low	good	very good	huge

Source: Desai, 2006.

Table 10.5: MSMEs performance

Year	Total MSME Units (l00 thousand)	Production (in INR 10 mill.)		Employment (100 thousand people)	Exports (in INR 10 mill.)
		(at 2001-02 prices)	(at constant prices)		
2002-03	109.49	314850	306771	260.21	86013
2003-04	113.95	364547	336344	271.42	97644
2004-05	118.59	429796	372938	282.57	124417
2005-06	123.42	497842	418894	294.91	150242
2006-07	261.01	709398	NA	594.61	182538
2007-08*	272.79	790759	NA	626.34	202017
2008-09*	285.16	880805	NA	659.35	NA

Note: The data for the period up to 2005-06 is only for small scale industries (SSI). Subsequent to 2005-06, data with reference to micro, small and medium enterprises have been compiled.
*: Projected
Source: MoMSME, 2010

3. Current status of and challenges to CEM

Along with rapid industrialisation and population growth, India, like any other developing Asian country, has experienced considerable environmental degradation in recent decades. According to the Centre for Science and Environment (CSE, 1999), while the Indian economy grew by a multiple of 2.2 between 1975 and 1995, industrial pollution and vehicular pollution grew by a multiple of around 3.5 and 7.5, respectively. The Asian Development Bank estimates that the cost of pollution in India during 1992 was equivalent to 6% of GDP. Greenhouse gas (GHG) emissions have also increased in line with rapid development of the nation. India accounts for 5.3% of global CO_2 emissions, making it the fourth largest producer of CO_2 (United Nations Statistics Division, 2009). The situation has continued to worsen over the last decade, with nearly two-digit economic growth.

3.1. Greenhouse Gas Emissions

India's carbon emissions have significantly increased in line with rapid the industrialisation and economic growth of the nation (Fig.10.3).

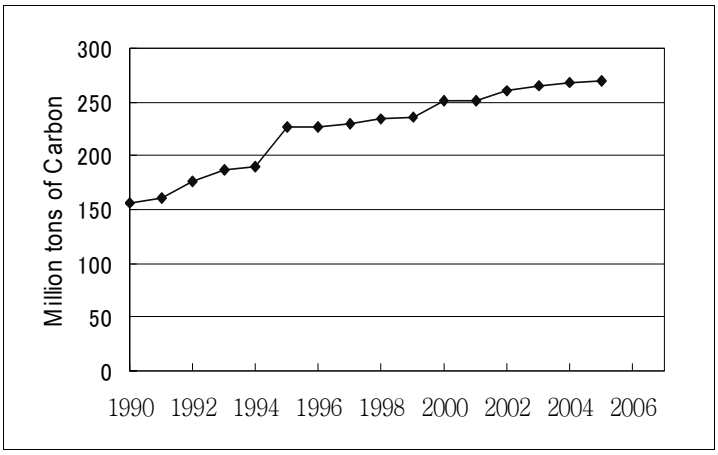


Fig.10.3: India's carbon emissions.

Although India is already the fourth largest producer of CO_2 (United Nations Statistics Division, 2009), it is expected to overtake other nations in coming years. On the other hand, India's carbon intensity has remained relatively flat and high over the past 20 years *i.e.* 25861 Btu US^{-1} in 1980 and 30459 Btu USD^{-1} in 1995. India's high energy intensity level is due in large part to the growth of energy-intensive industries that has taken place in the country during the course of its economic expansion, coupled with the virtual absence of energy efficiency and conservation measures in the most of the industrial sectors, in spite of strict standards (Pandey, 2007). The differences in carbon emissions per dollar of GDP between India and other developed countries like Japan suggest large emission reductions are possible through appropriate measures such as technology transfer from the advanced economies (Montgomery and Tuladhar, 2005).

3.2. Air and water pollution

India has more than 20 industrial cities with populations of over one million. Some of these cities such as New Delhi, Mumbai, Chennai and Kolkata, are among the world's most polluted. For example, airborne particulate matter (PM) is over 150 μg/m^3 in New Delhi. The economic

impact of air pollution is not negligible; World Bank supported a study which estimated the urban air pollution cost in India to be USD 1.3 billion a year. There are various sources of pollution in India, but industrial activities of both public and private enterprises are considered to be one of the major sources. Similarly, high levels of water pollution in excess of national ambient standards prevail in all major rivers. In India 70% of rivers and streams are polluted. Many small scale industries along the banks of these rivers not only source the water for their activities, but also at the same time discharge untreated effluent into these rivers. The economic impact of water pollution is even more significant than that of urban air pollution; the aforementioned study which was supported by the World Bank estimated that water degradation accounts for USD 5.7 million a year in India. In terms of health impact, the Ministry of Rural Development reports that about 1.5 million children under age of five and over 200 million citizens die every year due to water related diseases (Parikh *et al.*, 1999). The Central Pollution Control Board (CPCB) has designated 17 high impact industrial sectors (Table 10.6) as having significant environmental impacts in terms of water effluents, air emissions, hazardous waste and energy use.

Table 10.6: High impacts sectors, as designated by the government of India

Sector	Key Environmental Aspects
Aluminum	Disposal of red mud, bauxite tailings and other hazardous waste, dust emissions and high energy consumption
Caustic	Water pollution due to disposal of brine mud, mercury and chlorine; chlorine emissions
Cement	Fugitive dust emissions, high energy consumption
Copper	SO_2 and dust emissions; water pollution from electrolytic bath and other process; disposal of slag from smelter
Distillery	Water pollution from highly organic effluents from spent wash; soil contamination; high energy consumption
Dyes	Water pollution due to toxic azo-dyes, highly organic coloured and phenolic substances
Fertiliser	Water pollution due to heavy metal, ammonia and fluoride bearing effluent, ammonia emission, fluoride bearing dust and hazardous material
Iron and steel	Water pollution from cyanide, fluoride and heavy metal bearing effluent, ammonia emission, fluoride bearing dust and hazardous material; high energy consumption
Leather	Water pollution, particularly from hexavalent chromium and salt in discharge
Pesticide	Air pollution due to particulate and volatile organic compounds; effluent containing pesticide residues
Petrochemicals	Water pollution due to phenol and benzene containing effluent; fugitive emissions of toxic and carcinogenic and volatile organic compounds (VOC); hazardous material disposal
Pharmaceuticals	Water pollution due to organic residues bearing effluent; VOC and particulate emissions; hazardous waste containing process sludge and spent catalyst
Pulp and paper	Water pollution from high organic and inorganic substance and chlorinated compounds in black liquor; highly malodorous emissions of reduced sulphur compounds and VOC.
Refinery	Water pollution from effluent containing organic and inorganic materials, oil and solvent; air emissions of particulate matters, SO_2, benzene, toluene and xylene, VOC
Sugar	Water pollution due to high BOD and COD effluent and spillage of molasses; air pollution due to combustion of bagasse, coal etc; high energy consumption
Thermal power	Air emission from combustion, coal handling, water pollution due to discharge of boiler blow down, outflow from ash pond; land contamination due to fly ash disposal practices
Zinc	Air pollution due to fugitive zinc dust, water pollution containing residues, disposal of solid and hazardous waste

Source: CPCB, 2003.

3.3. Industrial wastes

Hazardous waste generation from industries is critical due to their large geographical spread in the country, leading to region wide impacts; the annual growth in hazardous waste generation can be directly linked to industrial growth in the states. States which are relatively more industrialised such as Gujarat, Maharashtra, Tamil Nadu, and Andhra Pradesh, face problems of toxic and hazardous waste disposal far more acutely than less developed states (MoEF, 2001).

Table 10.7 shows the number of units generating hazardous waste as well as the quantity of hazardous waste generated, which is further divided into three categories: recyclable, incinerable and disposable waste. In total, at present, around 7.2 million tons of hazardous waste is generated in the country of which 1.4 million tons is recyclable, 0.1 million tons is incinerable and 5.2 million tons is destined for disposal on land (MoEF, 2006). As per the information provided by the MoEF, there are 323 hazardous waste recycling units in India, and of these, 303 recycling units use indigenous raw material while 20 depend on imported recyclable wastes. The pressure on the natural resources is already high, and unless long term plans are made, industries will face serious problems for solid waste disposal in the coming years.

Table 10.7: Status of hazardous waste generation

State	No. of units generating hazardous waste	Quantity of Hazardous Waste Generated (tonnes per annum)		
		Recyclable	Incinerable	Disposable
Andhra Pradesh	501	61820	5425	43853
Assam	18	0	0	166,008
Bihar	42	2151	75	24351
Chandigarh	47	0	0	305
Delhi	0	0	0	0
Goa	25	873	2000	3725
Gujarat	2984	26000	19953	150062
Haryana	309	0	0	31046
Himachal Pradesh	116	0	63	2096
Karnataka	454	47330	3328	52585
Kerala	151	84932	5069	690014
Maharashtra	3953	847436	5012	1155398
Madhya Pradesh	183	89593	1309	107767
Orrisa	163	2841	0	338303
Jammu and Kashmir	57	0	0	0
Pondicherry	15	8730	120	43
Punjab	700	9348	1128	12233
Rajasthan	306	9487	19866	2242683
Tamil Nadu	1100	193507	4699	196002
Uttar Pradesh	1020	0	0	0
West Bengal	440	45233	50894	33699
Total	12584	1429281	118941	5250173

Source: MoEF, 2006.

4. Overview of environmental governance

4.1 Environmental policy

India has an extensive environmental governance system with a comprehensive set of laws, specific statutory mandates, regulatory instruments, and institutional frameworks to implement and enforce policy objectives (World Bank, 2007). Formal environmental planning in India started in 1972, when the preparatory committee for the Stockholm conference became the forerunner of the National Environmental Planning and Coordination Committee. The regulations to control and manage air and water related pollution were in place since 1974 and 1981 when the Water Act and Air Act were enacted respectively. They also led to the establishment of central and state pollution control boards with extensive powers for scrutinising the effluent management efforts of firms. However, as illustrated in Box 10.1, environmental issues have become a national concern in India only from 1980s. Accelerating economic growth through rapid industrialisation with little concern for environmental impacts was the guiding policy during the previous decades. Through the 1970s to 1990s, command and control dominated the legal approach to environment in India. Though various regulations were enacted, their implementation continued to be weak. This scenario changed with the leak of isocyanate gas from the Union Carbide factory at Bhopal in December 1984, leading to one of the world's worst industrial disasters, and causing nearly 3000 deaths. An oleum gas leak in a major chemical industrial facility in Delhi, which followed the Bhopal incident, further increased the level of fear. These incidents became a watershed in the history of environmental legislation in India, and generated nationwide fears regarding the safety status of companies, especially those near populated areas. Furthermore, these events highlighted the needs for improving safety and environmental protection systems and became a turning point for government and industry, both of which had paid minimal attention to the environmental hazards. Thereafter, the government and the private sector redefined their desired goals, formulated specific rules and set in place an enforcement programme and regulatory agencies to ensure compliance.

In 1986, the Ministry of Environment and Forests (MoEF) enacted the Environmental Protection Act. Subsequent to this Act, in order to prevent indiscriminate disposal of hazardous waste, the MoEF promulgated the Hazardous Wastes Management and Handling Rules in 1989, and efforts to establish inventories for hazardous waste management were accelerated. Though the hazardous waste rules were introduced in 1989, the response towards their implementation has remained very poor. The Bureau of Energy Efficiency (BEE) was established in 2002. The Public Liability Insurance Act of 1991 introduced the concept of a no-fault liability standard, under which compulsory and immediate compensation had to be paid to those affected in the case of accidental events. In addition to obtaining adequate insurance policies, firms were also required to contribute a prescribed amount for a relief fund to be set up in the state.

4.2 Institutional framework

India's high rate of environmental degradation is not due to the absence of a sound environmental legal regime, but to a lack of environmental enforcement at the local level (Pandey, 2007). In India, environmental legislation involves a shared responsibility between the central and the regional governments, with the central government having responsibility for

policy and regulatory formulations and the state governments for ensuring implementation and enforcement of national policies. As shown in Fig.10.4, the MoEF and the Central Pollution Control Board (CPCB) are the nodal agencies at the central level. Similarly, at the state level, the state departments of Environment and Forest (DoE/DoF) and the State Pollution Control Boards (SPCB) are the designated agencies to perform this function. Despite a strong policy and institutional framework, environmental degradation continues in many areas; compliance is often unmet and public dissatisfaction is strong. In principle, SPCBs are the primary designated agencies to implement and enforce most of the environmental laws at the state level. However, their responsibilities are vast and cover various areas. Thus, less time and emphasis is spent on monitoring and tracking compliance of existing facilities and pursuing enforcement actions against polluting facilities, resulting in poor compliance records (World Bank, 2007).

Box 10.1: An illustrative list of key environmental legislations in India

Policies

1992 Policy Statement on Abatement of Pollution
1992 National Conservation Strategy and Policy Statement on Environment and Development
1998 National Forest Policy
2002 Wildlife Conservation Strategy
2006 National Environment Policy

Environment Acts

1927 The Indian Forest Act
1972 The Indian Wildlife (Protection) Act (amended 1993)
1974 The Water (Prevention and Control of Pollution) Act (amended 1988)
1977 The Water (Prevention and Control of Pollution) Cess Act (amended 1992)
1980 The Forest (Conservation) Act (amended 1988)
1981 The Air (Prevention and Control of Pollution) Act (amended 1987)
1986 The Environment (Protection) Act (amended 1992)
1988 The Motor Vehicles Act
1991 The Public Liability Insurance Act (amended 1992)
1995 National Environment Tribunal Act
1996 National Environment Appellate Authority Act
2002 The Wild Life (Protection) Amendment Act
2002 The Biological Diversity Act
2003 The Water (Prevention and Control of Pollution) Cess (Amendment) Act

Environment Rules

1986 The Environment (Protection) Rules
1989 Hazardous Wastes (Management and Handling) Rules
1990 Forest (Conservation) Rules (amended 1992)
1991 Chemical Accidents (Emergency Planning, Preparedness and Response) Rules
1998 The Bio-Medical Waste (Management and Handling) Rules
1999 The Recycled Plastics Manufacture and Usage (Amendment) Rules
2000 The Municipal Solid Wastes (Management and Handling) Rules
2000 The Hazardous Wastes (Management and Handling) Amendment Rules
2000 The Ozone Depleting Substances (Regulation and Control) Rules
2001 The Batteries (Management and Handling) Rules
2002 The Noise Pollution (Regulation and Control) (Amendment) Rules
2003 The Recycled Plastics Manufacture and Usage (Amendment) Rules
2003 Bio-Medical Waste (Management and Handling) (Amendment) Rules
2003 Forest (Conservation) Rules
2003 Draft Biological Diversity Rules

Environnent Notifications

1994 Environnemental Impact Assessment Notification 1994 (amended 2002)
1998 Constituting the Taj Trapezium Zone Pollution (Prevention and Control) Authority
1999 Fly Ash Notification
2003 Charter on Corporate Responsibility for Environmental Protection (CREP)

International Agreements to which India is a Signatory

1972 The Rio Declaration on Environment and Development and the Agenda 21
1975 The Convention on International Trade in Endangered Species of flora and fauna (CITES)
1985 The Vienna Convention/Montreal Protocol on substances that deplete the ozone layer
1991 The Convention on Wetlands of International Importance (Ram Sar Convention)
1992 The Framework Convention on Climate Change
1992 The Convention for Conservation of Biological Resources

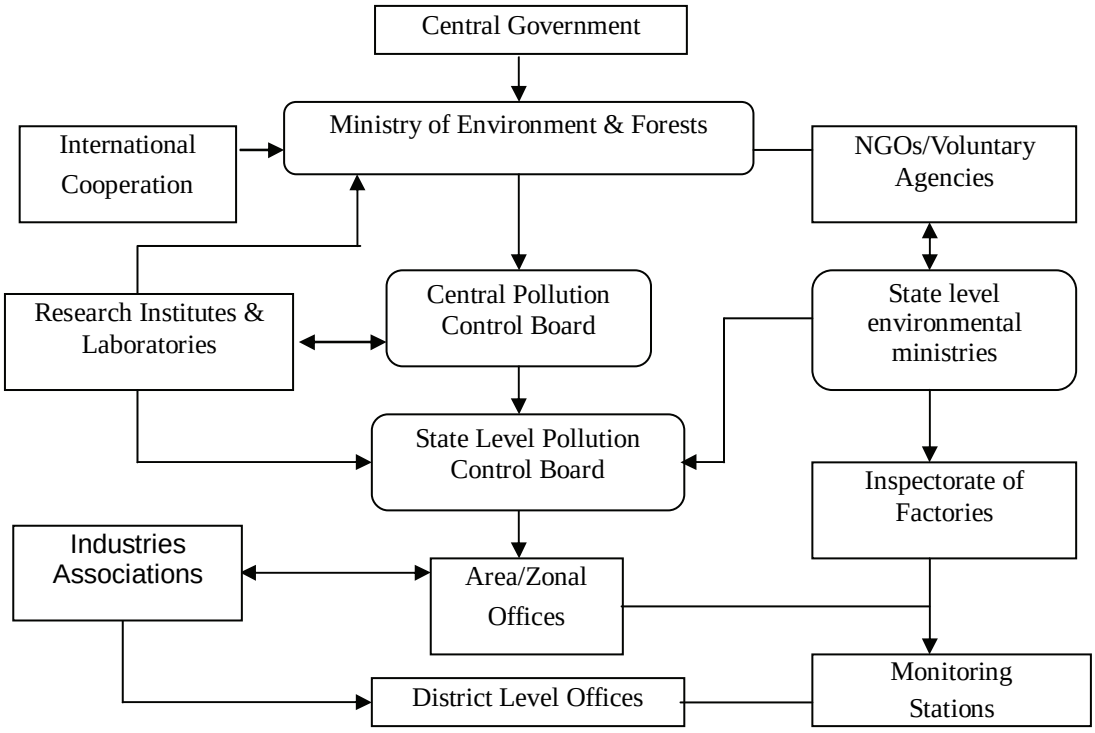


Fig.10.4: Institutional framework for environmental protection in India.

Although many SPCBs have relatively good records regarding the performance of the highly polluting units in the large scale sectors, the monitoring and inventory of small-scale units is very poor and often incomplete. In part, the lack of interdepartmental coordination between the SPCBs and the field units of small scale industries department result in the existence of highly polluting units in the various states (Planning Commission, 2005). Moreover, most of the SPCBs are under-staffed and under-funded in meeting their existing obligations to implement regulatory mandates of various national and state laws and directives from the courts. A recent report by the Planning Commission (2005) concluded that the SPCBs are currently characterised by a dominant presence of non-technical staff, differential availability of staff for monitoring polluting industrial units, large staff vacancy positions, vast variations in financial positions, and prohibitive spending restrictions imposed by State governments (as in Table 10.8). One of the main institutional challenges for SPCBs is regarding recruiting and maintaining quality technical staff to perform mandated duties. Many PCBs are chronically understaffed as indicated in Table 10.9 resulting in low compliance rates across the country.

4.3 Judiciary

In most countries, the judicial systems have been viewed as a last resort for the resolution of environmental conflicts. In India, however, they have often been the first resort because of perceived inabilities or lack of political will of government agencies to enforce environmental laws and regulations. In 1996, India's Supreme Court served closure notices to 225 polluting industrial units and ordered their relocation or closure (Table 10.9). In a number of judgments, Indian courts have ruled that under the constitution of India, citizens have a fundamental right to live in a pollution-free environment and that the court is duty bound to compel the statutory authorities to ensure the same. As exemplified in Table 10.10, the rise of judicial activism led to

the strengthening of existing provisions of the law, institutions and the corporate attitudes to environmental protection. It has also increased pressure on companies to respond to the grievances of local community through judicial systems.

Table 10.8: Comparison of staff resources and skills for every 100 polluting units in the states

State	Sanctioned staff	Staff in position	Number of technical staff	%of technical staff to total	% of vacant posts to sanctioned posts
Andhrapradesh	4.72	3.11	1.17	37.61	34.08
Assam	*	*	*	47.21	3.43
Bihar	16.66	15.69	10.28	65.52	5.48
Goa	9.68	5.24	1.61	30.77	45.83
Gujart	7.8	6.69	3.50	52.34	14.16
Haryana	12.37	8.59	2.16	25.14	30.62
Himachal Pradesh	52.65	44.25	11.50	26.00	15.97
Karnatka	22.19	7.77	4.47	57.48	64.97
Kerala	29.83	28.77	14.27	49.59	3.56
Madhya Pradesh	20.13	21.92	9.29	43.29	8.87
Mahrashtra	8.47	7.00	3.23	46.20	17.39
Orissa	21.05	15.31	5.84	38.13	27.27
Punjab	6.26	2.86	2.32	81.13	54.31
Rajasthan	9.93	9.09	3.89	42.72	8.44
Tamilnadu	11.42	8.54	3.62	42.39	25.24
Uttarpardesh	11.68	8.52	3.09	36.25	29.99
West Bengal	5.30	4.19	2.49	59.44	20.99
All boards	10.73	8.10	3.70	45.69	24.46

Source: Planning Commission of India, 2005
*: Not estimated

Table 10.9: Number of factories closed down due to judicial intervention

Category	Total number of units	Total number of units closed	Total no. of units complying	Defaulters
Aluminum	7	1	6	-
Caustic	33	-	33	-
Cement	205	17	182	6
Copper	4	-	4	-
Distillery	209	39	167	3
Dyes	102	10	90	2
Fertiliser	124	13	109	2
Iron & Steel	19	1	14	4
Leather	94	15	75	4
Pesticide	111	8	102	1
Petrochem	75	-	74	1
Pharma	401	41	350	10
Pulp & Paper	136	26	108	2
Refinery	16	-	16	-
Sugar	462	50	409	3
Zinc	6	1	5	-
TPP	151	3	133	15
Total	2155	225	1877	53

Source: TATA Services, 2005.

Table 10.10: Summary of selected public interest litigations and court directives

Case	Court Directive
Ratlam Municipality v/s Vardhichand – AIR 1980 SC 1622	The municipality was directed to construct toilets and remove filth from an open drain irrespective of financial constraints.
M.C. Mehta v/s Union of India & Others – AIR 1988 SC 1037	The authorities were directed to stop the operation of tanneries causing pollution in river Ganga.
M.C. Mehta v/s Union of India & Others – AIR 1987 SC 1086	The Court held that the enterprise engaged in hazardous or dangerous activity owes an absolute duty to the community to ensure that harm is avoided to anyone on account of hazardous nature of activity undertaken by such enterprise.
M.C. Mehta v/s Union of India & Others – 1997 (11) SCC 312	Directed the Government to constitute an authority for regulating and control of ground water management.
Vellore Citizens Welfare Forum v/s Union of India – 1996(5) SCC 647	Directed the polluter to pay the cost for remediation of the damaged environment as part of the process of sustainable development, polluter pays principle and precautionary principle.
S. Jagannath V/s Union of India – AIR 1997 SC 811	Directed shrimp culture industry to close its activities in view of the ecologically fragile coastal area and adverse effect on the environment due to its activities.
Rural Litigation & Entitlement Kendra v/s State of Uttar Pradesh – AIR 1987 SC 359	Directed the mining industry to stop the mining activities in the forest area of Doon Valley.
B.L. Wadhera v/s Union of India – AIR 1996 SC 2969	Directed the municipality of Delhi to remove garbage from various areas in the city.
M. C. Mehta v/s Union of India & Others 1997(11) SCC 327	Directed the authorities for closure/shifting/relocation of hazardous and noxious industries outside the territory of Delhi which were operating in violation of the Master Plan.

Source: the Supreme Court of India; website http://supremecourtofindia.nic.in/

4.4 Market based instruments

It is difficult to find solutions to various environmental problems through regulatory approaches alone. Moreover, solutions to issues that elude conventional approaches may lie in market-based approaches. There is growing attention to, and calls for, market-based instruments as a potential option to internalise the environmental externalities; however, no measures or plans, including carbon taxes and polluter-pay principles, have so far been contemplated for implementation in India.

The major barriers to the implementation of market-based instruments in India are outlined in the following points:

- Since India has traditionally focused on command and control for environment management, there is only little understanding or appreciation of market-based instruments among the various stakeholders. Furthermore, any move to a greener and a more transparent system is likely to face opposition in various ways, including from parties with vested interests in maintaining the status quo.
- There is no legal, institutional or organisational framework to mediate, administer, implement and monitor market based instruments. In addition, existing regulatory agencies have little capability for monitoring and enforcement.
- The existing industrial structure is also likely to be a barrier. For example, in India, the strategic sectors such as power, transport and fertilisers are dominated by large public sector

or government owned organisations. Such firms would be less responsive to market based instruments as they have the capacity to ignore market forces (Gupta, 1997).

4.5 Voluntary corporate environmental management activities

Among the Asian countries, India and Malaysia appear to be most active in the field of corporate social responsibility (OECD, 2005). The National Conservation Strategy and Policy Statement of Environment evolved in 1992 turned out to be the catalyst for changing the attitude of companies. The statement highlighted the need for integration and internalisation of environmental considerations in industrial and business activities. Even though voluntary approaches are fragmented and constrained by many factors, they have considerable potential. A number of voluntary approaches are discussed in the following sections.

4.5.1 Voluntary agreements and codes of conduct

The Confederation of Indian Industries (CII) and The Federation of Indian Chambers of Commerce and Industry (FICCI) work closely with government on environmental policy issues and provide a platform for sectoral consensus building and development of codes. CII has been organising environmental and social summits every year, and has established the Environmental Management Department (EMD) with a team of well-trained professionals to undertake a range of activities such as training and conducting audits for setting voluntary standards. EMD's focus is on building in-house capabilities within Indian industry to address environmental issues effectively and proactively. FICCI also has an exclusive Environmental Information Centre that compiles and disseminates information on environmental regulation, success stories, best practices, energy efficiencies and clean technologies.

Business associations play a fundamental role in the growth of numerous voluntary agreements to demonstrate environmental stewardship to company shareholders, communities, consumers and regulators. Furthermore, there are instances where successful voluntary agreements have been made between industry and government to gradually improve environmental performance beyond compliance requirements. One example is an agreement with the cement industry to reduce their emission levels to 50µg/Nm^3 from 100µg/Nm^3 which was set to become a legal requirement in 2006 (World Bank, 2007).

4.5.2 Environmental reporting initiatives

Indian companies actively participate in initiatives such as the Global Reporting Initiative (GRI). With CII as an organisational stakeholder in the Coalition for Environmentally Sustainable Economies (CERES), it helped UNEP in preparing the GRI reporting guidelines. Apart from this, a number of leading companies are also actively managing their environmental impacts and this is evidenced by some major companies producing detailed sustainability reports (OECD, 2005). India was also one of the first countries in which the Global Compact was launched. As of 2004, over 90 companies had committed to its Global Compact principles. Realising the need for nationwide network, India Partnership Forum, a joint UNDP/CII initiative was started in 2001, and exercises leadership within the broader regional business community. CII has adopted Social and Environmental Principles and continues to play an important role in promoting its principles to their members and refining their environmental reporting initiatives.

4.5.3 Environmental management standards

Among the international standards systems, ISO9000 in particular has seen impressive growth in India. The number of certified companies increased from 5,554 in 2001 to approximately 12,000 in 2006. ISO14001 is an environmental management standard that defines the environmental policy of an organisation. With just one ISO14001 certified company in 1995, the number grew to 257 companies over the next five years and reached 879 in 2003. By the end of 2005, approximately 1,500 companies were certified with ISO14001. Some SPCBs request companies in high environmentally impacting sectors to adopt ISO14001 certificates before the renewing of their consents and authorisation. However, in general, the certified firms are mostly the large industries, units or facilities, while SMEs have been relatively slow in their uptake of these standards.

4.5.4 Eco labelling and certification programs

Eco labelling assists firms to produce more environmentally benign products, and ensure that inputs necessary for their production processes are not environmentally damaging. There are now several certification and standard schemes, most of them voluntary, for product quality, environmental friendliness and organic production. Over 1,100 products have been certified for product quality standards by BIS, and 16,000 licenses have been issued to companies meeting these standards. Based on the popular labels issued in many industrialised countries, the Indian eco-label scheme - Eco-mark - was launched in 1991 for certifying and awarding a special product label to companies which meet specific environmental and quality standards. Eco-mark is basically a market-based non-regulatory instrument to reduce pollution and improve environmental protection. In India, the scheme consists of a three stage cradle-to-grave screening process, meaning that the life cycle analysis of the product is based not only on the environmental impacts of the manufacturer, but also on use and disposal of the product. The Eco-mark scheme was initially designed to cover 16 product categories; however, there are now 17 product groups for which Eco-mark is available. The BIS awards and oversees the progress of eco-labelling. Currently, there are Eco-mark criteria for more than 140 products in several categories such as soaps, detergents, paints and paper.

However, the overall business response to the Eco-mark scheme within India has not been very encouraging, and manufacturers have been hesitant to apply the label. Only a few companies have been granted the Eco-mark label. Moreover, none of certified companies are using the label on their products. Despite the failure of Eco-mark, Jain (2004) states that some independent certification schemes are rapidly spreading in India, especially in the context of fair trade and for certain export items such as tea. Furthermore, it should be noted that independent third party certification programmes in India are formed primarily for the purpose of ensuring the quality of products in trade; concerns for the environment are generally given lower priority.

Furthermore, the Ministry of Power launched an Energy Efficiency Labelling scheme in 2006 under the Energy Conservation Act, 2001 by the Union Government of India. The scheme is implemented by Bureau of Energy Efficiency. The scheme was initially piloted with two products, frost-free refrigerators and tubular fluorescent lamps; however, several other products were added later. Under this scheme, products are rated on a scale one to five stars, with five

stars being the most efficient and a single star being the least efficient. It is a voluntary programme that was developed in collaboration with multiple stakeholders. By comparison with the Eco-mark programme, energy efficiency labelling has received better acceptance among manufacturers. A sample label is depicted in Fig.10.5.

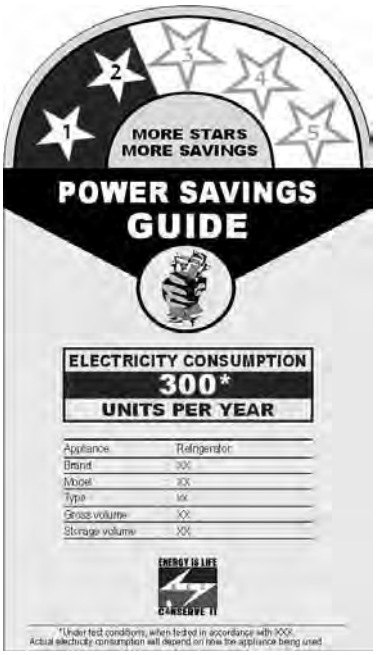


Fig.10.5: Energy efficiency label.

4.5.5 Registration scheme

A voluntary registration scheme aiming to establish environmentally sound facilities for the recycling of waste was introduced in late 1990s. The scheme is designed to voluntarily register factories with environmentally sound technology for recycling; for example, waste oil, non ferrous metallic wastes and lead batteries. The scheme also ensures that industries generating these wastes auction them only to registered units in the country.

4.5.6 Eco design

Better design of products, processes and services are fundamental to voluntary corporate environmental management. In general, the quality of production processes and services is proportional to the quality of product design. Moreover, better design has the potential to attract more customers as well as reduce pollution. Designs of consumer products have significant impacts on the environment during the product's life cycle. To develop sustainable products, the designers must be able to assess which design solution is environmentally preferable. They need to measure and evaluate the environmental consequences of their product designs. However, the consumer movement has not been taking significant strides in India, where demand for improved environmental performance is not very high.

4.5.7. Cleaner production

The cleaner production approach is a preventive, integrated strategy that is utilised to improve productivity by ensuring a more efficient use of raw materials. International organisations such as UNIDO are instrumental in promoting the concept. The results from demonstration projects

indicate substantial benefits. However, there are a number of barriers to the adoption of clean technologies in India. The barriers indicated by the National Environmental Engineering Research Institute are listed below:

- Polluting technologies often have a price advantage over the non-polluting processes. The current resources of firms may be insufficient to meet incremental costs for clean technology adoption.
- Lack of information regarding local markets such as availability of trained manpower. This may lead to over/underestimation of capital and operating costs.
- Low risk bearing capacity of firms in the small and medium scale sector.
- Practical and operational difficulties such as access to raw material with sufficient quality.
- The adaptability of imported technologies to local conditions.
- A lack of coordination and direction in research and development efforts and inadequate thrust for technology transfer from lab-to-commercial scale.

5. Preliminary survey of CEM in India

In order to better understand the CEM background in India, a preliminary survey on CEM in India was conducted in 2007-2008. The surveys aimed to gather relevant information on topics such as environmental concerns and risks. Three industries, namely automobile and auto-component manufacturing, food processing and textiles were selected for this survey. Around 120 companies from three industries were contacted and 24 companies responded. The number of samples from the automobile, food processing and textile industries was 8, 6 and 10, respectively.

The sampled companies from the automobile industry included SMEs. Their work forces ranged from 50 to 5000. The turnover ranged from INR 50.0 million to more than INR 100.0 million. Profitability ranged from 10 – 25 % of the sales turnover. The sampled companies from the textile industry included spinning mills, processing units, weaving mills and composite mills. Their work forces ranged from 50 to 5000. Sales turnover ranged from INR 5.0 million. to INR 100.0 million. Profitability ranged from 10 – 25 % of sales turnover. The sampled companies from the food processing industry consisted of companies with work forces ranging between less than 50 to a maximum of 500. The sales turnover ranged from INR 10.0 million to INR 50.0 million. Given the small number of samples, the results are unlikely to reflect Indian industry in all its complexity; however, the survey has provided some insights and implications.

5.1 Concern for environmental issues

Among all the respondents, 25% considered environmental issues related to their business to be of high priority; 50% and 25% considered such issues to be of medium or low priority respectively (Fig.10.6). However, there were differences between industries. Respondents from the textile and automobile industries prioritised environmental issues more than the food processing industry. Forty percent of respondents from the textile industry and 25% from the automobile industry attached high priority to environmental issues. By contrast, none of the food processing companies considered environmental issues to be important. The textile industry by nature has many processes involving considerable amount of water, organic

materials such as starch, and inorganic chemicals such as dyes and chemicals. Thus, environmental awareness levels within the textile industry are likely to be higher than those within the food processing industry. Furthermore, the textile industry has attracted attention from the media and NGOs in the past, and has undergone scrutiny; State Pollution Control Boards took a strong view regarding their production and effluent discharge practices. There was considerable litigation and, for example, the Honorable High Court of Chennai has ordered the closure of all textile processing units which had not conformed to pollution standards in Tirupur. Such experiences have also often resulted in considerably raised awareness and the implementation of proactive CEM activities.

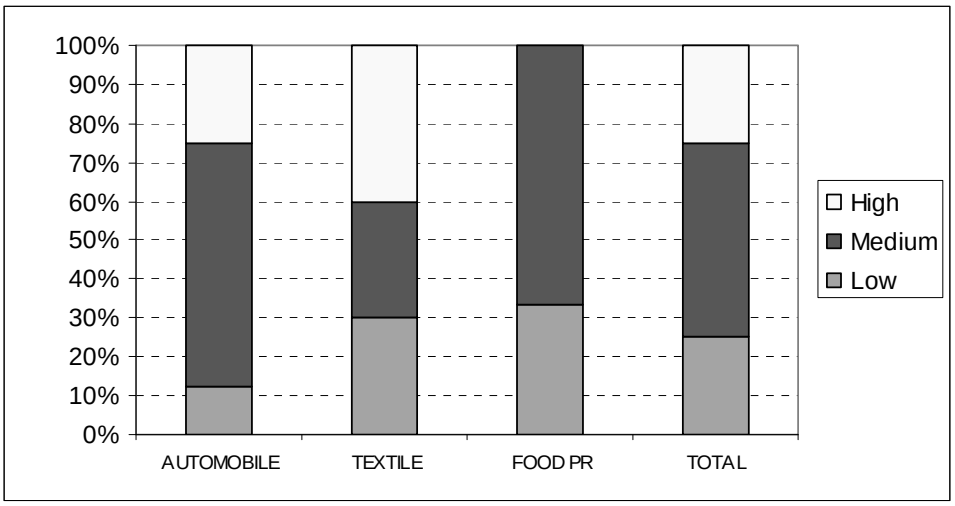


Fig.10.6: Industry-wise importance ratings regarding environmental issues.

5.2 Environmental management

More than 70% of the companies responded that they have initiated at least one environmental management activity; however, the implementation rates between sectors varied substantially. Whereas all the automobile industry respondents have initiated at least one environmental management activity, the implementation rates within the textile and food processing industries are 70% and 50% respectively. One of the major reasons for higher rate within the automobile industry is consumer pressure. Indian automotive and auto-component industries are part of the global auto industry; they are part of the global supply chain. Therefore, the stringent specifications of American and European markets exert influence over their manufacturing practices.

The Indian textile industry is also becoming a part of global industry. Both global exposures and legal actions from the Pollution Control Boards have increased the level of environmental activity in this industry.

5.3 Supply chain greening initiatives

Only approximately 40% of the total respondents reported that they have initiated supply chain greening initiatives. However, this rate varied between different industrial sectors. Rates for the automobile, textile and food processing sectors were around 30%, 60% and 40% respectively. In most of the cases, supply chain greening initiatives are considered as essential amongst

export-led businesses. As the textile industry is now directly in contact with the European and American markets, the importance of greening supply chains is increasing within the industry. In the case of the automobile industry, the greening of supply chains is also generally initiated by pressure from buyers abroad. European and American car manufacturers face stringent emissions norms, and such requirements have knock-on impacts on the Indian automobile manufacturers.

5.4 Operating risks

Around forty percent of the total companies surveyed foresee high operating risk due to environmental impact. Of the three selected industries, the textile industry perceives much higher operating risk than the other two industries. More than 90% of the textile companies surveyed face medium or high levels of operating risk (Fig.10.7). In the case of the automobile and food processing industries, about 60% of the companies surveyed face medium or high operating risk. Increasing awareness of global climatic change and carbon footprints has made the textile and automobile industries foresee operating risks. Moreover, in recent years, Right to Information (RTI) regulations and stricter judiciary stances are gradually changing the mindset of Indian companies.

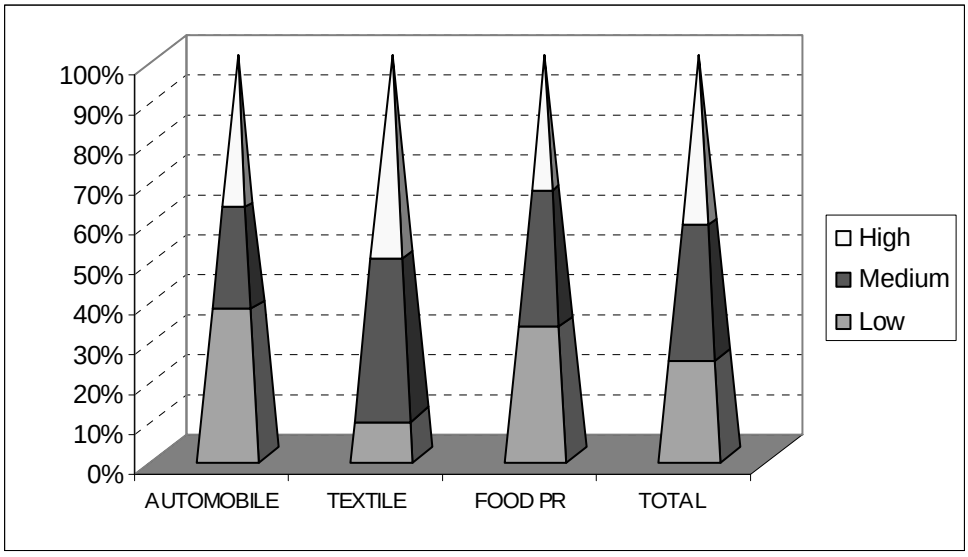


Fig.10.7: Industry-wise operating risks.

5.5 Competitive risks

In general, Indian industry does not perceive a great competitive threat due to environmental impacts (Fig.10.8). The textile industry shows a slightly higher competitive risk.

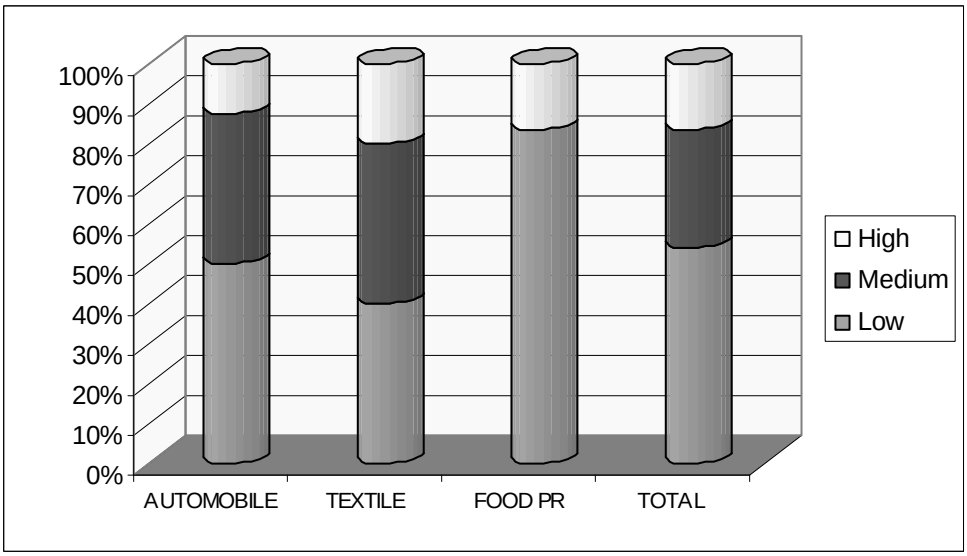


Fig.10.8: Industry-wise competitive risks.

5.6 Market risks

Thirty-three percent of respondents confirmed that they are faced with high market risks. The same percentage of companies faces medium or low risks. The automobile and textile industries face higher threats than the food processing industry (Fig.10.9). Within the textile and automobile industries, the percentage of companies facing market risks due to environmental impacts was approximately 80% and 60%, respectively.

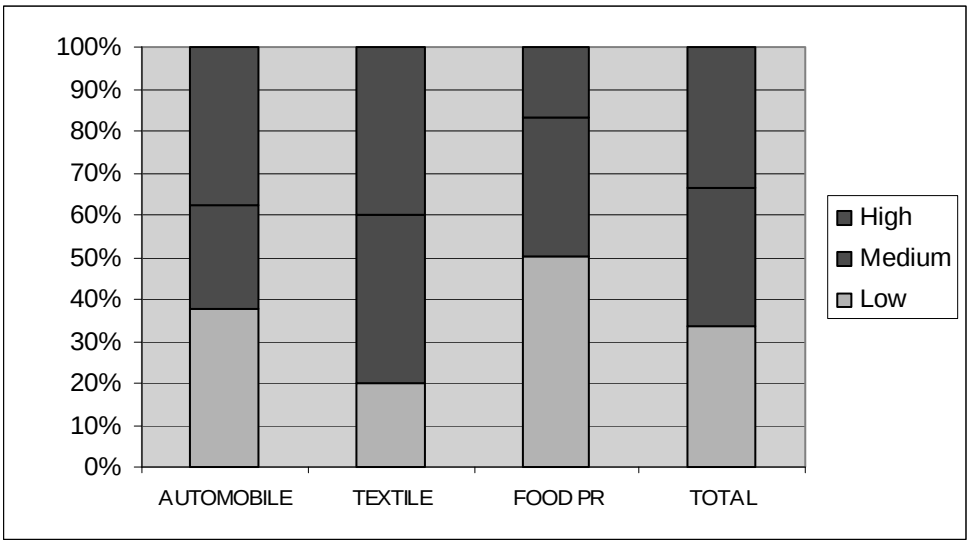


Fig.10.9: Industry-wise market risks.

5.7 Implications from preliminary survey

The results indicate that the three surveyed industries differ considerably in terms of their levels of awareness regarding environmental impacts, CEM practices and the level of their supply chain greening initiatives. The automobile industry has shown more awareness of, and has more readily adopted, CEM practices when compared to the textile industry, and much more than the food processing industry. The automobile and textile industries, which have more experience in

legal conflicts regarding environmental issues, seem to be relatively more proactive than the food processing industry, which has less experience. In addition, consumer pressure also seems to have a considerable impact on the environmental awareness of Indian companies. In general, the pressure from consumers regarding environmental issues is currently higher in the global market than in the Indian market. Thus, in fact, the results have implied that industries which are relatively more integrated with the global market, as is the case with the automobile industry, tend to be more proactive in practicing CEM. On the other hand, the food processing industry, where firms mainly serve only the domestic markets, showed a lower level of concern in dealing with environmental issues.

6. Survey of corporate EID

To respond to growing environmental concerns and to supplement traditional environmental regulations, a multi-stakeholder approach, which involves various aspects such as the reactions of community, has recently been recognised as an effective strategy (Tietenberg, 1998). This highlights the significance of environmental information disclosure (EID) as a tool in achieving environmental goals, especially in developing countries with weak enforcement capacities, including India (O' Neill and Poddar, 2008). Since EID has the potential to involve various entities, and effectively saves both the time and cost of putting pressure on companies, an EID approach is considered suitable in countries such as India.

In order to better understand the state of EID in India, this section depicts the level of EID carried out by Indian companies across various sectors. A preliminary survey was conducted by monitoring environmental information made available on the websites and in the annual reports of 147 companies in 23 different fields. Types of corporate environmental management (CEM) initiatives mentioned in theses sources were analysed to summarise the frequency of their occurrence.

6.1. Methods

Types of corporate environmental management (CEM) initiatives mentioned on company websites and in annual reports (such as sustainability reports) were monitored. Table 10.11 summarises four corporate environmental initiatives covered in the survey. These are: (i) Supply Chain Greening; (ii) Greening Operations; (iii) Climate Change; and, (iv) Renewable Energy Utilisation. These initiatives can further be divided into 18 sub-initiatives.

The survey was carried out on a focus group of the 100 most valuable private sector companies and the 50 most valuable public sector companies as rated by the Business Today (BT) 500. However, data was available for 98 private sector companies and 49 public sector companies; thus, a total of 147 companies comprised the data set. These 147 companies were classified into 23 different sub-sectors with their distribution being indicated in Table 10.12. These sub-sectors were further grouped into two large sectors: (i) Manufacturing (including automobile, automobile ancillaries, cement, chemicals, cosmetics and toiletries, food and beverages, machinery, metal and metal products, refinery and textile); and, (ii) Service/Others (including computer software, hotels and tourism, securities and stocks, telecommunication, construction, electricity generation, media, storage and distribution, trading, transport services, mining and

diversified). There were a total of 77 companies including 60 public and 17 private from manufacturing sector, while service/others totalled 70 companies, of which 38 were private and 32 were public.

Table 10.11: CEM initiatives and sub-initiatives analysed in this research

Initiative	Sub-Initiative	Description
Greening Supply Chain Initiatives	End of life	Taking back or recycling of products at the end of their life cycle
	Supply initiative	Initiatives such as sourcing raw materials in a sustainable manner
	Vendor management	Initiatives taken by the company to manage vendors and dealers to follow green supply chain practices
Greening Operations	Energy conservation	Increasing efficiency of equipments and other measures leading to energy efficiency
	Air pollution control	Measures to control emissions of polluting gases such as SO_x, NO_x and CFCs
	Resource conservation	Conserving the resources by replacing the existing raw material with a more efficient source or implementing better technologies
	Solid waste management	Efforts such as to generate zero or minimum waste, or using composting
	Hazardous waste management	Managing and handling the hazardous wastes generated as a result of the operations.
	Recycling	Recycling of raw materials or any process implemented that leads to recycling of resources
	Water conservation	Technologies used to treat the effluents generated from the business operations etc.
	Other pollution prevention measures	Any other special methods adopted to keep the pollution levels within the required standards
Climate Change	Carbon trading	Trading carbon credits with other companies or any other entities
	CDM	Projects taken up by companies in adopting Clean Development Mechanism
	GHG reduction	Practices to reduce GHGs
	Carbon sequestration	Measures taken by the company to sequester carbon dioxide by promoting forestry, afforestation, tree plantation or any kind of vegetation
Renewable Energy Utilisation	Alternate fuels	Utiliztion of alternate fuels
	Solar energy	Utiliztion of solar energy
	Wind energy	Utiliztion of wind energy

Table 10.12: Distribution of targeted companies

Sector	**No. of companies**		
	Private	**Public**	**Total**
Manufacturing	60	17	77
Automobile	6	0	6
Automobile Ancillaries	3	0	3
Cement	7	0	7
Chemicals	18	2	20
Cosmetics and Toiletries	5	0	5
Food and Beverages	4	0	4
Machinery	8	5	13
Metal and Metal products	6	3	9
Refinery	2	7	9
Textiles	1	0	1
Service / Others	38	32	70
Banking and other Financial Services	6	20	26
Computer Software	8	0	8
Hotel and Tourism	2	0	2
Securities and Stocks	2	0	2
Telecommunication	3	1	4
Construction	7	1	8
Electricity Generation	3	2	5
Media	2	0	2
Storage and Distribution	0	3	3
Trading	1	0	1
Transport Services	1	3	4
Mining	2	2	4
Diversified	1	0	1

6.2. Results

The results of the survey are summarised in Table 10.13. The survey depicted considerable differences in the level of EID depending on the sector (manufactures or service/others) and ownership (private or public). The results have implied the following general trends:

(i) The level of EID is relatively higher in manufacturing sector compared to service/others sector; especially regarding greening operations initiatives; and,

(ii) Private companies are more aggressive than public companies in most types of CEM initiative, except in renewable energy initiatives.

To further confirm the above implications, a one-tailed t-test was applied for comparison between: (i) manufacturing and service/others sectors; and, (ii) private and public companies. Disclosure ratios for the 23 sub-sectors, which were calculated independently, were used for this test. P values showed a considerable difference ($P < 0.05$) between manufacturing sector and service/others sector in the EID levels of greening operations and renewable energy initiatives. In addition, a substantial difference ($P < 0.1$) was found between private and public companies in green supply chain initiatives.

Table 10.13: Ratios (%) of Indian companies reporting different CEM initiatives

	Manufacturing			Service/Others			Total		
	Private	Public	Total	Private	Public	Total	Private	Public	Total
Green supply chain initiative	11.7	0	9.1	10.5	0	5.7	11.2	0	7.5
Greening operations	86.7	76.5	84.4	55.3	25.0	41.4	74.5	42.9	64.0
Climate change initiative	11.7	5.9	10.4	10.5	6.3	8.6	11.2	6.1	9.5
Renewable energy initiative	21.7	41.2	26.0	7.9	34.4	20.0	16.3	36.7	23.1

6.3 Discussions

There were several interesting findings and implications from the survey results.

Firstly, the manufacturing sector was found overall to have a higher EID level than the service/others sector in India. In particular, the EID level of greening operations and renewable energy initiatives among service companies appeared to be considerably lower than that of the manufacturing sector. This finding was in line with a survey targeting companies in Canada conducted by Henriques and Sadorsky (1996), which concluded that the service sector is less likely than the manufacturing sector to have environmental plans. This could be simply due to the nature of the two sectors. In general, the manufacturing sector consumes more energy and emits more pollutants, and is thus relatively more sensitive to environmental issues. However, further research is needed to confirm the reasons behind this trend and the similarities between different countries.

Secondly, public companies seem to be relatively reluctant to practice EID compared with private companies, with the exception of renewable energy initiatives. The EID level for green supply chain initiatives among private companies was substantially higher than that among public companies. Green supply chains have the potential to improve not just the environmental

performance of the implementing company, but also the performance of other agents in the supply chain. For example, quality and delivery of products and services of companies both upstream and downstream can be improved through cross-fertilisation of knowledge and know-how (Vachon and Klassen, 2006). Further investigation of this point is also suggested, as it bears special relevance to India, whose priority is generally given to economic development rather than environmental issues.

7. Survey on drivers for and barriers to CEM

In order to confirm the drivers for and barriers to CEM in India, a questionnaire was issued to 60 senior executives and mangers from the different industries.

7.1. Methods

The questionnaire was issued to 60 senior executives and managers from different industries in both manufacturing (e.g. IT hardware, chemical and pharmaceutical and petrochemicals) and services (e.g. software services, banking and consulting) through the Indian Institute of Management in Bangalore. Four major topics surveyed were: (i) Drivers for CEM; (ii) Barriers to CEM; (iii) Important stakeholders; and, (iv) Means of increasing environmental performance. Drivers for CEM were further categorised into six different risks. These were: (i) Operational risk; (ii) Competitive risk; (iii) Transaction risk; (iv) Capital cost risk; (v) Market risk; and (vi) Regulatory risk. There were 65 questions in total, all with choices ranging from 1 to 5 Likert scale as seen in Fig.10. 10.

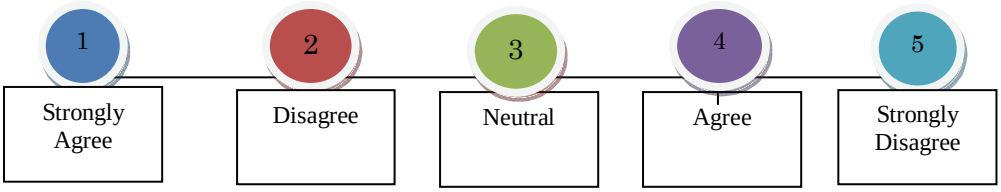


Fig.10.10: A 1-to-5 Likert scale used for the survey on drivers for and barriers to CEM.

7.2. Results

The results of the survey are summarised in Tables 10.14-17.

7.2.1. Drivers for CEM

The results for drivers for CEM are summarised in Table 10.14. *Corporate reputation/image* (related to market risk) and *greater regulatory oversight and control* (related to operational risk) received high scores, with mean values of 4.08 and 4.03 respectively. By contrast, mean values of competitive risk and transaction risks were substantially lower than the other types of risk. The category which received the highest capital cost risk was *pollution control expense*, whereas *increased enforcement* received the highest mean value amongst regulatory risks.

7.2.2. Barriers to CEM

The results “or barriers to CEM are summarised in Table 10.15. The only item which received a mean value of more than 3 was *lack of adequate staff* (mean value = 3.29).

7.2.3 Important stakeholders

The results for important stakeholders are summarised in Table 10.16. The only items which

received a mean value of 4 or more were *top management* and o*fficials of environmental agencies*, with scores of 4.28 and 4.00 respectively.

7.2.4 Means of increasing environmental performance

The results for effective means of increasing environmental performance are summarised in Table 10.17. The items which received a mean value of 4 or more were *training and education, improved law and enforcement, more information on environment* and *co-operation with external stakeholders*; 4.39, 4.05, 4.00 and 4.00, respectively.

Table 10.14: Survey results for drivers of CEM

	Scale					Mean	N
	1	2	3	4	5		
Operational Risk							
Greater regulatory oversight and control	1	3	6	10	16	4.03	36
Increased cost of operations	1	2	9	18	9	3.82	39
Increased input costs	1	3	13	16	6	3.59	39
Negative impact on employee morale and productivity	9	6	10	9	5	2.87	39
Customer retaliation	7	7	13	6	7	2.98	40
Stakeholder action	4	1	15	12	8	3.48	40
Action by NGOs	5	1	12	12	10	3.53	40
Actions by shareholder/financial institutions	3	7	19	4	7	3.13	40
Protest from neighbouring communities	4	5	10	9	11	3.46	39
Sub-total	35	35	107	96	79	3.42	352
Competitive Risk							
Customer boycott	11	7	9	7	6	2.75	40
Missed opportunities	5	5	8	16	5	3.28	39
Appearance of substitute products	6	7	9	10	6	3.08	38
Increase in potential financial liability	1	8	8	15	7	3.49	39
Damage to corporate reputation	4	2	5	17	12	3.78	40
Product liability claims	3	7	10	11	8	3.36	39
Sub-total	30	36	49	76	44	3.29	235
Transaction Risk							
Supply chain disruptions	8	6	10	8	6	2.95	38
Delayed or cancelled acquisitions and divestiture	0	2	2	3	2	3.56	9
Sub-total	8	8	12	11	8	3.06	47
Capital Cost Risk							
Pollution control expense	4	4	9	10	12	3.56	39
Product redesign cost	3	4	9	15	8	3.54	39
Insurance	3	6	11	8	10	3.42	38
Sub-total	10	14	29	33	30	3.51	116
Market Risk							
Corporate reputation/image	2	0	9	11	18	4.08	40
Loss of social legitimacy	3	2	11	12	11	3.67	39
Customer avoidance/boycott	6	5	13	10	6	3.13	40
Depressed stock prices	6	3	14	8	8	3.23	39
Sub-total	17	10	47	41	43	3.53	158
Regulatory Risk							
Increasing stringency of regulations	4	2	6	16	11	3.72	39
Increased enforcement	4	1	9	11	14	3.77	39
Increased potential for criminal persecution	6	5	9	8	9	3.24	37
Fines by enforcement agency	5	4	11	7	11	3.40	38
Shutdown of the business	9	7	10	4	9	2.92	39
Sub-total	28	19	45	46	54	3.41	192
Total	128	122	289	303	258	3.40	1100

Table 10.15: Survey results for barriers to CEM

	Scale					Mean	N
	1	2	3	4	5		
Weak environmental awareness among staff	9	5	10	8	6	2.92	38
Lack of capital	14	9	7	6	3	2.36	39
Lack of technology	13	5	7	9	4	2.63	38
Lack of information	10	10	6	7	5	2.66	38
Lack of adequate staff	6	6	7	9	10	3.29	38
Lack of supply chain capability	13	8	11	2	3	2.30	37
Total	65	43	48	41	31	2.69	228

Table 10.16: Survey results for important stakeholders

	Scale					Mean	N
	1	2	3	4	5		
Officials of environmental agencies	4	1	4	10	18	4.00	37
Shareholders	2	2	8	10	16	3.95	38
Top management	1	1	4	13	20	4.28	39
Employees	4	0	8	10	16	3.89	38
Domestic customers	2	5	11	9	11	3.58	38
Suppliers	4	4	13	10	7	3.32	38
International customers	2	7	7	6	15	3.68	37
Neighbouring communities	2	2	7	12	15	3.95	38
NGOs	6	6	8	6	10	3.22	36
Media	2	5	5	9	16	3.87	37
Industry associations	1	8	8	10	11	3.58	38
International agencies	4	3	9	13	10	3.56	39
Total	34	44	92	118	165	3.74	453

Table 10.17: Survey results for means of increasing environmental performance

	Scale					Mean	N
	1	2	3	4	5		
Improved law and enforcement	1	3	4	15	15	4.05	38
Allocated fund/subsidy	1	5	7	12	12	3.78	37
Cheaper loans and credits	3	7	11	10	7	3.29	38
Support for environmental management system	2	3	7	11	15	3.90	38
More information on environment	1	3	8	9	17	4.00	38
Training and education	0	2	4	10	23	4.39	39
Co-operation with external stakeholders	1	1	10	11	15	4.00	38
Shift in consumer preference to greener products	4	5	5	11	11	3.56	36
Total	13	29	56	89	115	3.87	302

7.3 Discussions

There were several interesting findings and implications from the survey results.

First, legal risks appear to be important drivers for CEM. Greater regulatory oversight and control, increasing stringency of regulations and increased regulatory enforcement all received significantly high scores. The results of questionnaires regarding stakeholders and means of increasing environmental performance also supported this finding. Officials of environmental agencies were considered to be some of the most influential stakeholders, and improved law and enforcement was considered to be the most important means of increasing environmental performance of the companies. Thus, legal risks were strongly implied to be the important drivers for proactive CEM in India.

Second, as a driver for CEM, market risks, particularly corporate reputation/image received significantly high score. This may explain why private companies were more proactive in EID

activities compared to public companies as revealed in Section 6. That is, since private companies are relatively more sensitive to various market risks in general, market risks could be influencing private companies more, which results in a difference in the level of CEM initiatives between the two sectors. In addition, interestingly, market risks were also found to be one of the important determinant factors in the Thai study as well.

Third, adequate staffing was also one of the important factors contributing to proactive CEM in India. The lack of adequate staff received the highest score in the survey investigating barriers to CEM, while top management received the highest score in the survey regarding companies' most important stakeholders. Moreover, training and education received the highest score as an effective means of increasing environmental performance among companies. These findings were confirmed in our interview (conducted on 16 November, 2009 in Bangalore) with Mr. Gupta of the Green initiative Group of Infosys, an IT company considered to be one of the most environmentally proactive companies in India. Mr. Gupta asserted that the mindset of top management is the most significant factor driving environmental activities in Infosys. Mr. Gupta particularly noted the significant role played by Mr. Nandan Nilekani, the former co-chairman of the company.

In addition, environmental information was also found to be considered important in increasing the environmental performance of the Indian companies.

8. Conclusions and recommendations

The state of proactive CEM in India is complex, as can be seen above. The conditions and the level of CEM initiatives appear to be determined by various factors including sectors and business characteristics. A given driver might significantly promote CEM activities in one sector while being much less effective in another sector. For example, market-based instruments could work for privately-owned companies; however, they may not work for publicly-owned companies. Therefore, strategies to further enhance proactive CEM in India should carefully consider this complexity.

Several potential drivers and barriers regarding proactive CEM initiatives were revealed through the set of surveys we conducted. Legal risks appear to be significant drivers, while the lack of adequate staff, including top management, seemed to be an important barrier. In addition, the results implied that corporate reputation (as a market risk) and international supply chains exert substantial influence on CEM. Environmental information was also found to be considered important in increasing the environmental performance of companies. This implied the potential effectiveness of EID-related strategies in India. However, considering the aforementioned significance of both legal and market risks as drivers for CEM, EID policy should be utilised not as a standalone policy, but rather as one component of a policy mix that includes command and control and market-based instruments. In addition, as mentioned above, there is no silver bullet for enhancing proactive CEM initiatives among Indian companies; characteristics of the target sectors and businesses should be considered carefully, and strategies should be adjusted to match these characteristics.

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Section IV:

CEM Policy Studies in Thailand

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Chapter 11: CEM policy studies in Thailand

1. Country profile and industrial portfolio

1.1 Country profile

Before 24 June 1939, also between 1945 and 11 May 1949, Thailand was named Siam. Currently, the official name of the country is "The Kingdom of Thailand", which shortens to "Thailand". As depicted in Fig.11.1, Thailand is located in South-East Asia, covering an area of nearly 513,115 square kilometers. It shares land borders with Myanmar in the north and west, the Andaman Sea in the west, Laos in the north and north-east, Cambodia and the Gulf of Thailand in the east, and Malaysia in the south.

Fig.11.1: Map of Thailand.

Thailand is divided into four geographical regions: Central (including Bangkok), Northern, Northeastern and Southern Thailand. The country also has an Eastern Region which is often included into the Central Region. The country has 76 provinces, and Bangkok is the capital. In 2009, the population of Thailand was about 65,905,410 people. They are of different ethnic groups - Thai: 75%, Chinese: 14%, and other: 11%, and of different religions – Buddhists: 95%, Muslims: 3.8%, Christians: 0.5%, Hindus: 0.1%. Thai is the national language; however English and Chinese newspapers are available.

Before the severe economic crisis that hit Thailand in 1997, the country had very high economic growth rates that stood around 9% annually between 1985 and 1995. Under the government of Thaksin Shinawatra, the economy recovered quickly with growth rates ranged

from 5% to 7%. The growth rate in 2007 was 4.9% and 2.75% for 2008 (Thaiwebsites.com). In the first 6 months of 2009, it decreased 6.0 % compared with the first 6 months of 2008, mirroring the global economic downturn (NSO home page).

1.2 Industrial portfolio

Since the first National Economic and Social Development Plan (NESDP) came into force in 1961, Thailand has been restructuring its economy from being agriculture-based to being industry-based. The share of the agriculture sector in GDP fell from 37% in 1961 to around 10% recently. As for 2008, the contribution of different sectors to GDP was as follows: Agriculture: 11.4 %; Industry: 44.5 %; Service: 44.1% (CIA world fact book home page).

Major Thai industries are: Tourism, textiles and garments, agricultural products, beverages, tobacco, cement, jewelry, electric appliances and components, computer and computer accessories, integrated circuits, furniture, plastics, and tin (Thaiwebsites.com).

Exports play a determinant role in Thai economic growth. they account for more than two thirds of Thai GDP. During 2007 and 2008, they amounted to 150.05 billion US dollars and 175.3 billion US dollars respectively. The majority of this value is accounted for by the following: machinery and mechanical appliances (15%), electrical apparatus (10.6%), vehicles, parts and accessories (8.5%), and electrical appliances (7.7%). Although a large proportion of the population is still working in agriculture, agricultural products account only for 9.2% of total export value (National statistics Office home page).

In Thailand, household industries and small and medium enterprises (SMEs) account for around 99% of all Thai enterprises in number, and generate more than 50% of total Thai GDP (OSMEP home page).

According to the National Statistical Office (NSO) and Ministry of Information and Communication Technology (MICT), a household industry is defined as one which manufactures any product, for sale and/or use, at any building owned by household such as a house, kitchen, garage, etc. The number of workers in most household industries is below 10 people, who can be either employees or members of the household. In 2004, the number of household companies in Thailand was around 840,000 and the total number of workers was around 1.8 million.

Most of Thai household industries are located in the North Eastern region of the country (Table 11.1). Recently, their number has been decreasing across all regions. It has decreased from 1,186,007 in 1999 to 843,273 in 2004 (NSO, 2005).

As listed in Table 11.2, weaving, garments and leather products as well as food and beverages account for the most household industries. In Thailand in 2004, the share of weaving garments and leather products was 39.3%, and the share of food and beverages was 22.2%

Table 11.1: Number and share of Thai household industry across regions

Region	Number			Share (%)		
	1999	2001	2004	1999	2001	2004*
Central	146,346	126,528	172,739	12.3	10.8	20.5
Northern	244,201	239,385	227,602	20.6	20.4	27.0
North Eastern	533,476	482,180	343,332	45.0	41.1	40.7
Southern	261,984	325,604	99,599	22.1	27.7	11.8
In total	1,186,007	1,173,697	843,272	100.0	100.0	100.0

Note: The data includes small industries other than household industry.
Source: (NSO, 2005)

Table 11.2: Share of household industry across manufacturing sectors

Manufacturing sector	Share (%)		
	1999	2001	2004 *
Food and beverages	16.3	17.2	22.2
Weaving, garments and leather products	38.1	32.4	39.3
Wood and wooden products, excluding furniture	17.5	19.7	17.2
Paper and its product	0.3	0.6	1.3
Chemicals, rubber and plastics	17.8	22.8	1.1
Mineral products	2.1	1.3	3.7
Refined steel, machinery and spares	2.9	1.9	6.0
Other manufacturing, including furniture	5.0	4.1	9.2
In total	100.0	100.0	100.0

Note: The data includes small industries other than household industry
Source: (NSO, 2005)

On September 11, 2002, the Thai Ministry of Industry defined SMEs based on their nature of business (sector), number of employees, and value of fixed assets. Consequently, an enterprise is categorized as small and medium enterprise (SME) if it has fewer than 200 employees and a value of fixed assets below 200 million Baht, excluding land and properties (see Table 11.3).

Table 11.3: Definition of Thai small and medium enterprises

Sector	Small enterprise		Medium enterprise	
	Number of Employees	Fixed Asset (million baht)	Number of Employees	Fixed Asset (million baht)
Production	Not more than 50	Not more than 50	51-200	51-200
Trading				
-Wholesale	Not more than 25	Not more than 50	26-50	51-100
-Retail	Not more than 15	Not more than 50	16-30	31-60
Service	Not more than 50	Not more than 50	51-200	51-200

Source: OSMEP home page.

The number of SMEs has increased from 2.19 million in 2004 to 2.27 million in 2006, and reached 2.42 million in 2009. The number of SMEs and their share across sectors and over time are reported in Table 11.4. About 40% of total Thai SMEs belong to wholesale and retail trade,

repair of motor vehicles and motorcycles, and personal and household goods activities. About 30% of SMEs belongs to the manufacturing sector. SMEs generate around 40% of total Thai GDP. They are hiring about 66% of total employees in the country, of which about 70% of them are in the manufacturing sector. In 2009, the number of employees in SMEs was around 8.91 million (OSMEP homepage).

Table 11.4: Number of SMEs and their share across sectors during 2004-2006

Business sector	Year					
	2004		2005		2006	
	Number	Share of SMEs in the sector	Number	Share of SMEs in the sector	Number	Share of SMEs in the sector
Agriculture						
Agriculture, hunting and forestry	3,183	98.8	3,564	98.9	3,826	98.7
Fishing	409	99.8	439	99.8	417	99.3
Non-agriculture						
Mining and quarrying	4,459	98.7	4,549	98.7	4,540	98.2
Manufacturing	682,550	99.7	686,898	99.7	662,742	99.6
Electricity, gas and water supply	1,325	98.7	1,366	98.5	826	97.9
Construction	85,176	99.7	91,064	99.7	88,832	99.7
Wholesale and retail trade, repair of motor vehicles and motorcycles, and personal and household goods	865,906	99.8	878,020	99.8	908,846	99.7
Hotel and restaurants	166,524	99.9	168,082	99.9	170,354	99.7
Transport, storage and communication	98,947	99.8	101,626	99.8	103,457	99.7
Financial intermediation	12,066	98.2	12,256	98.3	17,517	97.9
Real estate, renting and business activities	137,423	99.5	148,559	99.5	175,021	99.5
Education	1,513	99.3	1,793	99.4	3,561	99.7
Health and social work	4,924	98.4	5,124	98.5	5,905	97.6
Other community, social and personal service activity	114,667	99.9	115,528	99.9	110,873	99.9
Private household with employment person	3	100.0	3	100.0	101	100.0
Unknown	20,055	81.8	20,198	81.9	17,707	79.6
In total	2,199,130	99.5	2,239,069	99.5	2,274,525	99.4

Source: (OSMEP, 2007a)

1.3 Environmental problems raised by SMEs

1.3.1 Energy consumption of SMEs

In 2006, the Office of Small and Medium Enterprises Promotion (OSMEP) conducted a survey on the impacts of rising energy prices on SMEs based on data from 2005. There were 256 SMEs belonging to 24 sectors (based on The International Standard Industries Classification [ISIC] categorization) which participated in the survey. As indicated in Table 11.5, the result of the survey showed that the top five industries that have the highest average percent of energy cost per production cost are: manufacture of refractory ceramic products (ISIC 26920), manufacture of macaroni, noodles, couscous and similar farinaceous products (ISIC 15440),

manufacture of non-structural non-refractory ceramic ware (ISIC 26910), processing/preserving of fish (ISIC 15121), and tanning and dressing of leather (ISIC 19110) in descending order.

Table 11.5: Average of energy cost per production cost, and per product value across sectors

Sector	ISIC categorization	Average of energy cost per production cost (%)			Average of energy cost per product value (%)		
		SE	ME	SME	SE	ME	SME
Production Sector	Manufacture of refractory ceramic products	47.21	-	47.21	40.91	-	40.91
	Manufacture of macaroni, noodles, couscous and similar farinaceous products	22.70	-	22.70	20.24	-	20.24
	Manufacture of non-structural non-refractory ceramic ware	27.07	17.60	22.34	20.53	12.95	16.74
	Processing/preserving of fish	21.25	-	21.25	20.51	-	20.51
	Tanning and dressing of leather	14.75	-	14.75	13.33	-	13.33
	Manufacture of starches and starch products	-	13.35	13.35	-	12.40	12.40
	Processing/preserving of meat	15.81	6.70	11.25	7.51	4.59	6.05
	Manufacture of plastics in primary forms and of synthetic rubber	15.00	7.03	11.01	12.47	5.65	9.19
	Manufacture of grain mill products	11.52	8.36	9.94	9.69	6.70	8.19
	Preparation and spinning of textile fibers; weaving of textiles	15.22	2.96	9.09	2.87	2.37	2.62
	Finishing of textiles	15.62	1.15	8.38	11.38	0.92	6.15
	Manufacture of plastics products	5.41	7.89	6.65	4.32	7.38	5.85
	Manufacture of bakery products	6.04	-	6.04	4.53	-	4.53
	Manufacture of wearing apparel, except fur apparel	1.45	3.42	2.43	1.10	2.23	1.66
Trading Sector	Retail sale of textiles, clothing, footwear and leather goods	10.65	1.00	5.83	7.08	0.39	3.37
	Retail sale in non-specialized stores with food, beverages or tobacco predominating	7.27	1.15	4.12	5.23	1.07	3.15
	Wholesale of construction materials, hardware, plumbing and heating equipment and supplies	3.49	1.04	2.27	2.52	0.93	1.72
	Wholesale of agricultural raw materials and live animals	3.09	0.74	1.91	2.23	0.70	1.46
	Retail sale of household appliances, articles and equipment	1.47	1.57	1.52	1.14	1.09	1.11
	Retail sale of automotive fuel	0.63	-	0.63	0.59	-	0.59
Service Sector	Hotels and restaurants	20.71	30.51	25.61	15.31	18.05	16.68
	Building of complete constructions or parts thereof	27.48	24.73	26.10	24.59	21.66	23.13
	Supporting and auxiliary transport activities; activities of travel agencies	17.27	23.92	20.60	12.55	14.18	13.36

Source: (OSMEP, 2007b)

Energy consumption within the trading sector is lower than within the production, and service sectors. In the trading sector, businesses that have the highest average ratio of energy cost to

production cost are related to the retail sale of textiles, clothing, footwear and leather goods (ISIC 52320). However, in service sector, businesses that are related to building of complete constructions or parts thereof (ISIC 45200) have the highest average of energy cost per production cost.

1.3.2 Wastes and hazardous wastes from SMEs

There is no available data regarding the quantity of waste and hazardous waste generated solely by SMEs. However, information is available for the amount of waste and hazardous waste generated by Small and Medium Industries (SMIs) which are a sub-group of SMEs. In 2006, SMIs generated around 1.6 millions tons of non-hazardous wastes. The iron and steel, non-ferrous base metals, furniture, and woodwork industries account for around 50% of this waste. As for hazardous waste, the quantity generated by SMIs during the same year was around 0.22 million tons. Iron and steel, non-ferrous base metals, plastic products, petroleum and chemical products, electric products, and metal products industries generate around 70% of hazardous waste. SMIs account for around 19% of the non-hazardous waste and around 15% of the hazardous waste generated by the industrial sector (Table 11.6).

Table 11.6: Non-hazardous and hazardous wastes generated by SMIs

Type of waste	SMIs	Industrial sector	Share of waste generated by SMIs (%)
Non-hazardous waste (tons)	1,640,522,56	8,684,653.29	18.89
Hazardous waste (tons)	228,726.33	1,558,743.20	14.67

Source: JICA and Kokusai Kogyo Co., Ltd. 2002

2. Overview of national CEM policies in Thailand

Generally, Thailand creates all national policies based upon the National Economic and Social Development Plan (NESDP). Based on the framework and strategic issues of the NSDP, as well as natural resources and environmental strategies of the Ministry of Natural Resources and Environment, other plans are implemented such as the Environmental Quality Management Plan (2007-2016) and the Enhancement and Conservation of the National Environmental Quality Policy and plan B.E. 2540-2559 (1997-2016). As for corporate environmental management (CEM), it has gained more and more attention from the government in recent years and was represented the last four NESDP (the 7^{th}, 8^{th}, 9^{th}, and 10^{th}). Regarding regulatory measures, many acts have been promulgated to control and monitor the activities of Thai companies in term of wastewater management, waste management, energy conservation, and so on. In addition to regulatory measures, the Thai government has also used market-based instrument, and other governmental programmes to promote CEM activities.

2.1 Regulatory measures to promote CEM

The Thai government has promulgated many acts to control and monitor the activities of Thai companies in term of wastewater management, waste management, and energy conservation.

As for wastewater, the Factory Act B.E. 2535 (1992) prohibits factories from discharging wastewater that does not meet standards unless they have carried out an appropriate treatment (not dilution). It also enforces factories to make six-month report on types and quantities of their discharged pollutants, and to submit the report to the Department of Industrial Works (DIW). The Public Health Act B.E.2535 (1992) also requires all factories to control and treat wastewater in terms of odor, light, radiation, sound, heat, hazardous substances, vibration, dust, and poisonous tar/ash, and allows local authorities to control and manage breaches of the law.

As for waste, the Factory Act B.E 2535 (1992) requires a company to be registered under one of the following categories: waste generator, waste transporter or waste disposal facility. It requires all facilities to declare and report the movements of wastes and unused materials, hazardous and non-hazardous, to the DIW. The Industrial Estate Authority of Thailand Act B.E 2522 (1979) gives authority to the Industrial Estate Authority of Thailand (IEAT) to control and monitor the activities of factories regarding wastes, hazardous wastes and unused materials. The definition and nature of hazardous materials are provided in the Hazardous Substance Act B.E. 2535 (1992), which was also promulgated to control and monitor the import, export, production, sale, transportation, storage, disposal and treatment of hazardous materials. Regarding industrial waste, the Public Health Act B.E. 2535 (1992) requires all factories to control and manage garbage and waste in terms of odour, light, radiation, sound, heat, hazardous substances, vibration, dust and poisonous tar/ash, and allows local authorities to control and breaches of the law.

With regard to energy conservation, the Energy Conservation Promotion Act B.E. 2535 (1992) gives authority to the National Energy Policy Council to supervise energy conservation policies, targets and plans, and energy conservation operational guidelines. The Act prescribes regulations regarding energy consumption in factories. The Act also specifies which factories have to conserve energy, undergo energy audits and analyse their energy consumption. In addition, it requires the owners of designated factories to submit information of energy production, consumption and conservation, as well as to keep records of energy consumption activities. To achieve the stated goals, the Act also establishes the Energy Conservation Promotion Fund, which was established in order to provide working capital, grants and subsidies to support energy conservation programmes and activities. The owner of any designated factory is obligated to make contributions to the Fund at rates set by the council.

2.2 Market-based incentives to promote CEM

In addition to regulatory measures, the Thai government has used market-based instruments to promote CEM activities. Taxation, subsidies, awards and other incentives are outlined hereafter.

Taxation

Ttax exemption, tax differentiation and tax reduction have been used to promote CEM. Tax exemption takes place to reduce environmental management costs. For example, imported equipment related to the treatment of pollution and waste, environmental conservation and pollution prevention is exempted from taxes. Environmental experts and environmental international experts who travel to the country for installing, inspecting, controlling, and running environmental controlling systems are also exempted from income taxes. Tax differentiation refers to the fact that charged taxes depend upon the level of pollution generated by the production process. The more pollution is generated, the higher the taxes. Tax reduction is applicable in the case of energy saving. The condition to receive this benefit is to reduce consumption of electricity. Factories have to reduce the consumption of electricity by the designated rate and submit the proof of reduction (electricity bills) to the Office of Technology Promotion and Transfer under the Ministry of Science and Technology.

Subsidies

There are two kinds of subsidy measures: supporting funds and allocated loans. Private companies are eligible only for allocated loans, which are low interest loans used for establishing environmental treatment facilities, especially for air and wastewater treatment.

Awards

Award programmes are supporting tools aiming not only to reward the entrepreneurs who have contributed to improve the environmental performance of their companies, but also to increase awareness among other entrepreneurs and persuade them to take initiative with regard to environmental management. One of the most well known awards is the Prime Minister Award, which is conferred by the Department of Industry Promotion and awarded by the Prime Minister.

Green procurement

The government is a large purchaser in the country and it has established a green procurement programme, to promote CEM in general and especially to enhance the greening of supply chains. This is achieved through the setting of environmentally- friendly purchasing criteria for products and services. Although the green procurement programme was declared to be expanded to all governmental agencies, it is still limited only to some of them (Pollution Control Department. 2009).

2.3. Other governmental programmes to promote CEM.

The Thai Government is also providing energy audit programmes and establishing pilot projects to promote CEM activities.

Providing energy audit programmes

Audit programmes and consultation assistance are provided for the promotion of energy efficiency and energy management within the industrial sector. Many of these activities are provided to factories by governmental departments under the Ministry of Industry and the Ministry of Energy. The programmes are usually free or low-cost using governmental budgets.

Establishing pilot projects to promote waste management

The Pollution Control Department (PCD) initiated pilot projects in order to promote the Polluter Pays Principle (PPP), Extended Producer Responsibility (EPR) and waste management. One of the pilot projects related to waste is the recalling of fluorescent light bulbs. This pilot project requires co-operation between PCD and fluorescent light bulb producers. Various governmental buildings participated in this project by returning fluorescent light bulbs to their producers.

The Industry Waste Exchange Program is another pilot project to exchange wastes between industries. The concept is that waste of one industry can be used as raw materials by another industry. Both suppliers and purchasers can benefit from this activity. Suppliers can cut off their waste disposal cost, and purchasers can have raw materials with lower prices. Participating factories can benefit of database of the Ministry of Industry to match wastes and raw material.

Eco-town is another project created by IEAT and the Ministry of Industry in order to effectively manage the waste of factories in specific industrial estates. The pilot project was implemented in five industrial estates namely: Map Tha Phut, Bang Poo, Northern Region, Eastern Seaboard and Amata Nakhorn.

3. Current status and challenges of CEM in Thailand

Environmental management in Thailand was mainly conducted by government agencies through command and control mechanisms up to 1992. Policy-makers have implemented different laws and regulations and kept revising and updating them from time to time to respond to national and international economic and environmental changes. Starting from 1992, some proactive initiatives with regard to environmental management took place within the private sector and marked the starting point of a public-private joint effort to deal with environmental issues. These proactive initiatives have increased in scope and number especially after 1995. From this date, a multi-stakeholder approach to deal with environmental issues has become more evident. There has been more involvement from non-governmental

institutions such as those within the private sector, Non Governmental Organisations (NGOs), communities and academic institutions, aiming to combat climate change and drive the business sector to achieve more sustainable development. While proactive CEM initiatives have increased in number, their implementation has been limited to large and multinational companies. Initiatives are mainly related to Environmental Management System (EMS), Cleaner Production (CP), Corporate Social Responsibility (CSR), Life Cycle Assessment (LCA), Corporate Environmental Information Disclosure (CEID) and Green Supply Chain Management (GSCM). While the first four practices are briefly outlined in the section below, the last two practices, namely CEID and GSCM, will be assessed in separate sections.

3.1 Environmental Management System (EMS) and ISO 14001

The number of businesses certified with ISO 14001 has been increasing remarkably over last years (Fig.11.2). As of March 2009, the total number of certified companies with ISO 14001 reached 1,542.

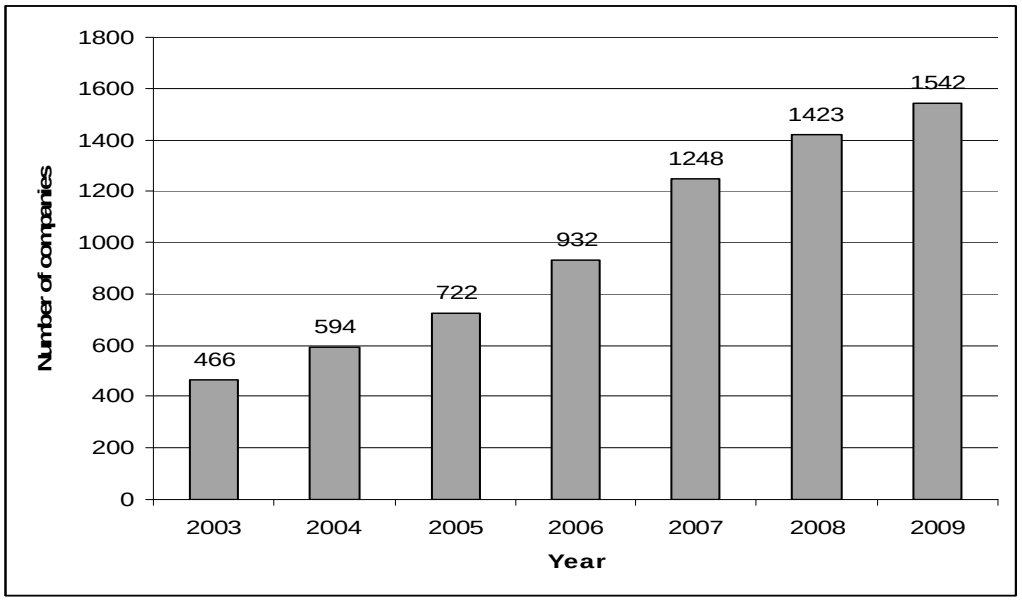

Fig.11.2: Number of Thai companies certified with ISO 14001 standards
Source: (TISI, 2008a)

Thailand is ranked first among members of the Association of Southeast Asian Nations (ASEAN) for having the highest number of certified companies compliant with ISO_140001 standards and is in sixth place in Asia, namely after Japan, China, Republic of Korea, India, and Taiwan. As depicted in Fig.11.3, large numbers of certified companies (approximately 1,300) belong to the manufacturing and related sectors. They represent more than 80% of total certified companies. The rest of the certified companies belong to service sectors such as hospital (1.43%), education (2.33%), public administration (0.71%), transport and supporting activities (4.22%), and wholesale and retail trade (3.70 %).

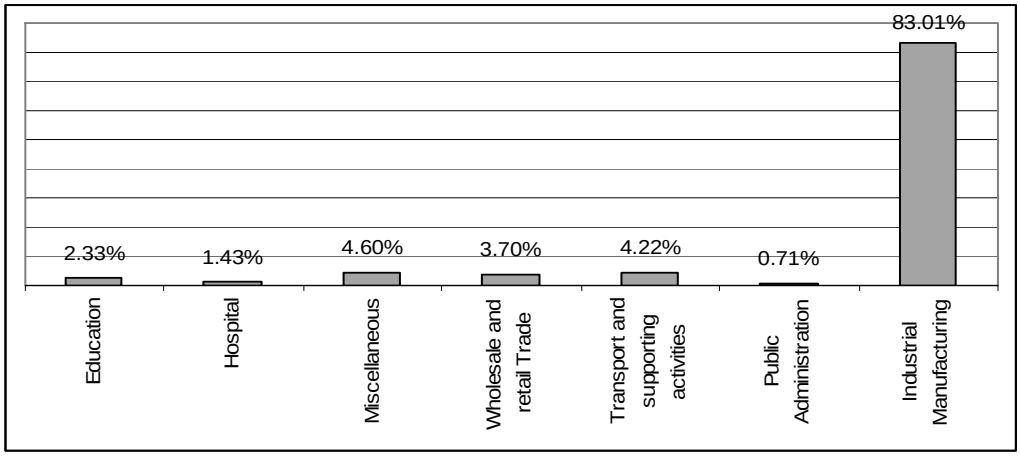

Fig.11.3: Share of each sector of total certified companies with ISO 14001 (Source: TISI, 2008b).

Besides promoting companies to accredit international standards such as the ISO 14001 certification, Thai governmental agencies established a national EMS standard targeting Thai SMEs. The programme is known as EMS for SMEs. It is considered to be the first and the only project to deal fully with environmental management in SMEs. The project started in 2002 and initially focused on factories located in six provinces: Suphanburi, Nakhonpathom, Samutsakhon, Songkhla, Phatthalung and Nakhonsithammarat. They are situated in two important river basins namely Songkhla River Basin (located in the Southern region) and Tajeen River Basin (located in the Central region). Recently, the project was extended to SMEs located in the central and northern regions of the country. The core responsible governmental agencies for the project are: the DIW, The Thai Industrial Standards Institute (TISI), and OSMEP.

The DIW designed the implementation guide of EMS for SMEs to be compatible with international environmental standard ISO 14001. The EMS for SMEs programme allows SMEs who can not be certified with ISO 14001 to get a first-step certification or second-step certification according to their environmental performance (Fig. 11.4 and 11.5).

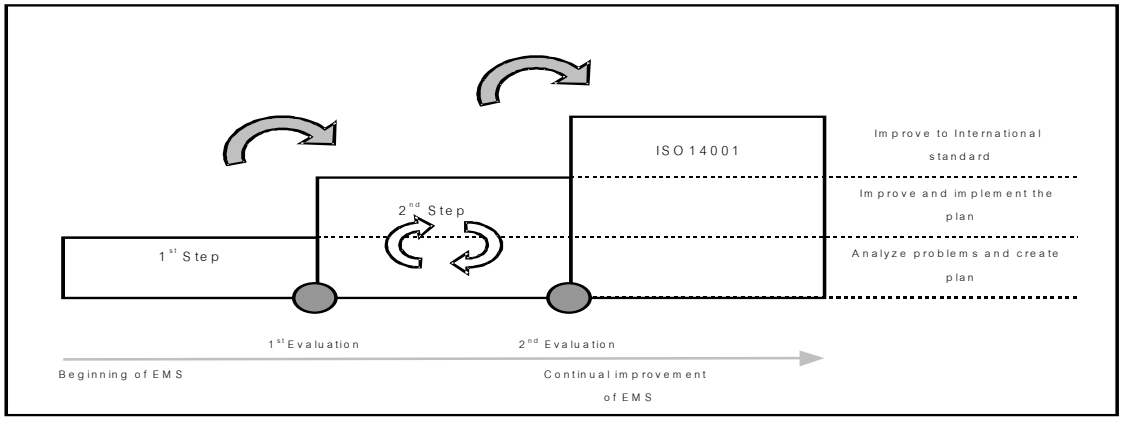

Fig.11.4: Overview of EMS's implementation in SMEs (Source: DIW, 2004).

External evaluation by a team from the DIW is required for both steps. Evaluation for companies certified with the first step is yearly, so that they can move to the second step in the next evaluation if they comply with the requirements. However, evaluation for companies certified with the second step is every two years. Companies certified with the second step certification can renew their certification after evaluation if they still comply with the requirement.

According to Mr. Rintawat Sombutsiri, Engineer at the Bureau of Water Technology and Industrial Pollution Management (DIW), the EMS for SMEs certification was obtained by 115 enterprises, where 85 enterprises obtained the first step certification and 30 enterprises obtained the second step certification.

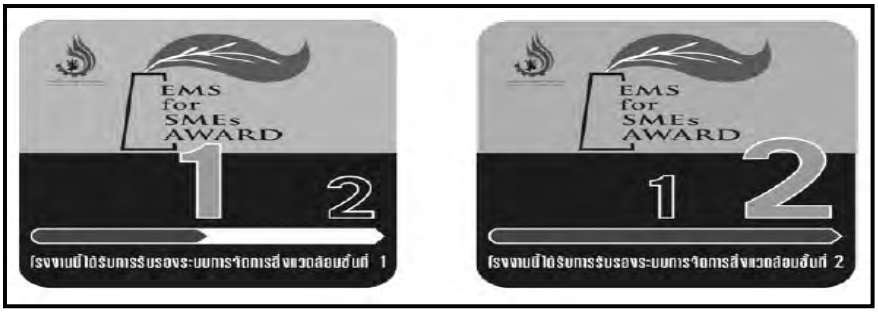

Fig.11.5: Logos of the first and second step certifications on EMS for SMEs (Source: DIW, 2004)

3.2 Cleaner Production (CP)

Since the beginning of 1990s, activities concerning CP practices have taken place and were mainly devoted to capacity building through educating and developing human resources on CP. In 2002, the PCD developed and implemented the National Master Plan on Cleaner Production to promote CP activities. Main strategies for implementing the plan are listed below:

-Modifying laws and regulations to be compatible with CP promotion. This strategy incorporates measures to add/modify/edit laws and regulations regarding CP promotion, to enhance participation of local authorities in CP, to promote green procurement, to revise methodologies for preparing and considering Environmental Impact Assessment (EIA), and to promote energy efficiency and waste reduction in the governmental sector.

-Revising policies and budget allowances for promoting CP. This strategy involves prioritizing all plans relevant to CP; increasing the number of CP projects in annual implementation plans of governmental departments and local authorities; indicating CP as a condition to consider for annual allotted budgets, supporting budgets, and loans for governmental projects; supporting special budget for CP implementation; and allocating budget and supporting finance for improving personnel, teaching, and R&D for CP.

-Promoting CP to be implemented in the industry, agriculture, travel and service, household and community, education, and R&D sectors. The strategy deals with producing Code of Practice and implementation handbooks for CP in industry, agriculture, and travel and service sectors; verifying and certifying parties implementing CP; registering CP auditors; supporting knowledge and finance for proceeding CP implementers; supporting the use of other environmental management tools; building up green finance; and establishing CP disseminating networks and centres.

The DIW, the PCD, the Federation of Thai Industries (FTI) and the Thailand Environment Institute (TEI) are examples of institutions that are government agencies, non-government agencies and research institutions implementing CP activities. In the industrial sector, more than 2,000 companies (in more than 34 industrial types of industry) have implemented CP by participating in more than 30 types of CP activity. In the service sector, more than 40 hotels and hospitals are engaged in CP activities and have developed CP handbooks about their activities.

At the enterprise level, mainly multinational and large enterprises are engaged in implementing CP practices. These enterprises are working together with FTI and the Thailand Business Council for Sustainable Development (TBCSD) on environmental performance evaluation, supply chain greening, and benchmarking. They are also working with governmental and non-governmental agencies to promote CP practices among SMEs, especially on energy management issues. The DIW estimated that more than 1,000 SMEs are already implementing CP practices. Many industrial sectors, such as dairy, canned food, frozen food, palm oil and rice mill participated in CP pilot projects with the DIW in order to set up good practices as a showcase on pollution prevention and cleaner technology. Furthermore, SMEs participated in pilot projects created by PCD and Department of Environmental Quality Promotion in order to promote CP and create good practice handbooks, which have been used as a guideline framework for voluntary environmental management. CP guidelines of good practices have been drawn up and publicly disseminated for industries manufacturing a variety of products,, such as dairy products, canned food, rice, fermented rice noodles, palm oil and meat balls.

As a result of CP practices, the DIW reported that recently there has been a decrease in the amount of non-hazardous waste disposed of in landfills and incinerators, and an increase in the amount of non-hazardous waste reused as alternative fuel.

3.3 Corporate Social Responsibility (CSR)

Corporate Social Responsibility (CSR) is defined as the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life for the workforce and their families, as well as for the local community and society at large. Until recently, the concept of CSR was not very clear to Thai companies and many of whom

engaged in charity and donation activities to surrounding communities and SMEs as CSR activities to demonstrate their concerns for society and the environment. However, after the development of "ISO 26000: Social Responsibility" by the International Organization for Standardization (ISO), the concept and scope for CSR implementation become much clearer.

In Thailand, the DIW is the leading government agency for the promotion of CSR activities. For instance, in the beginning of 2008, the DIW used the draft ISO 26000: Social Responsibility as a guideline for CSR implementation and launched a CSR project in the industrial sector. At the end of the year, there were approximately 30 factories successfully adopting CSR in their businesses, as well as complying with the draft ISO 26000: Social Responsibility. Given this encouraging result, DIW allocated approximately THB 20 million in 2009 to expand the same project on a broader basis. It planned to spend approximately 20 million in 2010 to carry out CSR implementation. The DIW expects that more than 100 factories will adopt and comply with the draft by the end of 2009.

3.4 Life Cycle Assessment (LCA)

LCA was introduced to Thai industries in 1997. A forum about LCA named "Thai LCA Network" was established by Chiang Mai University (CMU). The first formal Life Cycle Inventory (LCI) study was conducted by TEI in 2000 to develop LCIs for Electricity Grid Mixes. Several LCI and LCA projects have been conducted by the Cleaner Technology Advancement Program under the National Metal and Materials Technology Center (CTAP/MTEC) in collaboration with many universities and the TEI since 2000. In 2005, the Thai National LCI database project was established with technical support from the Japanese Government through the Green Partnership Plan. The MTEC is the core implementing organisation of this 3-year project with the support from several partner organisations such as the FTI, the Petroleum Institute of Thailand, the TEI, the Ministry of Industry, the Ministry of Natural Resources and Environment, etc.

In Thailand, several factories are adopting LCA to redesign their products manufacturing processes and to produce more environmental-friendly products. Most of these industrial factories are foreign companies such as Japanese electrical and electronic manufacturers located in Thailand. They are doing so mainly to comply with EU Directive of Waste Electrical and Electronic Equipment (WEEEs) and Restrictions on the use of Certain Hazardous Substances (RoHS). Currently, the MTEC collaborate with the DIW, the Thai Research Fund (TRF), the FTI, and the TEI to develop the Thailand National LCI Database. Their main goal is to develop a national LCI database which compiles information suitable for LCA implementation in Thai industry. The LCI database developed for some industries is displayed in Table 11.7.

Table 11.7: LCI database developed for some industries

Work Group	Targets	Status
WG1: Natural Gas	Natural Gas, Methane, Ethane, Propane, LPG, CO_2	Finished
WG2: Refinery	LPG, Gasoline, Kerosene/Jet Oil, Diesel/Gas Oil, Naphtha, Fuel Oil, Asphalt	Finished
WG3:Petrochemical (Phase I)	Ethylene, Propylene, Benzene, Toluene, P-Xylene, VCM, PVC, LDPE, LLDPE, PP, ABS	Finished
WG3: Petrochemical (Phase II)	HDPE, PU, Polycarbonate, SM, HIPS, GPPS, EPS, PTA, EO, EG, PET, Nylon 6, SAN, Caprolactum, Cyclo-hexane, Mixed C4, Bisphenol A	Ongoing
WG4: Ferrous and Non-ferrous	Ferrous: Slab, Billet, Steel bar, Wire rod, Hot-rolled flat steel, Cold-rolled flat steel, Galvanized sheet, Stainless steel Non-ferrous: Zinc, Copper, Aluminum, Tin, Lead	Finished
WG5: Infrastructure	Trucks: 6 Types of truck defined by Department of Land Transport	Finished
WG6: Construction Material	Glass & Mirror: Flat Glass, Insulated glass, Tempered glass, Laminated glass, flint glass bottle, amber glass bottle, glass fiber	Finished
	Ceramics: Floor tiles, Wall tiles, Wash basin, Water closet bowls, Urinal, Bathroom accessories	Finished
WG7: Agriculture/ Agro-industry	Rice: at least 10 dataset Feed mill: Swine Feed, Broilers Feed, Layers Feed, Fishmeal from Surimi, Fishmeal from Tuna, Fishmeal from Trash fish, Surimi, Canned Tuna, Maize, Maize Silo, Soybean, Soybean meal, Trash fish (Fishery) Rubber: Latex, Cup lump, Concentrated Latex, Block Rubber (STR5L, STR 10, STR 20)	Ongoing
WG8: Basic Chemical	Paint: Emulsion Paints, Enamel Paints, Fast dry automotive Paints, Lacquer or Nitrocellulose Paints, Epoxy Paints, Powder Coating Paints	Finished
	Hydrochloric acid, Sulfuric acid, Fertilizer, Carbon black, Calcium carbonate, Sodium hydroxide, Silicon dioxide, Hydrogen peroxide, Sodium sulfite, Citric acid, Acetic acid, Chlorine, Pesticide, Herbicide, Fungicide	Ongoing
WG9: Waste Management	Incineration (Municipal and Industrial Waste)	Finished
WG10: Others	Textile: Cotton, Silk, Nylon, Polyester, Rayon, Acrylic Wood Furniture: Plywood, MDF, Particle Board	Finished

Source: National Metal and Materials Technology Center homepage

3.5 Corporate Environmental Information Disclosure (CEID)

3.5.1 Overview

CEID refers to the disclosure of information about the operational activities and environmental behavior (products, production process, management procedures, etc.) of a company to consumers, investors, government officials, communities and the public at large. CEID has an advantage of enabling concerned social actors to act on CEM, and bringing them on board, together with government agencies, to generate pressure and incentives for companies to adjust their production activities. Informed stakeholders accordingly make more sound decisions and their reactions are translated into incentives for good performers and pressure for poor ones.

CEID also educates companies on their own performance and helps them to identify potential areas of environmental improvement.

The CEID system in Thailand operates between different stakeholders and could be classified into three categories: 1) from company to government, 2) from company to public, and 3) from the government to public. With regard to the first category, companies are required to provide specific environmental information to the government through Environmental Impact Assessment (EIA), environmental pollution reports, and other reporting system (continuous emission monitoring system and online reporting system). With regards to the second category, companies are required to communicate their environmental information with the public through EIA, and Pollution Release and Transfer Register (PRTR) system. In addition, some companies proactively report their environmental information to the public in their annual reports such as CSR reports or environmental reports. With regard to the last category, under promulgation of the Official Information Act B.E. 2540 (1997), governmental agencies shall disclose their information to the public, and citizens have the rights to request information from governmental agencies, including environmental information. Thus, environmental information of companies that is withheld by the government is disclosed to the public through regular environmental information disclosure (overall industrial pollution data) and requests submitted to governmental agencies.

In addition to governmental policies on environmental information disclosure, there are numerous organisations and institutes, such as the Stock Exchange of Thailand (SET), the TBCSD, the Social Corporate Responsibility Institute (CSRI) and the Department of Business Development that have encouraged corporations to disclose their environmental information to the public for the purpose of Sustainable Development, CSR, and Corporate Governance.

In Thailand, there are two types of CEID based on the content of environmental information: 1) product/service based CEID, and 2) non-product/service based CEID.

Product/service based environmental information disclosure

In this type of CEID, environmental information is disseminated through labels that are associated with a product/service of the company. The amount and the type of the disclosed environmental information depend upon the type of label. In Thailand, there are four label schemes namely: the green label, the carbon label, the energy saving label and the carbon footprint label.

- The green label is an Eco Label Type I that is awarded to specific products that are proven to have marginal impact on the environment in comparison with other products serving the same function.

- The carbon label is a certified label to inform the consumers about the level of greenhouse gases (GHG) that will be emitted from the use of the product.
- The energy label is a certified label for energy-using appliances. This label ranks appliances according to their energy efficiency level. Appliances are ranked from 1 to 5, with one being the most energy efficient and five being the least energy efficient.
- The carbon footprint label is still at developing stage. It takes into account the quantity of GHG emissions of a particular product over its whole life cycle.

Non-product/service based environmental information disclosure

This type of environmental information disclosure is a direct method of communicating environmental information and the environmental performance of a company to target stakeholders, be the government, the trading partners, or the public at large. This could be done through publishing documents like annual reports, environmental and safety reports and sustainable development reports. It could also be through using media such as television, radio, publication, billboard, and websites. As far as the scope of environmental information being disclosed is concerned, it can vary from raw material extraction to disposal depending on the approach that the company takes.

3.5.2 Efforts to practice CEID in Thailand

In Thailand, both the public and private sectors see the importance of environmental information disclosure. At government level, the concept of good governance, including information disclosure, has been adopted. In addition, the IEAT and factories located in Maptaphut Industrial Estate disseminate environmental information to local communities through electronic billboards in front of participating factories and in communities in Maptaphut, and by website and community radio. Moreover, the IEAT staff also work closely with the residents of local communities surrounding industrial sites. In the case of an emergency industrial situation, the IEAT sends warning messages by SMS. Both real-time and online systems have been set up by the PCD to monitor some environmental information for particular factories. The Department of Industrial Promotion (DIP) also initiated CSR projects for SMEs in order to provide engagement opportunities between factories and communities leading to environmental information sharing.

Many national companies have disclosed environmental information through their annual, sustainability and environmental reports. Thai companies such as SCG and Bangchak also put tremendous efforts into the disclosure of environmental information. For instance, SCG has disclosed environmental information through its annual report and sustainability reports. It has adopted GRI as a guideline for disclosing its environmental information. SCG also has teams to work closely with neighbours and communities surrounding its site in Maptaphut to share

environmental information with them, and to answer their environmental related questions. Bangchak Co., Ltd. has even adopted door-to-door visits as regular practice in order to communicate company information (including environmental information) surrounding communities. All levels of Bangchak staff will knock on every door in the community in order to communicate with residents as much as they can. Bangchak has endeavoured to ensure that its newsletters, pamphlets, and group meetings with villagers supply residents with adequate environmental information, and build a good relationship between the community and the company.. Bangchak also encourages the community to report environmental complaints in their area to Bangchak staff by any means at all times.

Multinational companies operating in Thailand are also engaged in environmental information disclosure scheme which are a part of their overall development policy. For instance, Daikin, Toyota and Honda use their annual reports, sustainability reports, environmental reports and their websites to communicate their environmental information with the public. The factories of Honda and Toyota are largely open for public visits. Honda and Toyota also report environmental information to their parent companies. All of the information of Honda Thailand is sent to Honda Motors in Japan. Similarly, Daikin Thailand has followed the environmental policy of its parent company. It sends a report every three months to Japan and publishes an environmental annual report every year.

3.6 Green Supply Chain Management (GSCM)

3.6.1 Forms of GSCM in Thailand

In Thailand, GSCM practices involve buyers and suppliers of goods and take one of the following forms:

- Buyer-and-supplier partnerships

This method refers to the fact that both buyers and their suppliers cooperate with each other about different environmental issues. Under this form, suppliers can be involved in buyers' activities. Conversely, buyers can provide consultancy to their suppliers for dealing with environmental issues.

- Assistance and consultancy for partners

Under this form, buyers build their suppliers's awareness regarding environmental issues. They provide with them technical assistance through training courses to improve their environmental knowledge so that they can improve their environmental performance. Moreover, buyers could offer financial assistance to their suppliers.

- Determination of a product's characteristics and specifications and environmental friendly purchasing practice for partners

This form allows buyers to use their negotiating powers to motivate their suppliers to produce environmental-friendly products. Buyers can restrict their purchases to those products that fulfill special environmental standards or have specific labels. They can provide technical assistance on how to produce the desired product.

- Auditing and certification for partners

Under this form, a buyer should review their supplier's work processes by asking for documents reflecting their environmental information. A buyer could ask suppliers to fill in an evaluation form on environmental management, or they could bring an auditor from their company or a government organisation to audit the supplier's factory. Moreover, a buyer should establish procedures for suppliers that do not meet their standards, such as offering consultancy.

3.6.2 Efforts to practice GSCM in Thailand

Greening supply chain has been raised as an important topic at both government and business level. At government level, the Thai government has, since 2006, overseen a Green Procurement programme (GP) within its agencies by setting environmental friendly purchasing criteria for products and services. The GP was initially implemented at PCD as a pilot project, then, it has been extended to other governmental agencies, which resulted in a growing market for environmental friendly products and services. At the business level, large national and MNCs have engaged in activities to green their supply chains. For instance, SCG and Toshiba Lighting have adopted GP as a measure to green their supply chains. Some of Japanese, US and Western European MNCs in Thailand require their suppliers to be involved in GSCM and /or to adopt some CEM practices. In this regard, Toyota Motor Thailand Co., Ltd is a good example. As GSCM measure, it requires all of its suppliers to obtain the ISO 14001 certification. To this end, it assists and supports them. At the end of 2008, 224 of Toyota's suppliers obtained ISO 14001 (Toyota Thailand Co., Ltd, 2009). Toyota Motor Thailand Co., Ltd. has also implemented a "green purchasing guideline" as measure to green its supply chain and to cooperate with its suppliers in order to improve their understanding and to increase their engagement in reducing environmental impacts. Honda Thailand ranks its suppliers based upon their environmental management status, and assists them in obtaining the ISO 14001 certification by helping in auditing and resource management.

It was noted in a roundtable meeting about CEID and GSCM practices held at the TEI that GSCM has extended beyond the first tier. In some cases, GSCM has "trickled down" to include suppliers of suppliers, who are already involved in GSCM with buyers. After suppliers of the downstream product have implemented GSCM, they expand the implementation to their suppliers of intermediate products as well.

4. Survey of CEID and GSCM in Thailand

4.1 Survey of CEID in Thailand

Promoting CEM has been mainly through traditional approaches, such as command and control and market-based instruments that looked solely at the relationship between regulators (government) and the regulated (companies). Theoretical and empirical studies showed that such instruments have been introduced with varying degrees of success. Investing in the provision of corporate environmental information through a multi-stakeholder approach that links companies, the governments, the community and the market has become an alternative policy option since the beginning of 1990s. Existing literature supports the idea that CEID can influence corporate activities; as a result, CEID has been characterised as a third wave of environmental regulations (Tietenberg, 1998). To highlight the extent of CEID in Thailand and the type of corporate environmental information disclosed, we conducted a comprehensive review of the FY2006 or FY2007 environmental and safety reports and/or sustainable development reports of some randomly selected companies. To examine and analyse the determinant factors for CEID in Thailand and its impact on Thai companies' financial and environmental performance, we conducted a questionnaires/interviews within the companies between December 2008 and March 2009. The details about the methodologies and findings are given below.

4.1.1 Extent and content of CEID in Thailand

In order to assess the extent of CEID and the content of revealed environmental information by Thai companies, we made a comprehensive review of their environmental and safety reports and/or sustainable development reports of FY2006 or FY2007 (depending on availability).

Companies were randomly selected upon two criteria: 1) Company registration (listed vs. non-listed); 2) Business activity (industrial vs. non-industrial). Very important industrial and non-industrial sectors were targeted. For the industrial sector, selected companies belonged to the 1) automotive; 2) material & machinery; 3) petrochemical & chemical; 4) energy & utility; and 5) food & beverage sectors. For the non-industrial sector, selected companies belonged to the 1) banking; 2) finance & security; 3) property development; 4) commerce; and 5) information & communication sectors.

We prepared a list of randomly selected companies, and then we made telephone calls to them to ask for their reports, or directly downloaded the reports from their websites if they were available. The target was to review at least five reports from five companies per sector, for both listed and non-listed companies. After obtaining environmental and safety reports and/or sustainable development reports of all selected companies, we subjected these reports to a comprehensive reading process to establish what environmental information they contained.

We classified environmental information under seven categories: 1) environmental policy; 2) environmental achievement; 3) emission, effluent, waste & other pollutants; 4) environmental compliance; 5) environmental projects including environmental friendly products & services; 6) greenhouse gas emissions; and 7) environmental plans.

The result of the comprehensive review is reported in Table 11.8. The following main findings are worth mentioning:

-The extent of environmental information reported in annual reports is still very low. As for listed companies, although there is some information related to each of the seven categories identified earlier, less than a single page of environmental information is contained in each report, with the exception of energy and utility companies. As for non-listed companies, although we initially contacted more than 500 companies, we were unable to collect enough reports. Few large companies, foreign-invested companies and multinational companies published sustainable development reports, as reported in Table 11.8.

Table 11.8: Extent and content of CEID in Thailand (for listed companies)

Sector	Number of listed companies		Level of CEID (No. of pages)	Type of disclosed environmental information
	Disclose	Do not disclose		
Industrial Company				
1) Automotive	6	0	0.23	1, 2, 3, 4, 5
2) Material & machinery	6	2	0.07	2, 4, 5
3) Petrochemical & chemical	6	0	0.83	1, 2, 3, 5
4) Energy & utility	3	0	1.28	1, 2, 3, 4, 5, 6,
5) Food & beverage	5	0	0.52	1, 2, 3, 4, 5, 6, 7
Non- Industrial Company				
1) Banking	5	0	0.07	1, 2, 5
2) Finance & security	4	0	0.23	1, 5
3) Property development	3	1	0.6	1, 2, 3, 5
4) Commerce	2	3	0.13	1, 2, 5, 7
5) Information & communication	3	0	0.3	1, 5

Note: Disclosed corporate environmental information is classified under seven categories, each number from 1 to 7 in the last column of the table refers to specific categories of information that have been reported. 1) environmental policy; 2) environmental achievement; 3) emission, effluent, waste & other pollutants; 4) environmental compliance; 5) environmental project including environmental friendly product & service; 6) greenhouse gases emission; and 7) environmental plan.

-Among industrial companies, energy & utility companies tend to provide more pages on environmental information than the others, with the average of 1.28 pages per report.

-Among non-industrial companies, those belonging to the properties and development group disclosed more pages on environmental information than other companies with the average of 0.6 pages per report.

- Various types of environmental information are being disclosed in companies' annual reports. However, companies are more willing to disclose qualitative environmental information such as information about the overall environmental policy of the company, information about their

environmental friendly product and services, and information about their environmental achievements. Companies are reluctant to share quantitative information on actual environmental performance in terms of GHG emission, or their level of compliance with government environmental regulations.

4.1.2 Determinant factors for CEID and the impact of CEID on the financial and environmental performance of companies

A questionnaire/interview was conducted between December 2008 and March 2009 to examine and analyse the determinant factors for CEID in Thailand and its impact on the financial and environmental performance of companies. Executives of companies from the industrial and non industrial sectors, who participated in "economic and environmental seminars for executives" organized by the TEI were randomly selected to either fill in the questionnaires, or to undergo interviews on environmental information disclosure. From a total of 80 responses, only 34 responses were relevant (28 from companies who are disclosing their environmental information and six from companies who are not).

Some results of the questionnaire survey are reported in Table 11.9 and Table 11.10. The following main findings are worth mentioning:

- In general, the majority of companies see the importance of environmental information disclosure. Approximately 94% of all participating executives reported that they perceive environmental information disclosure as an important practice for the company.

-Environmental information is more readily disclosed if the policy of the company specifically states that this must be done.. Gaining a good reputation for the company and responding to market demand are the second and third main determinant factors respectively (see Table 11.9).

- Half of all companies who are disclosing their environmental information cannot identify whether there is a financial and/or environmental benefits from disclosing their environmental information to the public. Those who respond that they achieved some environmental and/or financial benefit still hold the opinion that these benefits are very small in size (see Table 11.10). The benefit is mainly in terms of the license to operate and a better reputation.

Table 11.9: Determinant factor of CEID

	Number of companies	Minimum score	Maximum score	Average score
Part of the company's policy	18	3	5	4.61
Mimicking other competitors	8	1	3	2.12
Responding to foreign demand	12	1	5	2.50
Responding to domestic demand	16	1	5	3.06
Gaining good reputation for the company	18	1	5	3.66
Increasing the profit of the company	8	1	5	3.00

Note: Score is from 1 to 5 with 1 being "not determinant factor/very weak determinant factor", and 5 being "very strong determinant factor".

Table 11.10: Impact of CEID on corporate environmental and financial performances

Benefit	Number of companies	Minimum score	Maximum score	Average score
Environmental benefits	8	1	5	2.33
Financial benefits	6	1	5	1.83
Cannot identify	9			
No benefit	5			

Note: Score is from 1 to 5 with 1being a small benefit from CEID" and 5 being a "strong benefit from CEID".

4.1.3 Conclusion of the CEID survey

In Thailand, the extent and the type of disclosed environmental information is different from one company to another and from one sector to another. Our findings are in accordance with the finding of Suphamit Techamontrikul (1997) who conducted a survey on environmental information disclosure in million-baht businesses for both listed and non-listed companies in 1995. The extent of CEID in Thailand is still marginal, and listed companies revealed more information than non-listed companies. In their annual reports Thai companies seems to simply state their environmental commitment and goal for improvement without significant data, interpretation, or clearly specified steps being taken. They are disclosing their environmental information not for profit-based purposes but mainly because the policy of the company specifically states that this must be done and because it allows them to improve their reputation. Disclosing environmental information seems only to result in slight environmental and financial performance improvement. The benefit is mainly in term of license to operate and a better reputation for the company. These interesting findings are based on a small sample of companies with further in-depth study being necessary.

4.2 Survey of GSCM in Thailand

4.2.1 Methodology and findings

A questionnaire/interview was conducted between December 2008 and March 2009 to examine the determinant factors of GSCM in Thailand and its impact on the financial and environmental performance of companies. Executives, of companies from the industrial and non industrial sector, that participated in "economic and environmental seminars for executives" organised by the TEI were randomly selected either to fill in the questionnaire form, or to undergo interview on GSCM practices. From a total of 80 respondents/participants, only 34 responses were relevant, as listed in Table 11.11.

The main findings from the survey concerning GSCM in Thailand are as follows:

-Companies that are both already engaged in GSCM practices and also those that are not yet engaged in GSCM practices recognise the importance of such proactive CEM initiatives for a company to reduce the impact of its activities on the environment and society. From a total of

34 relevant responses, 30 companies recognize the importance of GSCM as a CEM initiative. Among the 18 companies not yet engaged in GSCM practices, 14 companies also recognise its importance, a figure that raises hopes that these companies may engage in such environmental practices in the near future.

-GSCM is more readily practiced if the policy of the company specifically states that this must be done.. Considering it as CSR activities toward suppliers is the second most important factor for a company to engage in GSCM activities. Considering it as a tool to reduce production and environmental cost, and as a tool to gain good reputation for the company are also recognized as determinant factors by some companies.

Table 11.11: Determinant factors of GSCM

	Number of companies	Minimum score	Maximum score	Average score
Company policy	9	4	5	4.88
Response to international buyers	2	4	5	4.50
Response to domestic buyers	2	4	5	4.50
Assisting supplier as an environmental CSR	7	2	5	4.00
Establishing good relationship with supplier	4	1	5	3.25
Decreasing environmental costs	5	3	5	4.00
Creating company image	3	2	5	4.00
Increasing company's profit	2	4	5	4.50

Note: Score is from 1 to 5 with 1 being "very weak determinant factor" and 5 being "very strong determinant factor".

-GSCM practices take mainly take the form of technical assistance from buyer to their supplier in the form of training and knowledge sharing.

-According to the survey conducted in this study, financial and environmental benefits from implementing GSCM are marginal.

-Limited technical and financial capacities as well as limited participation from the supplier side are the main barriers preventing companies from engaging in GSCM activities.

-Although the survey conducted in this study found that financial benefits from GSCM implementation are marginal, the study conducted by the TEI (2005) gave the amount of financial benefit that could be generated from implementing some GSCM practices. These amounts are reported in Table 11.12. The financial benefit is related to cost reductions and better productivity due to material use reduction, energy consumption reduction, fuel consumption reduction, maintenance cost reduction (machinery and equipment), higher recycling rate and collected recyclable wastes (can be sold) and higher productivity (TEI, 2005).

Table 11.12: Financial benefits from GSCM implementation

Supplier company	Activity	Financial benefits
1	5S (sorting, straightening, systematic cleaning, standardizing, and sustaining.)	170,000 Baht
	Increased production and effectiveness	134 Baht/piece
2	Sold unused scrap metal	240,000 Baht
	Recycled unused metals	500,000 Baht
	Waste management for scrap iron from lathing process	200,000 Baht/month
3	Waste management for scrap iron from lathing process	25,000 Baht/month
4	Fuel saved	1,047,000 Baht/4 month
5	Energy saved (electricity)	29,910 Baht/km of length of core paper (10.4% reduction)
	Material saved (adhesive)	63,848 Baht/4 month

Source: (TEI, 2005)

4.2.2 Summary of GSCM survey in Thailand

Earlier studies conducted by the TEI on GSCM and the roundtable meeting organised by the TEI on CEID and GSCM concluded that the existing Thai programmes on GSCM among companies are effective. Outcomes are tangible. For instance, cost reduction, improvement of environmental management, efficient resource utilisation and achieving ISO 14001 certification are clear results of involvement in GSCM (TEI, 2005).

Although GSCM could bring environmental and financial benefits to both buyers and suppliers, the level of engagement in GSCM practices is still limited in Thailand. Tthe existing GSCM programmes are mostly conducted in a direct supply chain management approach, which requires mostly a combination of different forms of GSCM (buyer-supplier partnership, assistance and consultancy for partners, determination of product's characteristics and specifications and environmental friendly purchasing practice for partners, establishment of criteria, standard or environmental management system for partners, and auditing and certification for partners).

GSCM is more readily practiced if the policy of the company specifically states that this must be done.. Considering it as CSR activities toward suppliers is the second-most important factor for a company to engage in GSCM activities. Considering it as a tool to reduce production and environmental cost, and as a tool to gain good reputation for the company are also recognised as determinant factors by some companies.

5. Drivers of and barriers to CEM practices in Thailand

5.1 Drivers of CEM practices in Thailand

Many factors seem to drive Thai companies to engage in CEM activities. Some of the identified factors are reported below:

Being part of the policy of the company: Many Thai companies are implementing CEM practices because they are already parts of the policy of the company. This was proven in the survey conducted about CEID and GSCM in Thailand.

Response to market demand: Many Thai companies are improving their environmental management practices to respond to market demand. Some are doing so to comply with international regulations and trading standards such as WEEEs and RoHS. Others are doing so as a response to the increasing domestic demand for environmentally friendly goods and services through green procurement programmes.

Energy cost: Many Thai companies are improving their environmental management practices to reduce energy cost. The global energy issue and skyrocketing prices of energy produced from fossil fuels throughout the world are affecting all types of Thai companies including SMEs and driving them to look for effective ways to reduce their energy costs.

Available information: The availability of information regarding some environmental management activities, such as EMS and CP, has encouraged and facilitated some Thai companies towards adopting such practices and has driven them to improve their environmental management. Good practices for EMS and CP conducted in several types of business, including industrial and service sectors, are available and were published as handbooks, which have been distributed around the country. Furthermore, responsible agencies, non-governmental organizations and research institutes also disseminated relevant information through various channels, such as websites, announcements, newsletters and other publications.

Regulatory enforcement: Some Thai companies were driven to improve their environmental management by stricter regulatory measures. Government enforcement and monitoring is becoming stricter. Air pollution, wastewater and waste laws and regulations are now revised and updated more often in order to prevent, control and minimise the impacts of pollution.

Multi-stakeholder involvement and support: Supporting programmes, training programmes, consultations, audits, awards, and other persuasive incentives are provided not only by governmental agencies,but also by non-governmental organisations, international organisations, and educational institutes to companies in order to improve their environmental management practices. For example the DWI cooperated with The Siam Cement Group (SCG) to launch a project for assisting Thai SMEs on EMS and improving industrial standards on environment issues including: adjustment of production process; organisation administration; available information and consultancy agents; operation between supply chains; and ability to assess products and monitor analysis. Another example is the co-operation between the MTEC, the DIW, the TRF, the FTI, and TEI to develop Thailand's National LCI Database. Last but not least, large companies and multinational companies are also assisting their suppliers and other

SMEs to improve their environmental practices as a win-win strategy. For instance, Toyota Motor Thailand Co., Ltd., assists its supplier in getting the ISO 14001 certification.

Technical and financial opportunity: Some Thai companies are implementing clean development mechanism (CDMs) to benefit from the technical and financial opportunities that these programmes may generate. Currently, Thailand is very active in CDM projects, especially, projects related to energy and wastes.

Award schemes: Many awards are given to encourage companies to improve their environmental management practices. These awards are not only from the government but also from other national and international organizations. For example, we can mention the prestigious Stock Exchange of Thailand Award, which is conferred in order to promote activities related to CSR.

5.2 Barriers to CEM practices in Thailand

Many factors seem to be barriers preventing Thai companies from adopting CEM practices. Some of them are identified below:

Lack of awareness: Some entrepreneurs view CEM practices, such as EMS and CP, only as additional costs. Furthermore, they lack clear information about specific concepts such as CSR which many companies practice simply in the form of donating a sum of money to neighbouring people or other communities.

Limited financial and technical capacities: Mainly multinational companies and large national companies are engaged in CEM activities. Other companies lack the financial and technical capacity to do so. Their capital is mainly devoted to expanding their business activity rather than promoting environmental management. Furthermore, banks and governmental agencies can only provide a limited amount of green finance for entrepreneurs to improve the environmental performance of their companies. Furthermore, most Thai companies are SMEs that lack systematic data collection. The detailed data on resource consumption, energy consumption, water consumption, wastewater, waste generations and other environmental data, which is necessary to implement CEM practices, is not collected, or is not systematically collected. The lack of environmental experts and data about some specific activities, such as LCA activities, is also a factor that hinders the promotion of CEM practices in Thailand.

The co-operation and linkage between stakeholders: Co-operation and linkage between different stakeholders is a key factor for promoting CEM practices. In Thailand, although there are different governmental agencies, non-governmental organisations and business organisations who are attempting to promote CEM practices, the cooperation between these institutions is limited to small groups of interested stakeholders. Limited participation from the

supplier side was identified among the main barriers hindering companies to engage in GSCM activities.

6. Summary and policy recommendations

The Thai government has been active in the promotion of CEM practices. It has used regulatory measures as well as market based incentives and other governmental programmes to achieve this goal. Proactive initiatives taken by private sector in regard to environmental management, have been taken since 1992. These proactive initiatives have amplified and increased in number especially after 1995, since there was more involvement of more stakeholders such as NGOs, communities, academic institutions, etc, beside private sector and government agencies.

At the business level, many factors seem to drive Thai companies to adopt proactive CEM practices. Responding to market demand is considered to be the main driving factor. Many Thai companies opt to comply not only with national standards but also with international standards such as WEEE and RoHS to gain market share. Skyrocketing energy prices are also driving many companies to adopt CEM practices in order to reduce their energy cost. Furthermore, stricter government enforcement and monitoring measures are driving many companies to adopt proactive CEM to identify themselves as good performers and to avoid additional environmental costs. Last but not least, supporting programmes, training programmes, consultations, audits, awards, and other persuasive incentives are provided not only by governmental agencies but also by non-governmental organisations, international organisations, and educational institutes. These incentives are also considered as factors driving Thai companies to improve their environmental performance.

Initiatives regarding proactive CEM practices in Thailand are mainly related to Environmental Management System, Cleaner Production, Corporate Social Responsibility, Life Cycle Assessment, CEID, and GSCM. While these proactive CEM practices increased in scope and number, their implementation has been limited to large national and multinational companies. This could be attributed to the fact that around 99% of Thai companies are household industries or SMEs which lack awareness about CEM practices and view them only as an additional cost. They are also hindered by financial and technical capacities which are insufficient for adopting these practices.

By focusing on CEID and GSCM in Thailand, the findings concerning these two proactive CEM practices can be summarised as follows:

With regard to CEID, there are no existing governmental policies and regulations beside environmental impact assessment (EIA) enforcing corporations to directly disclose environmental information to the public. The extent of CEID in Thailand is still marginal, and listed companies reveal more information than non-listed companies. In their annual reports,

Thai companies seem simply to state their environmental commitment and goal for improvement without significant data, interpretation or clearly specified steps being taken. As opposed to disclosing their environmental information mainly for profit-based purposes, they do so because it is a part of their policy, and because they hope to gain a good reputation. Disclosing environmental information seems to result only in slight improvement of environmental and financial performance. The benefit is mainly in terms of license to operate, and in achieving a better reputation for the company.

As for GSCM, we found that there is no existing government policy and regulatory framework for companies to green their supply chains. Rather than implementing a regulatory approach, the government has initiated a green procurement programme. But this programme has not been efficiently extended to all government agencies. Thai companies that are already engaged in GSCM practices and those that are not yet engaged in GSCM practices recognise the importance of such proactive CEM practices for a company to reduce the impact of its activities on the environment and society. GSCM is more readily practiced if the policy of the company specifically states that this must be done. Considering it as CSR activities toward suppliers is the second most important factor. Considering it to be a tool to reduce production and environmental cost and considering it to be a tool to improve the reputation of the company are also recognised as determinant factors by some companies. The current study revealed that GSCM practices generate marginal financial and environmental benefit to the company, however earlier studies conducted by the TEI about GSCM in Thailand concluded that GSCM practices generate both environmental and financial benefit to a company regardless of whether it is a supplier or buyer in the supply chain. The current study revealed that limited technical and financial capacities as well as limited participation from the supplier side are main barriers preventing companies from engaging in GSCM activities.

The Thai government is very active in its promotion of CEM practices; Thai companies are ready to take proactive initiatives as well. However, there are different institutional, technical, and financial barriers that are hindering the promotion of CEM practices. Overcoming these barriers is a prerequisite for the promotion of CEM in a more significant way. To this end, the following recommendations could be proposed.

- Since more than 99% of Thai companies are household industries or SMEs which are not very active in adopting CEM practices, finding strategies and tools to encourage them to do so is crucial. To this end, government efforts and capacity should be oriented to better design market based instruments to influence their behaviors.
- The Thai government can play an active role in the promotion of GSCM activities through successful implementation of the green procurement programme that has been

taking place. It can also take the lead in implementing GSCM practices within state-owned companies. If such programmes are successfully implemented, they will encourage other private companies to follow.

- Despite the fact that CEID was considered as a CEM practice that does not generate additional environmental and financial benefit to corporate activities in Thailand, we still think that this scheme should be promoted. It should be recognised as a tool that complements command and control and market-based instruments, not as a standalone policy. For this strategy to work effectively, challenges should be taken up on different fronts such as the provision of accurate information for stakeholders; empowering stakeholders to create sufficient pressures or incentives; and coupling CEID with enforcement or incentive tools.
- Thailand must also learn from the experiences of other countries that use incentives or enforcement tools to promote CEID. As incentives, establishing environmental reporting awards (such as the green reporting award in Japan or the Association of Chartered Certified Accountants [ACCA] award in the UK) and publicly awarding good performers (as does the Program for Pollution Control, Evaluation and Rating [PROPER] in Indonesia) is a good strategy for encouraging businesses to actively disclose and report their environmental information.

At the end of this chapter, it is important to mention that due to the fact that the study activities about CEM policies in Thailand were carried out only for the first two years of the project, and to the fact that there was some difficulty of requesting cooperation from companies, the study provided less information compared to the other two study activities about CEM policies in China and in India, which limited us to have a better comparative analysis and pick up the common issues from the three target countries.

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