The Development of A Sustainability Policy Model for Promoting Cleaner Production: a Special Focus on Korea

De ontwikkeling van een duurzaamheidsbeleid model voor de promotie van Schonere Productie: met een speciale aandacht voor Korea

청정생산을 위한 進化的 지속가능 政策모델 개발
- 지속가능성갭과 삼각지식(三角知識)에 바탕을 둔 新환경정책 -

'Return of the Flock', Jean-Francois Millet (1814-1875)

Dongwon Shin

The Development of A Sustainability Policy Model for Promoting Cleaner Production: a Special Focus on Korea

De ontwikkeling van een duurzaamheidsbeleid model voor de promotie van schonere productie: met een speciale aandacht voor Korea

Thesis

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'See how the lilies of the field grow. They do not labour or spin. Yet I tell you that not even Solomon in all his splendour was dressed like one of these.' (Matthew 6: 28-29)

As the Book of Matthew says the industrial activities of human society cannot go beyond the providence of the natural ecosystems. They cannot create life. We have witnessed what has happened to the global society from the Industrial Revolution in the early nineteenth century to the Rio Declaration in the late twentieth century. Our aspiration for Cleaner Production must be one of the important human efforts to reconcile conventional industrial production with the ecological demand for a sustainable society and for environmentally sustainable production patterns. This thesis author's seven-year academic journey began as an exploration of evolutionary sustainability policy for Cleaner Production based upon my professional experience both as a policy designer in the Korean Ministry of Environment (KMOE) and as part of a three-year mission in the UNEP Cleaner Production (CP) Program, all done while being within the framework of the Erasmus Ph.D. Program on Environment and Sustainability.

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Dongwon Shin
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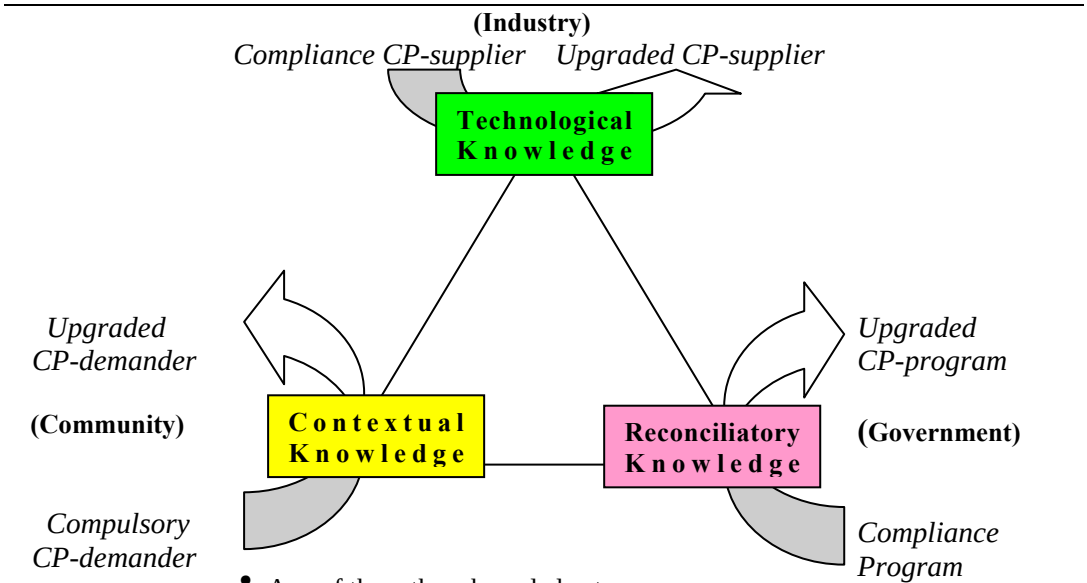
Executive Summary

I. Theoretical Framework

Cleaner Production (CP) can be a necessary condition for societies to establish and maintain sustainable production systems. Based upon the significant challenges for making progress toward sustainability and the currently stagnated situation of CP implementation, this thesis author questioned, '*What types of governmental policies are adequate for facilitating the continuous implementation of CP?. In answer, the author developed and presents an evolutionary sustainability policy model* for designing and implementing CP.

In order to progress to that stage, the author hypothesized that the behavioural pattern of firms evolves through four developmental stages of CP implementation: the compulsory motive, the financial motive, the communal motive, and the pioneering motive (Hypothesis 1). He further hypothesized that links among three types of knowledge – contextual, technological, and reconciliatory – (This author called it 'Triangular Knowledge Cycle' in Figure A.) play crucial roles as driving forces for upgrading the current level of CP implementation (Hypothesis 3, See Figure A).

Figure A: Process of CP Evolution as portrayed by the 'Triangular Knowledge Cycle'



♣ Any of these three knowledge types can serve as a trigger for adoption and implementation of CP. The other two knowledge types provide additional momentum for continual implementation of CP.

♣ Therefore, these three types of knowledge work together and complete the foundation of knowledge that is essential for implementation of the sustainability.

Recognizing that CP has the mixed characteristics of economic activities and ecological activities towards a sustainable society, the author found that the community's demands for CP implementation are based upon their contextual knowledge and their desire for a more sustainable society. The firms' willingness to implement CP supplies the essential elements of technical knowledge. The governments' policies for promoting CP implementation supply the main contents of reconciliatory knowledge. (See Figure A) Therefore, these three types of knowledge work together and complete the workable knowledge base to support sustainability implementation.

Within the framework of the triangular knowledge links for implementation of CP, this author assumed that there exist socio-economic gaps between the community's aspirations for CP implementation and the firms' willingness for providing and implementing CP technologies and services, because there are two different driving forces for implementation of CP in a sustainable society: the paradigm of economics and the paradigm of ecology. Therefore, continuous implementation of CP will not be achieved without continuous efforts to close these gaps. This author called these the 'sustainability gaps.' (Hypothesis 2)

Therefore, supposing that cooperation of the three main social subsystems – industry, community, government – is necessary for continuous implementation of CP (Hypothesis 3), sound governmental policies for CP in a sustainable society depend on how effectively governments make efforts to close those sustainability gaps, which constitute the theoretical objectives of governmental policies for CP implementation. Governments should take actions to reconcile the sustainable aspirations of the community for CP with the firms' practical willingness to implement CP activities. (Hypothesis 4)

Under this normative framework for continuous implementation of CP, this thesis author focused on developing the evolutionary policy model. What policies can be developed and implemented that will help to ensure the continuous implementation of CP? Considering that CP policies should not be based on command-and-control activities, but be sustained, based upon voluntarism and innovation, this thesis author proposed that the governmental CP program should take an 'adaptive and evolutionary approach' for encouraging CP implementation as the *reconciliatory knowledge* of government to ensure both environmental effectiveness and economic efficiency. (Hypothesis 5, See Figure–A)

II. Empirical Studies

Based upon the theoretical framework, this author focused on identifying the main characteristics of the proposed evolutionary sustainability policy model for continuing implementation of CP by undertaking three empirical studies on CP cases and CP policy (See Part III & Part IV).

- The motivation survey of 59 successful CP companies worldwide was designed to obtain a set of *contextual knowledge* insights about CP implementation; (*That is, the demand for CP implementation.*) It includes the data to support the 'functional cooperativeness between social sub-systems', the 'necessity of the governmental role for CP', and the 'evolutionary stages of the firms' motives for implementing CP';
- The UNEP documents on 100 CP cases were evaluated to obtain the data pertaining to *technological knowledge* of CP (*That is, the supply of CP activities*), to ascertain if data present evidence of the 'existence of sustainability gaps between CP-demanders and CP-suppliers.' This was investigated to ascertain the impact of the different 'evolutionary stages of the firms' upon their motivation for implementation of CP';
- The 1998/2002 Environmentally Friendly Enterprise Certification Program (the EFEC Program of Korean government) Survey of 80 certified companies was conducted to obtain data on the *reconciliatory knowledge* of CP (*That is, CP-policy*), to include testing the characteristics of the proposed 'evolutionary sustainability model' in the Korean context and evaluating the 'efficiency of the current CP policy of the Korean government.'

1. The results of the motivation survey support the importance of functional cooperativeness for CP implementation among the social sub-systems – industry, community, and government (92% of the respondents), and underscore the necessity for governmental involvement in fostering CP implementation (decisively 34%, moderately 69%). The data revealed that government was and should be one of the most active CP motivators.

The survey results showed that 25% of respondents implemented CP due to the 'profit motive', 39% due to the 'compulsory motive', 23% due to the 'communal motive' and 13% due to the 'pioneering motive'. Developing countries' companies had a relatively larger percentage of companies responding to the 'compulsory motive' (32%), while developed countries' companies had a relatively larger percentage of companies responding to the 'pioneering motive' (22%), which supports, indirectly, the assumption of the 'evolutionary sustainability policy model' that the CP motive evolves through four developmental stages. In addition, according to the survey results, the predominant motivators for CP implementation are: the 'Top-manager's Environmental Leadership' (23%); the 'Profit Incentive' (13%); the 'Governmental Regulations' (13%); and the 'Good Public Image' (13%). These factors were decisive in six out of ten CP practices.

The key findings from the motivation survey of successful CP cases provided basic contextual knowledge sources of CP implementation from the CP-motivators' perspective. It revealed that there is an evolutionary pattern of firms' motivations for CP implementation, and that the firms rely upon a diverse and inter-connected motivational structure for helping them to implement CP. The results of this survey also established the ranking of each CP motivator, emphasizing the important role of government in the firms' implementation of CP. (See Chapter 5)

2. The evaluation of the 100 UNEP CP cases provided important technological knowledge sources of CP implementation from the CP-practitioners' perspective. The data revealed that the number of technological CP-types employed per company increased over time, which strongly indicated that some CP approaches appear to be driving-forces for fostering corporate leaders to upgrade their level of CP implementation. In terms of capital investment in CP implementation, the least expensive technological options for CP were the 'good housekeeping approaches,' while the relatively expensive technological options for CP were, in general, the 'material substitution approaches' and the design of products for the environment.' In terms of payback periods, 95% of the CP cases recovered their initial investments within five years. However, the data showed that the majority tried to avoid implementation of CP approaches with a payback period of more than three years, and/or an eco-efficiency rate of less than fifty percentages.

The data revealed that there are four types of CP program-providers: 'Internal Compliance CP-suppliers', 'Internal Non-compliance CP-suppliers', 'Governmental (or External) CP-suppliers', and 'International CP-suppliers.' The analyses revealed that the major parts of CP implementation in the private sector were confined to a certain threshold level of 'light' risk-taking. This phenomenon was considered to be a 'sustainability gap' on the supplier's side.

The data revealed that:

(i) 'Internal Non-compliance CP-suppliers' prefer significantly 'less risky CP cases' than 'Governmental CP-suppliers' or 'Compliance CP-suppliers';
(ii) 'The Compliance CP-suppliers' adopted a much more risk-friendly approach than 'the Non-compliance CP-suppliers.'

These facts indirectly support the four dialectic types of governmental program for sustainability (or CP) policy in parallel with the developmental stages of the CP motive: the 'Hard Compliance Program', the 'Soft Compliance Program', the 'Voluntary Program', and the 'Sustainability Program.' These four programs are the core theoretical elements of the *'Evolutionary Sustainability Policy Model for CP implementation.'*

The findings from the documents on successful CP cases provided important technological knowledge sources on CP implementation, such as the behavioural patterns of CP practitioners, the identification of certain threshold levels for CP implementation, the different types of CP program-providers and the evolutionary policy types for CP implementation, adapted to the firm's evolutionary and motivational stages for CP implementation.

3. Based upon the two sets of empirical findings: (i) a set of *contextual knowledge* insights about CP implementation from the CP-motivators' perspective, and (ii) the data pertaining to *technological knowledge* of CP from the CP-practitioners' perspective; this author developed five guiding principles for governmental CP policies, which broadly characterise the evolutionary sustainability policy model for CP. According to the triangular knowledge cycle framework, these five guiding principles underlie the conditions of *reconciliatory knowledge* for CP implementation, which can help policy-makers work for environmental reconciliation between the CP demands of the community and the CP implementation of firms by closing the sustainability gaps.

These principles include:

- The Aspiration Principle: maintaining a balanced or pioneering motivational structure for CP among the three main social sub-systems;
- The Adaptation Principle: adjusting governmental policies to the different 'evolutionary stages of companies in their journey of implementation of CP';
- The Knowledge Principle: invigorating CP markets based upon the triangular knowledge links (e.g. collaboration);
- The Program Principle: diversifying CP suppliers (e.g. program-providers);
- The Sustainability Principle: establishing 'CP Sustainability Programs' designed to continue to support efforts to upgrade the level of CP implementation to help societies make progress toward their goal of a sustainable society.

4. These principles of the sustainability policy model for CP were tested in a Korean CP policy context by using the triangulation method. Three types of data from different sources were collected: (i) from the empirical data worldwide; (ii) from the historical records and documents on the cases within the CP program; (iii) from the survey results of the 1998/2002 EFEC Program participants. This testing process was useful for both the scientific purposes of this thesis and for re-shaping of the Korean CP policy, because the current Korean CP policy, the EFEC Program that was started in 1995, was facing many problems. Therefore, the following questions had to be answered:

- Have the guidelines of the current EFEC Program satisfied the five guiding principles?
- Do the views and opinions of the EFEC Program participants support the guiding principles?
- Do the five guiding principles – individually and taken together, – help to generate useful and innovative insights for designing a more evolutionary, and sustainable CP policy for Korea?

5. This thesis author identified, from the historical data and the survey results, that the current Korean EFEC Program does not fulfil all five guiding principles. It was further revealed that there is a logical consistency among the five guiding principles and the survey results of the 1998/2002 EFEC Program participants that provide insights into the achievements and problems of the current EFEC program. (Chapter 9) Therefore, it was concluded that the five guiding principles can be helpful for generating useful and innovative insights for designing a new CP policy for Korea. It was inferred from the research results that the current CP policy of Korea may be placed in the initial stage of the proposed evolutionary policy model. The current EFEC Program has not developed new policy instruments designed to evolutionarily respond to the increasing demands of current and potential program participants for continuous improvement of CP implementation.

III. Recommendations

Based upon the proposed evolutionary sustainability policy model for fostering continuing implementation of CP and the empirical findings, Table A presents recommendations for CP policies in Korea. The fifteen prioritized policy options for promoting implementation of CP

(the right pillar of Table A) are clustered into the three developmental levels of CP policy (the left pillar of Table A) along the four motivational stages. Their rankings of necessity are in parallel with the developmental stage of the proposed evolutionary sustainability model for CP. The information in Table A highlights the logical consistency between the psycho-social motives of firms for CP implementation, the evolutionary sustainability policy model for CP, and the characteristics of the 'Fifteen Prioritized CP Policy-options' in light of the evolutionary policy model.

• According to this proposed sustainability model, the current EFEC Program of Korean government undertook only two options among fifteen policy options with relatively low priority rankings: the 10^{th} option (Public-private Partnership for 'End-of-pipe' Management) and 13^{th} option (Regulation/deregulation Program on 'On-site Recycling'). Therefore, the Korean government needs to adopt the other highly prioritized policy options including 1) Public-private Partnership Program for 'New Cleaner Technology' 2)Provision of 'New Cleaner Technology Information'3) Public-private Partnership for 'Process Modification' and 4) Technical 'Green' Training for 'Managerial Group,' into their new CP policies.

• It is strongly recommended that the Korean government should diversify its policy instruments of the EFEC Program much more than the current ones in order to bridge the various sustainability gaps. Under the conventional profit maximization assumption of private firms, it might be natural for industry to face various kinds of sustainability gaps. As the responsible manager of ecological systems, therefore, Korean government must have the vision for a sustainable society, which can make it possible for them to identify sustainability gaps, and to make efforts to reconcile the demands of the current economically oriented society and the aspirations for environmentally sustainable society.

• The Korean government should progressively shift its central paradigm of environmental policy from the current "Compliance Program" towards the "Sustainability Program" via the "Soft Compliance Program" and the "Voluntary Program." Further, governmental programs to promote knowledge/technology for CP must be extensively underpinned by the 'Triangular Knowledge Cycle' for CP implementation, which requires the harmonized links of the three types of knowledge required to close the sustainability gaps.

To summarize, two combined theoretical frameworks of this thesis were satisfactorily tested by diverse empirical studies. The "Evolutionary Sustainability Policy Model for CP," which is built upon the proposed, five guiding principles, and the "Triangular Knowledge Cycle for CP Implementation," which, together, can provide crucial driving forces for progressing beyond the current level of CP implementation in Korea, can also be useful for other societies that wish to design and implement CP policies to close their 'sustainability gaps' between community and industry and where there is the societal will to progress toward a sustainable society.

Table A: The Proposed Elements of the Evolutionary, Sustainability Policy Model for Fostering the Continuing Implementation of CP in Korea.

Theoretical Assumptions		Empirical Results
Firm's Evolutionary Psycho-social Motives for CP	Evolutionary Levels of Gov'tal CP Program	Required CP Program Options in Korea (Prioritized based upon the '98/'02 Surveys)
Pioneering Motive	**Sustain-ability Program**	1. Public-private Partnership Program for Development and Implementation of 'New Cleaner Technologies'; *2*. Provision of 'New Cleaner Technology Information';* 3. Public-private Partnership for making better 'Process Modification'; 4. Managerial and Technical '*Green*' Training for the Firm's 'Managerial Group'; 5. Public-private Partnership Program for making better 'Material Substitution'; *6*. Provision of Technical Knowledge on 'Design for the Environment';* 7. Public-private Partnership Program for improved 'Design for the Environment'.
Communal Motive	**Voluntary Program**	2. Provision of 'New Cleaner Technology Information'; *4*. Technical 'Green' Training for the firm's "'Managerial Group';* 6. Provision of Technical Knowledge on 'Design for the Environment'; 8. Provision of Technical Knowledge on improving 'On-site Recycling'; 9. Public Awareness & Education for the firms' 'Managerial Group'; 11. Provision of Technical Knowledge on 'Material Substitutions'; *12*. Provision of Technical Knowledge on 'Process Modifications'.*
Financial Motive	**Soft Compliance Program**	13. Regulation/deregulation Program on 'On-site Recycling' – the EFEC Program; - 14. Economic Instruments (taxes, subsidies) for developing New Cleaner Technologies; 15. Economic Instruments (taxes, subsidies) for implementing 'Process Modifications'
Compulsory Motive	**Hard Compliance Program**	10. Public-private Partnership for improving 'End-of-pipe' Management – the EFEC Program - • Various compliance programs based upon Legal environmental standards and guidelines • Command-and-control approach

Table of Contents

List of Tables

List of Figures

List of Terms and Acronyms

AV	Aesthetic Value
CK	Contextual Knowledge
CP	Cleaner Production
EFE	Environmentally Friendly Enterprise
EFECP	Environmentally Friendly Enterprise Certification Program
EMAS	Eco-Management and Audit Scheme
EMS	Environment Management System
EOP	End-of-Pipe
EPA	Environment Protection Agency, USA
EV	Ecological Value
GMO	Genetically Modified Organisms
HDC	Highly Developed Countries
IEE	Individual Company's Ecological Efficiency Level
ISO	International Standard Organization
KMOE	Korean Ministry of Environment
MGC	Marginal Governmental Cost
MPB	Marginal Private Benefit
MPC	Marginal Private Cost
MSC	Marginal Social Cost
MSB	Marginal Social Benefit
MV	Market Value
NGOs	Non-Governmental Organizations
NHDC	Non-Highly Developed Countries
OTA	Office of Technology and Assessment, USA
RK	Reconciliatory Knowledge
ROK	Republic of Korea
SD	Sustainable Development
SEE	Socially Sustainable Ecological Efficiency Level
TK	Technological Knowledge
TQM	Total Quality Management
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
VA	Voluntary Approaches or Agreements
WEF	World Economic Forum

Chapter 1 Introduction

> - Discovery commences with the awareness of anomaly, i.e., with the recognition that nature has somehow violated the paradigm-induced expectation that governs normal science (Thomas S. Kuhn, 1962). -

1.1 Problem statements

Different environmental problems arise in different ways in different contexts (Samuelson and Nordhaus, 1985). Pollutants take a variety of forms and lead to damage in a variety of ways. The conception of the environment covers a wide range of issues which changes according to the era and space. For example, in the nineteen-sixties, when the democratic capitalism of western society was flourishing, the basic psychosocial meaning of the environment was one of negative externalities of normal economic activities which prevented the market from functioning well, even though many economists classified environmental quality as an important public or collective good similar to national defense or public health.

As the environmental problems have diversified and globalized, the perception of society about the environment has changed beyond the externalities of the economic activities into something more important and fundamental. The Rio Declaration of 1992, states that environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it in order to achieve sustainable development (Agenda 21, 1992). Therefore, we need to recognize that the nature of an economically efficient environmental program is dependent not only on established rules and coherent goals but also on the type of pollutant under consideration (Perman *et al*, 1996) and a specific socio-economic context where the problem is situated.

The worldwide Cleaner Production (CP) movement was started in the early 1980s in the context of the dialectic evolution of the relationship between environmental policy and economic development. Even though the CP movement or pollution prevention efforts can be traced back to the 3 M company in the U.S. which started its Pollution Prevention Pays Program in 1975, (van Berkel, 1996), the worldwide environmental management campaign in the name of ‘cleaner production’ was triggered by UNEP’s efforts beginning in 1989 (Robins and Trisoglio, 1992)

The emergence of the CP programs since the 1980s was not due to any single factor but rather to a number of distinct forces converging to promote implementation of CP, including the emergence of the “Sustainable Development” (SD) world model, and an environmental policy paradigm shift from the ‘end-of-pipe’ approach to the ‘pollution prevention’ approach (Long, 1994). The CP programs of the early 1990’s expanded in scope and application as well as in methodology as shown by ecological industry policies and a series of ISO 14000 (Geiser, 2001).

Conflict and Concert of the two human visions

In the context of such diverse environmental movements and policies, when we look back on the history of environmental policy of the past three decades, it is not difficult to observe that there were two persistent and central forces that shaped environmental policy and its implementation: one is the paradigm of economics and the other is the paradigm of ecology. The paradigm of economics reflects the conventional, dominating social value since the advent of democratic capitalism in our society in the 20th century. On the other hand, the paradigm of ecology emerged as the antithesis of capitalistic vision of the 20th century. The report of the Club of Rome, the Declaration of the Stockholm Summit 1972 and Rio Declaration of 1992, are

symbolic and historical expressions of the ecological paradigm in our modern society.

The root of the ecological vision of human beings can be traced back to the natural philosophy of the Middle Ages or even earlier. Although, the natural philosophy has a long historical background based upon people such as Frances of Assisi, Rousseau, Goethe, Schweitzer who contributed much to its development; however their reflections and recommendations were not very influential for effecting changes in public attitude, at that time. For example, Schweitzer believed that the ethic of 'reverence for life' was the core answer to the question of how man and the natural world should be related to each other. (Palmer, 2001)

> A man is subordinate to the course of events which is given in the totality of life; on the other hand, he is capable of affecting the life which comes within his reach by hampering or promoting it, by destroying or maintaining it. …Let a man once begin to think about the mystery of his life and links which connect him with the life that fills the world, and he cannot but bring to bear upon his own life and all other life that comes within his reach the principle of 'reverence for life' (Albert Schweitzer, 1933).

Recent global environmental problems have awakened the social inactivity of the natural philosophy and have led to a new relationship between humans and the natural world. Many environmental declarations and multilateral environmental agreements have been concluded recently and the ecological paradigm has emerged very rapidly as one of the most important value-systems of our society due to the increasing environmental damage that is being caused by human activities. (See Caldwell, 1971; Pepper, 1996; Perman *et. al*, 1996)

However, one needs to recognize that these two visions – the economic vision and the ecological vision of human being - are basically different in many respects. Economic activities are one of the most fundamental human activities, based on human nature's desire to be free from poverty and his/her desire for economic wealth. The economic paradigm has been one of the most important gravitational forces in the construction of human society, culture, and history. Adam Smith, the founder of the philosophy behind the modern market economy stated:

> It is not from the benevolence of the butcher, or the baker that we expect our dinner, but from their regard to their own interests. We address ourselves, not to our own necessities but of their self-love. Man is led by an invisible hand to promote an end, which was no part of his intention. By pursuing his own interests he frequently promotes interests of the society more effectually than when he really intends to promote it (Adam Smith, 1776).

Man can accumulate or save or invest the profits of his economic activity as he wishes. The accumulated riches can be used to provide him higher social prestige as well. In this context, a good government would be expected to refrain from interfering with individual enterprises and private people's economic behavior.

In contrast, the ecological impacts of an individual enterprise or individual person are usually motivated not by *its self-interest,* at least in light of the short-term perspective, but primarily by its social responsibility or its aesthetic appreciation for cleaner products and living conditions. Benefits from ecological activities, unlike those of typical economic activities, are usually provided for many, both in the short-term as well as in the long term. The actor cannot appreciate it exclusively by himself. (Samuelson, 1985) Nor can he reserve or accumulate the benefits from ecological activities in order to use or invest them by himself later. Rather, the results of ecological activities contribute to recovering or improving the shared ecological assets of the community. The goal of ecological activities cannot be achieved by the sum of each member's ecological inputs; instead the ecosystem supplies benefits for all members of the

community, without preference. In general, the market cannot work well in allocating ecological goods.
Therefore, ecological activities, whether of firms or of private people or of governments, are not the result of primary human nature. Rather, they come from moral or social backgrounds. When a community wants to sustain a sound ecosystem within the community, each member of the community should conduct his/her ecological duty in a concerted way. Such a fundamental difference in the ethical foundations of the two paradigms may account for why economists and ecologists find it so difficult to agree on many environmental issues. (See Peman *et al*, 1996)

This thesis author does not wish to deepen the philosophical debate between the two in this study, but wishes to remind us that the term *sustainable development, an overarching idea of our age,* is a constructed merger of the two different paradigms. This means that *sustainable development*, as a goal of post-industrial society, is not a foregone conclusion from past empirical studies for our society but has become a normative political goal of certain industrialized nations. According to the most frequently quoted definition of sustainable development proposed by the Brundtland Commission (1987), ``SD is development that meets the needs of the present without compromising the ability of future generations to meet their own needs`` (WCED, 1987; Holmberg and Sandbrook, 1992). Thus we can understand easily that the philosophy of SD does not have its own built-in driving system, but indicates a normative goal for our global society to pursue. It does not entail subsequent methodological approaches and policy instruments to reach its goal.

Therefore, if a society endeavors to make a positive advancement in the way of SD, it must accept that it might face unexpected fundamental complexities, frequent trade-off situations and time-consuming implementation-processes. To achieve the vision of SD requires that the society should have an innovative and systematic way of thinking to ensure its sustainability. To this end, every appropriate part of the social system also needs to make an effort to develop practical and culturally/regionally approaches and instruments for attaining the aspired goal of SD.

Problem statement for the implementation of Cleaner Production (CP)
Assuming that sustainable development (SD) has been developed as an ideological dimension of our age like ‘the liberty of the people’ or ‘the justice of the country’, at least based upon two authoritative documents: the ‘Brundtland Report on Environment and Development’ for introducing the vision and definition of SD, and the Agenda 21 for implementing SD as a result of Rio Earth Summit 1992 (UNEP, 2002), it would be helpful for sorting out complicated SD-related terminologies to re-categorize the wide range of potential SD activities into several sub-categories in terms of the following perspectives:

(i) Economic approaches: *sustainable production*, sustainable consumption, sustainable service and trade, etc.
(ii) Thematic approaches: climate change, biodiversity, desertification, hazardous wastes, supply of fresh water, etc.
(iii) Political approaches: governance for sustainability, sustainable technology, indicators for sustainable development, sustainable finance, regulations for sustainable development, education and training for sustainable development, social ethics for sustainable development, etc.
(iv) Geographical approaches: sustainable Africa, sustainable Pacific, sustainable Switzerland, sustainable Seoul, etc.

According to the suggested categories, CP activities are one of the social efforts for SD in the area of the economic production sector. Considering that the production sector is the most

important area of the key economic activities – such as production, consumption, investment, trade, and government - in conventional economics, the environmentally successful management of the production sector in our society such as industry and business must be one of the key determinants of SD (Agenda 21, 1992). As evidence of the importance of the supply side in achieving SD, it is noteworthy that *a wide array of environmental action programs similar to CP* have been designed and implemented so far. This is exemplified by the pollution prevention programs, ISO 14000 environmental management, the 'Responsible Care Program,' eco-efficiency programs, Green Productivity, development of ecological economics, industrial ecology activities, and many country-specific or company-specific environmental programs, etc. Even though most of these activities have their own background and methodologies, they also share many overlapping areas with each other and thus contribute to the advancement of sustainability in the production sector.

When CP activities are defined as 'the continuous use of industrial processes and products to prevent the pollution of air, water and land, reduce waste at the source' (UNEP, 1994), they have at least three basic characteristics:

i) CP is a preventative environmental management movement in the industrial sector;
ii) CP activities focus on developing not only more environmentally sound but also economically beneficial systems of production beyond governmental regulations;
iii) The CP movement requires intrinsically *evolutionary* [1] and environmentally positive changes in the production processes.

In line with many environmental management systems in the developed countries as well as the adoption of Agenda 21, in 1992 in the global society, the CP approach has spread extensive applications rapidly and many kinds of practical tools have been developed. [2] There have been international conferences, national roundtables, and recently the development and adoption of the UNEP International Declaration on Cleaner Production has accelerated the adoption of CP (Geiser, 2001).

However, despite the steady increase of the number of companies considering CP (Berkel, 2001), progress on CP has slowed, particularly in the more developed countries (Geiser, 2001). In many developing countries, the CP strategy is showing serious limitations in many respects (Mebratu, 2002; Hamed, 2002). Many CP practices are not gaining evolutionary momentum, nor are their inherently sound principles being widely accepted, at least not without overcoming the constraints and barriers to their adoption (Berkel, 2001). Even the number of ISO 14001 certified companies in the developed countries is limited to about 0.5% of total enterprises including services and wholesale sectors (ISO 14001, 2002 Statistics; Kornevall, 2002). Korea is not an exception as a country with lukewarm CP implementation activities. Since the adoption of a CP program – the *Environmentally Friendly Enterprises Certification Program* (EFEC Program) - in 1995, many CP performers including EFECP participants have not kept up their initial efforts (KMOE, White Paper on the Environment 2001).

1.2 Research questions and hypotheses

CP and the Sustainability Gaps

Why is the development of CP so slow and the implementation of CP is not widely accepted by firms in spite of its economic and environmental benefits?

Once a company begins to implement CP, they can utilize a very wide range of CP options such

as ‘changes of input material’, ‘changes of process technology’, and ‘changes of product or product-design’ by each production facility. From an economic point of view, however, even if a company has good CP ideas in each step of the production process, the company, as a practical actor and provider of CP service, will be very cautious in adopting the suggested CP options, for the CP approach does not have a mandatory requirement for the company to accept it without conditions or prior assessment. The actual adoption of CP depends primarily on the managerial decision of the firm. The environmental regulatory system does not force the firms to adopt and implement specific CP approaches.

Therefore, it can be envisaged that many company leaders implement CP practices on the condition that they benefit business or at least not lessen its economic profits according to the company’s expectation. At this point, a couple of fundamental questions about CP are raised.

Is the CP approach really an economically beneficial and environmentally sound approach based on voluntarism?

Theoretically, this is possible. Practically, there are many contradictory views and statements published, especially concerning sustainable development activities which are usually designed to integrate ecological activities with economic activities or economic activities with ecological ones. For example, even though an economic activity is good and right for a particular actor, the same activity could be bad and wrong for the whole community, as we know from the G. Hardin’s ‘The Tragedy of Commons.’ Likewise even though an economic activity might be good and right in the short-term, the same economic activity could be bad and wrong in the long-term, for instance when ecological economists make assertions on the unsustainable use of natural resources. Also, even though an economic activity is correct and acceptable in an industrial area, the same could be bad and wrong in a national park.

CP is usually being implemented or being considered for implementation - in such contradictory social situations. The thesis author terms these contradictory phenomena, ‘sustainable development *conflicts*’ and identifies the social differences between economic values and ecological values on sustainable activities as ‘*sustainability gaps*’. These are mainly caused by different social functions, different time-dimensions, and different community-environments.

Therefore, if successful implementation of sustainable development is the first and foremost responsibility of Governments (Agenda 21, 1992) and environmentally sound management approaches such as CP in the production sector are among the necessary elements that are conducive to making progress towards a sustainable society; *it is significant to characterize behavioral patterns of firms concerning CP: (i) Why do firms not implement CP? (ii) Why do firms implement CP? (iii) If they have implemented CP, what are the main driving forces for it?* These three questions are facets of the same thing. Considering that the number of CP-performers is much smaller than that of non-CP-performers, this thesis focuses on analyzing why firms implement CP.

Motivational structure for implementing CP

Which type of motivation is the most influential factor for implementing CP empirically? Do one or two motivation items dominate the top priority in terms of decision-making? Or is there any motivational collaboration among various CP-motivators?

Normatively speaking, when a private company seeks to conduct a SD activity by implementing CP options only from an economic viewpoint, it might be difficult to keep up the continuing driving force of CP within a firm. Because frequently, the ecological benefits from a CP

approach may not return its economic benefits exclusively and directly to the actor and broader perspectives must be incorporated within the evaluation criteria. If a firm invests in restructuring its existing production system for recycling waste, the CP activity might not bring benefits directly and exclusively for the company. It will take time for the company to be paid back by the new, cleaner system. In some cases, it may be impossible for the company to be paid back fully by the criteria of the firm's conventional accounting system. The ecological effect of a CP activity, however, directly and continuously contributes to enhancing the quality of environment of the community. This dual value-system of a firm's economic activity towards sustainability might be one of the most critical characteristics of sustainable activity of the private sector represented by the CP approaches.

Therefore, even if a community targets pursuing a sustainable society, and the industry and business are necessary actors of the sustainable society, and CP practices are prerequisite to enhancing sustainability of the private sector, firms may not have sufficient resources and willingness for continuous CP implementation by themselves. As a corollary, *in order to narrow such sustainability gaps the other economic actors of society, especially governments as providers of public goods, need to encourage and facilitate the CP activities of firms.*

Therefore, it is meaningful to identify the driving forces of firms for CP implementation in the real world. This thesis analyzes the results of a motivation survey of the firms worldwide, which have implemented CP. The results of the motivation survey provides useful knowledge and information not only on how correctly our society can identify such sustainability gaps between the economic viewpoint and the ecological context in a real industrial setting, but also how effectively social subsystems work together to bridge them.

Need of social collaboration for continuing CP and 'linked triangular knowledge'
From a semantic and empirical point of view, SD and CP have many similarities. The first similarity is their dualism. The two phrases address both economic and ecological activities. The term 'sustainable development' is the combination of at least two conceptions: 'sustainable life-supporting system' and 'economic development'. "Cleaner production" is the mixed conception of 'cleaner' and 'production'. Ecological and economic activities have basically different motivation, different driving forces, and different visions.

The two expressions have inherently double value systems in one explicit activity. Therefore it can be reasoned that achieving such dual-purpose activities at the same time is inherently very difficult and complicated. Secondly, the two are considered as politically compromised goal-oriented expressions designed to satisfy the demands of socially different groups. They are not derived from accumulated scientific research or from conventional social phenomena. The two concepts do not provide the detailed guidelines for making progress with social phenomena. They are focused upon political goals. Thirdly, even though the two are the result of compromise within the existing society, both contain ideal and desirable objectives, which the members of society must pursue. In this sense, the expressions themselves may contain latent solutions. Fourthly, even though the term 'Sustainable Development' was suggested officially by the Brundtland Report on Environment and Development and 'Cleaner Production' was started as the name of a program of UNEP/Industry and Environment (Robins and Trisoglio, 1992), it is noteworthy that the two phrases 'SD' and 'CP' have been established as newly constructed concepts in our society (Baas, 1995; Hannigan, 1995).

One of the differences between them is that SD focuses on a macro and long-term perspective which national or international governments are interested in. In contrast, CP has a micro and corporate-oriented perspective, which the business and industrial community are interested in.

Two questions can be raised about CP in terms of enhancing the sustainability of a society in consideration.

Is continuous implementation of CP possible? If it is possible, what are the necessary conditions for ensuring continuous implementation of CP?

These questions implicitly indicate that the application of the CP approach may not continue effectively if it is done without the appropriate internal and external motivation systems, which may enable the continuous, higher level of CP implementation, over time.

Adam Smith believed that individual's selfishness to be rich, leads to social welfare in a natural way. Many reports on CP cases and CP manuals, however, highlight various constraints on implementing CP practices. Many of those generic constraints on implementing CP suggest that they are not purely economic, but dualistic activities, which are a mixture of economic and ecological activities. [3] Some firms usually think that many kinds of barriers to CP are beyond their managerial concerns. Widespread pollution from general industrial activities in the past proves that the ecological impacts of their production are considered as external factors. It is recognized that the ecological activities of firms have usually been conducted by being motivated by certain kinds of external pressures. Because ecological activities cannot be accumulated on a personal level and the benefits from the activities cannot be given to the actor exclusively (Taylor, 1998), the inherent property of the ecological activities of firms cannot meet their goals of profit-maximization. A normal corporation does not have the natural willingness to conduct ecologically sound activities continuously.

In this regard, this researcher hypothesizes that the continuous development of a new knowledge system of CP should facilitate the integration process of different social subsystems in implementing CP (See, Karl-Heinz Ladeur, 1994). The new knowledge system for CP has to include three necessary areas:

(i) Identification of social circumstances surrounding CP needs;
(ii) Technological information and knowledge for CP options;
(iii) *Social reconciliatory language to link the CP needs and technical CP options*.

This researcher has designated these as the contextual knowledge, the technological knowledge, and the reconciliatory knowledge of CP respectively and their conceptual relationship as the *'triangular knowledge cycle'* for CP. (Chapter 2 & 3 describe the conception of the 'triangular knowledge links for CP in more detail.') It can be envisaged that if such newly reformulated and integrated knowledge beyond the specific social group and specific discipline are established and provided in the implementing processes of the voluntary program approach, they are expected to facilitate and drive the continuous implementation of CP. Among these related different social subsystems for implementing CP, this thesis author focuses on developing the adequate role of government in continuing CP implementation towards a sustainable society.

Research questions and hypotheses of this thesis

Therefore, the basic research questions of this thesis are:
- Within the framework of such triangular knowledge links for CP, what types of policy are adequate for the continuous implementation of CP?
- Are there any guiding principles which help to design and implement such sustainable policies for the continuous implementation of CP?

These research questions were raised based upon three fundamental recognitions in designing an

adaptive and effective policy to encourage CP implementation. First, if the CP is a typical 'sustainable activity', CP policy should be basically different from the conventional environmental policies. According to Baumol/Oates' classification, conventional environmental policy instruments are classified into four broad categories; direct controls (e.g. regulatory approaches), economic instruments (e.g. financial measures), government investment (e.g. providing municipal treatment plants), and moral suasion such as voluntary approach (Baumol/Oates, 1975). [4] All these policy instruments can be taken as tools for encouraging implementation of CP (UNEP, 1994). For example even tough regulations could stimulate innovation such as superior technologies and improved environmental performance, making firms generally fitter and more competitive (Wallace, 1995). Further, there could be a direct link between government regulations and the CP approach in a fashion that the formulation and implementation of company CP plans should be compulsory conditions for granting of license (Dieleman and Hoo, 1993). Economic instruments such as taxes, charges, subsidies, etc. can also harness their own energy and creativity to find the best way to reduce emissions by including the CP approach (Field & Field, 2002). However, these three salient conventional instruments have been developed as basic tools for the 'command-and-control' pollution control approach.

It is not appropriate for environmentally-sound creative activities or innovations of the firms to be the objective of legally-binding regulations and economically-oriented instruments, because a system of direct control or direct financial instruments such as taxes have a legal basis over the target activity and must be operationalized through a range of implementing structures and procedures to ensure compliance (Gouldson & Murphy, 1998). Considering that CP can be and should be a SD activity beyond the 'command-and-control' approach in the industrial sector, which incorporates a basic production activity into an ecological factor through various CP options in a preventative and creative way, policy forms for CP implementation need to be different from the conventional patterns. (David Wallace, 1995) [5]

Secondly, if CP activities are economically beneficial and ecologically sound, CP policies should be designed and implemented based upon the practical identification of the main driving-forces for implementation of CP and the behavioral patterns of CP-suppliers in a society. Some approach sustainable activity with a view of improving social image. Some CEOs view it from the point of management. Some environmental activists support it from an ecological viewpoint. Therefore, different from standardized and compulsory responsibility for the environment in the end-of-pipe approach, it is more important in CP policy for government and industry how to adaptively apply various policy tools to *a specific problem situation* in an economically effective and ecologically sound manner. [6]

Thirdly, a society where CP implementation is confined within an in-house technological framework cannot ensure the continual improvement of CP implementation. Consequently, *the sustainability gaps* in the industrial production area would not be reduced without external motivations.

Therefore, government, as one of the most important sub-systems in the society, should cultivate the appropriate socio-economic conditions for the industrial sector to have easy access to CP approaches, if a sustainable society is to be achieved. In this point, these research questions refer to 'how can government design and implement, in an economically beneficial and environmentally sound manner, the socially reconciliatory policies and programs that link the CP needs of the community and the technical CP options of the potential or existing CP firms.' Therefore, this thesis is designed to help develop the policies of a sustainable society.

Hypotheses of this thesis

In order to develop this sustainability policy model for continuing CP, this thesis researcher developed the following five hypotheses:

(*H*1) The CP supplier's (e.g. firm) motivational pattern of CP implementation evolves with four developmental stages: the compulsory motive, the financial motive, the communal motive, and the pioneering motive.

(*H*2) In implementing a CP practice, there is a psycho-social gap on the desirable level of sustainability between the demander's (community) aspirations to ensure that these options are implemented and the supplier's (a firm) willingness to supply and implement them. This researcher calls this the '*sustainability gap*' in CP. To bridge these 'sustainability gaps' is the main objective of a sustainable CP policy.

(*H*3) Not only company-related factors but also community-related factors and government-related factors work together as joint determinants for CP implementation. Some governmental factors could be the primary determinants of CP implementation.

In evolutionary stages of CP implementation, *the harmonized triangular knowledge links for CP* based upon those collaborations among different social subsystems play a role as the central driving force in changing the current level of CP implementation into more upgraded level of CP implementation.

(*H*4) In order to promote continuous implementation of CP, governments are required to play a reconciliatory role between the societal aspiration for CP and the practical will of firms for CP implementation, having the vision for a sustainable society.

(*H*5) In order to effectively close the sustainability gaps which may be generated in the process of CP implementation, the governmental CP programs should be designed and implemented in adaptive and evolutionary ways to enhancing the sustainability of industry and business, based upon the framework of the *triangular knowledge cycle* for CP implementation.

An '*adaptive and evolutionary approach'* for CP implementation is different from the standard-oriented regulatory approaches; in this situation, a government has a policy flexibility, which makes it possible to adjust its policy-instruments according to the technological situation and the changing contexts.

Through finding evidences to support or to falsify the proposed hypotheses based upon the results of empirical studies, this thesis author developed the guiding principles of a sustainable policy for the continuous implementation of CP, which are the essential characteristics of the proposed evolutionary sustainability policy model.

1.3 Overall research structure of this thesis

1.3.1 Part I. Introduction to the thesis

Part I presents the problem statement that CP implementation has not made satisfactory progress at the national and global level and continuous improvement of CP implementation has not been made satisfactorily at the corporate level in spite of its being recognized as a necessary way to sustainable development (Agenda 21, Chapter 30) and it introduces theoretical background of why such contradictory phenomena could happen in the area of CP. Based upon these practical and theoretical recognitions, this author suggested research questions and hypotheses to help to

solve these fundamental problems which CP is facing with, focusing on how to develop desirable governmental policy model for continuous CP implementation.

In order to address these research questions and to test these five hypotheses, this thesis author designed the following research strategy which is comprised of three main parts:

(i) The theoretical framework of CP (Part II): This thesis starts with identifying, theoretically, the socio-economic system for implementing CP activities through a systematic approach. mental
Key conceptions: sustainable society, four types of motive for CP implementation, sustainability gaps, evolutionary dynamics of industry for CP, triangular knowledge links for CP;

(ii) Analyses of two empirical studies and development of the sustainability policy model for CP (Part III): This part, as the main body of the thesis, presents the design of an evolutionary sustainability policy model for promoting CP based upon the analyses of two empirical case studies. Based upon main findings of these two empirical studies, it explores the five guiding principles of the sustainable policy to ensure the continuity of CP within a country. These guiding principles constitute the main characteristics of the proposed '*Evolutionary Sustainability Policy Model for CP.'*
Key conceptions: rankings of motivation items for CP implementation, motivational structure, technological knowledge of CP, CP-suppliers, guiding principles of sustainable CP policy;

(iii) Testing of the proposed five guiding principles of policy model (Part IV): This section aims to test the developed sustainability policy model in a Korean context by analyzing the results of Korean CP Program evaluation surveys, suggesting policy recommendations to enable the continuous CP practice in Korea in light of the proposed evolutionary sustainability policy model.
Key conceptions: EFEC Program, degree of necessity of governmental involvement in CP plans, more risky CP options, less risky CP options, preference for policy instruments, desirable CP programs in Korea

Following sections describe the research strategy of each part adopted in this thesis.

1.3.2 Part II. Theoretical characterization of CP implementation system

One of the main purposes of this thesis is to provide insight of CP activities within the framework of socio-economic structure and to find a sound way to cultivate SD culture in industry and business. [7] Part II (Chapter 2, Chapter 3, and Chapter 4) of this thesis identifies theoretically, the contextual system, structure, and policy model of CP implementation.

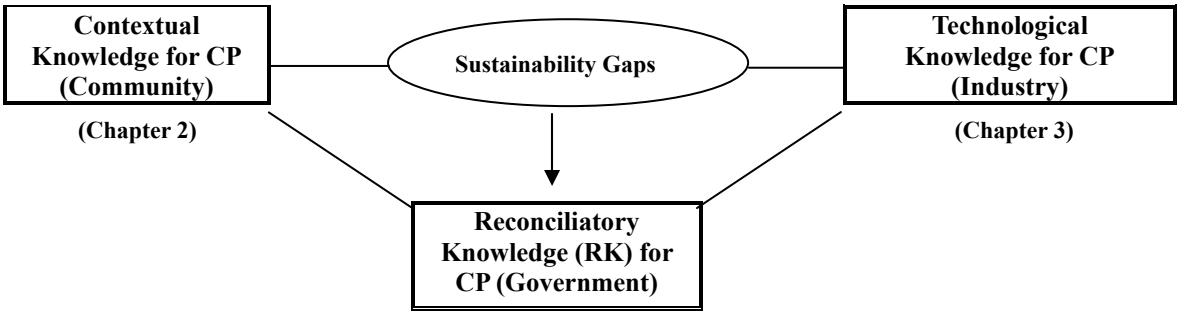
First, this thesis takes a problem-solving approach. The purpose of the research is to attempt to address the proposed research question as to 'How can governments help existing and potential CP companies to implement CP activities in a continuous and evolutionary way?'

Secondly, in line with the problem-solving approach, this research is based on an interdisciplinary approach to the problems. Many researchers in CP used to address the issue from a specific disciplinary point of view or from a technological perspective only. The fact is that in developing a theory for environmental problem solving, in-depth, discipline-specific approaches to CP implementation are required. However, a specific discipline's point of view or a special social sub-system's perspective is not enough to provide effective solutions for the

continuing implementation of CP. Therefore, comprehensive, interdisciplinary perspectives are required to identify the mechanisms of CP implementation and to suggest effective policies to ensure it. [8]

Based on the interdisciplinary approach to explaining the structure and the system of CP, the thesis author developed a basic conceptual framework to ensure the development of evolutionary CP policy- '*Triangular Knowledge Cycle for Cleaner Production'*. This conceptual framework presupposes that a sustainable society requires the 'reconciliatory knowledge' of a government to play a *reconciliatory* role between the 'contextual knowledge' of the CP-demander (a community) and the 'technological knowledge' of a CP-supplier (a firm) (see Figure 1-1).

• **Figure 1-1: Simplified Theoretical Framework for CP Implementation (Part II)**



Therefore, these three types of knowledge are normatively necessary components for continuous CP implementation. [9] (See Chapters 2 & 4.) In order to clarify the adequate role of government for promoting continuous CP implementation, Part II addresses three theoretical parts of CP activities:

(i)The theoretical analysis on contextual social subsystems of CP (Chapter 2);
(ii) The theoretical analyses of the structure of CP from the technological, economical, and legal perspectives (Chapter 3);
(iii) The theoretical mechanism of the CP implementation process (Chapter 4)

1.3.3 Part III. Two empirical analyses on successful CP cases and development of evolutionary sustainability policy model

Part III (Chapters 5, 6 & 7) of this thesis is designed to present the evolutionary sustainability policy model for CP by incorporating the results of analyses of two empirical data sets as foundations of the theoretical framework of '*triangular knowledge links to CP'* (Part II). The first empirical study analyzed the results of the motivation survey for CP of 59 successful companies worldwide. The second empirical study analyzed UNEP's documentary data on 100 successful CP cases. [10]

i) A questionnaire to identify patterns of CP motivation: This researcher conducted survey of CP companies worldwide to identify the primary, secondary and tertiary motivations for adopting CP activities. The questionnaire was comprised of two main questions to obtain insight into their present and future determinants in adopting and developing CP practices. [11] [12]
The survey was designed to identify: (a) Patterns of CP motivation and their relative weighing; (b) Degree of social collaboration between government, company, and community; (c) The importance of government in promoting CP. In order to identify indirectly the interrelationships

among three social subsystems in implementing CP, the questionnaire asked the respondents to prioritize their top three motivations for implementing CP among fifteen motivation items, which were given. The fifteen items consisted of five government-related items, five industry-related items, and five community-related items, respectively. The results of the motivation survey were expected to provide the 'contextual knowledge of CP'.

ii) Data on the behavior of CP implementation in the supply side: types of supply of CP options: In order to identify the behavior of CP implementation in the supply side, this author conducted a secondary analysis of 100 success cases of CP implementation, derived from the UNEP CP Database from 1979 to 1998. The periods of 1979 to 1998 covers the initial, developmental stage of the CP program of UNEP. [13] The purpose of this analysis was to identify empirically, the technological patterns of CP activities from a suppliers' perspective. [14]

To this end, the data from these case studies were re-categorized according to the four suppliers' (or firms') managerial factors available: (a) technological types of CP (b) initial capital investment (c) payback period (d) eco-efficiency. In light of the 'triangular knowledge links to CP,' the results of this analysis provide the 'technological knowledge of CP' and made it possible to identify qualitatively where the sustainability gaps exist.

(iii) Data collection methods and expected results of these two empirical studies are presented in Table 1-1.

Table 1-1: Data Collection Methods of Two CP Case Studies and Expected Results

Data Collection Methods	Topics and Respondents	Linking with theoretical framework
1. Questionnaire survey of cleaner production companies worldwide (1998)	● Topic: 6 questions - decisive determinants in adopting CP (now and future) ● Respondents: 59 respondents among 250 sample companies worldwide - acceptable response rate: 23.6%	● Contextual knowledge of CP ● Practical demand for CP ● Present rankings of CP motivators ● Expected rankings of CP motivators ● Cooperation mechanism of CP ● Hypotheses test : H2, H3
2. 100 Cleaner Production Cases worldwide selected randomly from UNEP CP Database ● 1st periods '79 –'89: 25 cases ● 2nd periods '90 – '98 : 75 cases	● Topic: Data sheet of 100 successful CP cases ● Data items: country, industry, type of CP, capital investment, payback period, eco-efficiency	● Empirical definition of CP ● Technological knowledge of CP ● Hypotheses test : H2, H3, H4

(iv) By incorporating the results and findings of these two empirical analyses into the theoretical framework of CP identified in Part II, the thesis author develops *the evolutionary sustainability policy model for CP*. Based on this evolutionary sustainability policy model, the author also characterizes the guiding principles of a sustainable society under consideration to maintain continuous CP implementation.

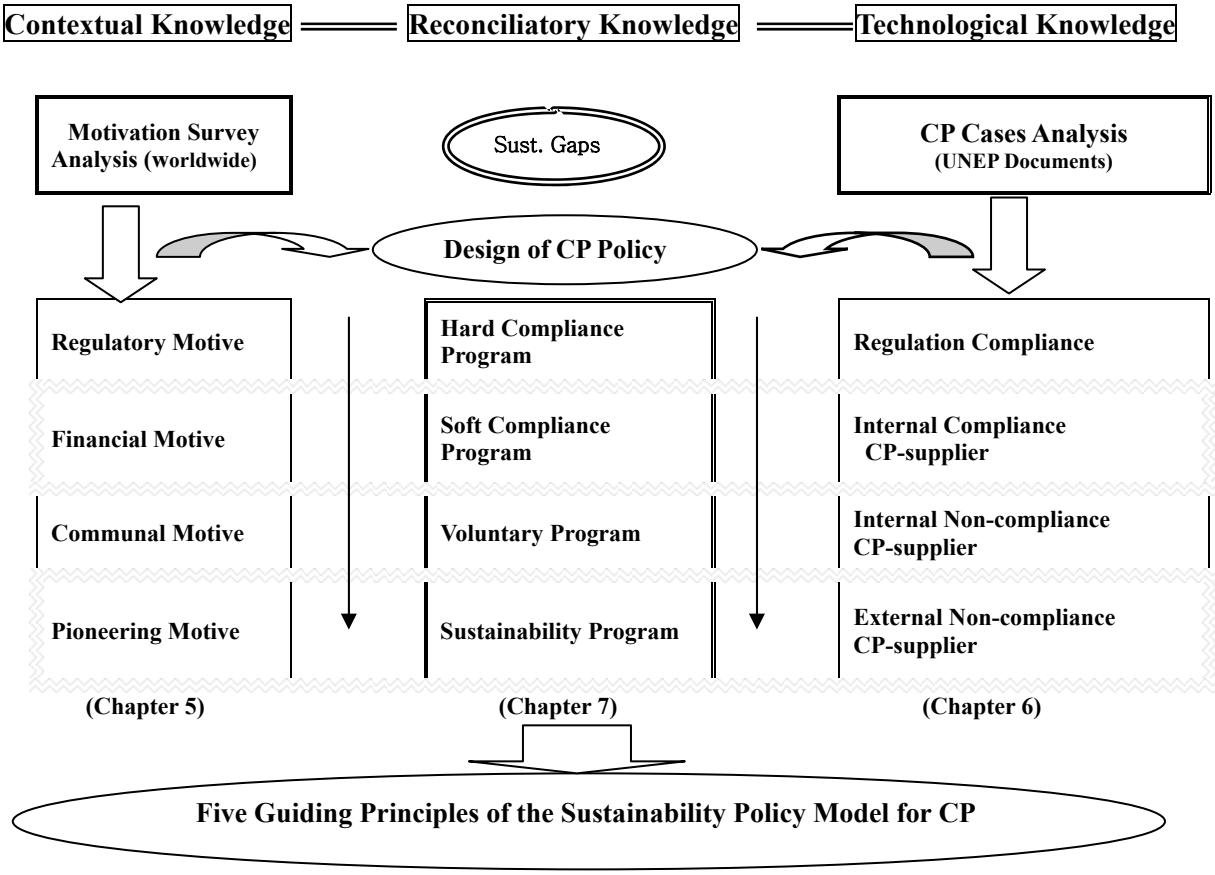
These suggested guiding principles should constitute the main objectives of governmental policy for CP so that governmental policies, based on the guiding principles, may bridge the sustainability gaps between industry and community. An environmentally sustainable government should reconcile the technical constraints of firms in terms of CP implementation with social demands for the sustainable society. Therefore, a reconciliatory CP policy can be

envisaged only through recognizing the framework of the evolutionary policy model (see Figure 1-2).

Thus, this model-building process has three steps:

- Chapter 5: Empirical identification of patterns of motivation for CP implementation (*Contextual knowledge*) and the empirically required role of government for CP implementation;
- Chapter 6: Empirical identification of technological approaches for implementation of CP, capital investment, payback period, and eco-efficiency (*Technological knowledge*) and development of patterns of CP-supply;
- Chapter 7: Design of the evolutionary sustainability policy model for CP with developmental patterns of CP policy (*Reconciliatory knowledge*) and development of adequate preconditions of a sustainable society with continual CP implementation.

Figure 1-2: Design of the Evolutionary Sustainability Policy Model for CP (Part III)



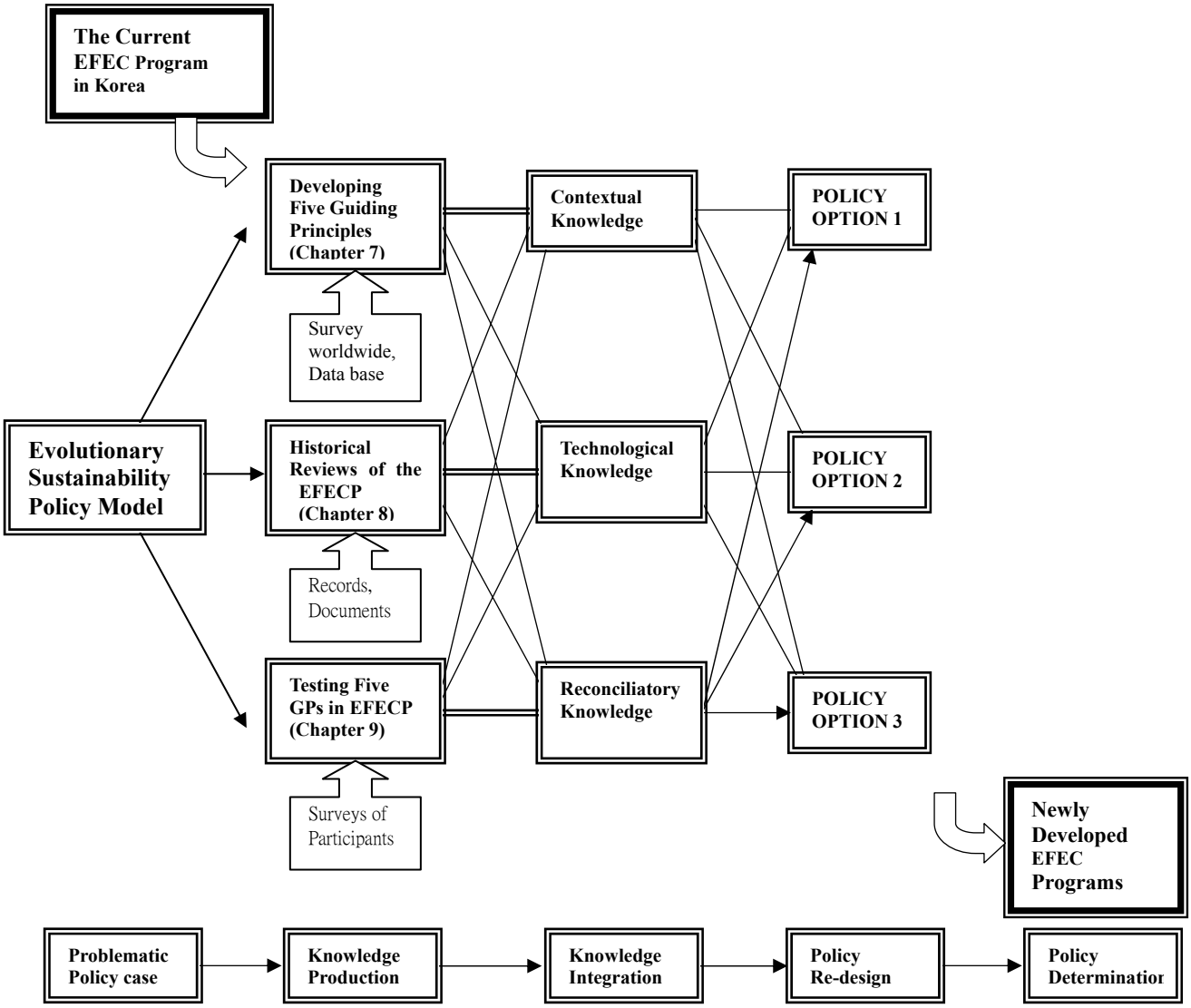
1.3.4 Part IV. Testing the developed evolutionary sustainability policy model in a Korean policy case

Part IV is designed to test the developed model and the five guiding principles in a Korean CP policy case (see Figure 1-3). In Parts II &III, the evolutionary sustainability policy model for continual implementation of CP was developed. It is grounded in four evolutionary psycho-social motives of firms for CP: the compulsory motive, the financial motive, the communal motive, and the pioneering motive. Such a developmental pattern of firms for CP implementation is identified

empirically in Part III. Based on the proposed evolutionary sustainability model, five guiding principles of a sustainable society for continual CP implementation are proposed in Chapter 7.

The Korean government started the 'Environmentally Friendly Enterprise Certification Program' in 1995 (EFEC Program). Considering that the Korean environmental policies had been dominated by the command-and-control approach based on legally-binding emission standards, it is a unique voluntary agreement approach in Korea. [15] The term 'Environmentally Friendly Company' is almost the same concept as 'CP practitioner.' Therefore, it was theoretically and practically meaningful to test the developed sustainability policy model for CP by examining how well the EFEC Program was designed and implemented and to suggest a new CP policy in Korea.

Figure 1-3: Overall Testing Framework of the Evolutionary Model in the EFEC Program



The thesis author obtained data and information mainly by conducting the EFEC Program Evaluation Surveys of participants companies and partially by historical documents of Korean government and related statistics and records available.
The survey was designed to evaluate the EFEC Program by program-participants themselves and to

explore more effective CP policy by querying their views and opinions regarding the ongoing EFEC program and their preference for governmental policy instruments to encourage firms' CP implementation. [16] This thesis author conducted these surveys once in 998 and once in 2002. Survey samples were derived from participant firms of the EFECP – from 102 firms in 1998 to 108 firms in 2002. Table 1-2 presents data collection methods, main questionnaire items and expected results of this EFEC Program Evaluation Surveys. [17] In order to obtain more data and information to empirically identify the achievements and barriers of the EFEC Program the author utilized governmental documents such as collected best practices (KMOE, 1998) and official statistical data of the EFEC Program. [18]

Table 1-2: Methods of 1998/2002 EFEC Program Participants Surveys

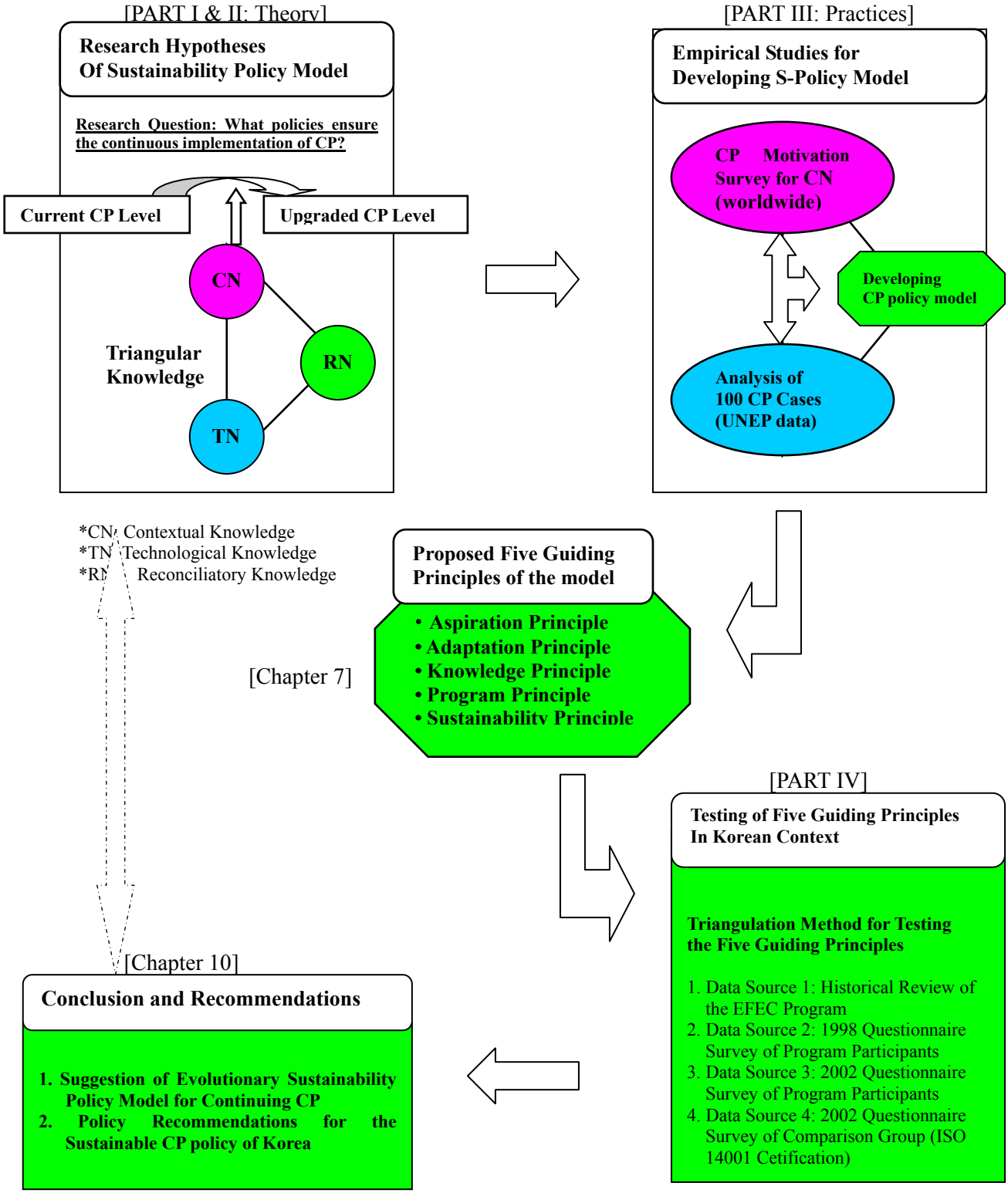
Data Collection Methods	Topics and Respondents	Linking with theoretical framework
Questionnaire survey of the EFE Program participants in Korea ● First survey: 1998 ● Second survey: 2002 * As a comparison group survey of Korean ISO 14001 companies was also conducted with the same questionnaire.	● Topic: 'the role of government for encouraging 'environmentally friendly companies' (29 item 117 questions) - ecological situation and opinion about cleaner production - effectiveness of the program - desirable role of government ● Respondents: - First Survey: 77 respondents among 102 firms (KEFC program) *acceptable response rate: 75% - Second Survey: 80 respondents among 108 firms (KEFC program) *acceptable response rate: 74% - Third Survey: 73 respondents among 220 firms (ISO14001 program) (excluding overlapping companies with KEFC companies) * acceptable response rate: 33%	● Reconciliatory knowledge of CP ● Evaluation of Korean CP Program ● Cooperation mechanism of CP ● Company's preference on CP Policy ● Best 10 policy-associations between three subsystems and worst 10 policy associations between three subsystems in Korean CP-policy case ● Hypotheses test : H1, H2, H4, H5,

Triangulation method to test the proposed model

Considering that the results of the survey do not prove directly that the hypotheses are right, the researcher used the triangulation method to test the guiding principles of the proposed sustainability policy model [19]– in this thesis, three types of data from different sources: (i) from the empirical data worldwide (See Chapter 5 & 6.); (ii) from historical records and documents on the case CP program (See Chapter 8); (iii) survey results of CP program participants (Chapter 9) - in order to enhance the validity of the data. Through this triangulation method, he provided a firmer foundation for evaluating the findings against the hypotheses.

Therefore, this testing process of the proposed sustainability model (Part III) is comprised of three steps. The first step was to review a current Korean CP policy and evaluate its achievements and challenges by historical data, official documents and records in terms of the evolutionary sustainability policy model. The second step was to test five guiding principles of a sustainable society for continual CP implementation mainly by survey results of the EFEC Program participants. The third task included the development of a new CP policy in Korea; that is, new reconciliatory knowledge of the Korean government for continual CP implementation by analyzing the survey results of EFEC Program participants.

Figure 1-4: Overall Roadmap of the Research Strategy



1.3.5 Part V. Conclusions and recommendations

By undertaking these integrated research strategies, this thesis author developed and tested the evolutionary sustainability policy model for continuing CP implementation, which is characterized by the proposed five guiding principles. Consequently, based upon the empirical findings and the proposed guiding principles, this author recommended the sustainable CP policy sets to ensure continuous implementation of CP in Korea.

Figure 1-4 above summarizes the overall roadmap of the research strategy of this thesis.

NOTES

1. 'Evolutionary' here generally refers to any process of change over time. Especially in this thesis, it is used in terms of the sociological view that a social organization or system has to pass through certain stages over time as it moves from being simple to developed or complex in its system, organization, and culture. That is why it is called 'Clean**er**' Production.
2. World Summit Declaration (2002, Johanesburg) states:
   (III. 13) Fundamental changes in the way societies produce and consume are indispensable for achieving global sustainable development. All countries should promote sustainable consumption and production patterns, with the developed countries taking the lead and with all countries benefiting from the process, taking into account the Rio principles, including, inter alia, the principle of common but differentiated responsibilities as set out in principle 7 of the Rio Declaration on Environment and Development. Governments, relevant international organizations, the private sector and all major groups should play an active role in changing unsustainable consumption and production patterns.
3. The author differentiates theoretically, between a purely economic activity and an ecological activity. By these classifications, for example, selling a conventional TV-set in the market for profit is a purely economic activity, but selling an ecologically soundly designed TV-set for profit and environment can be both an economic and an ecological activity. By this definition, 'CP' can be a typical sustainable activity in the production sector, as a 'sustainable consumption pattern' can be a typical sustainable activity in the consumption sector. Therefore, CP should not be confined within an in-house technological framework.
4. However, the names or classifications of environmental policy instruments are slightly different from the points of views and time. Some are adding information related policy and governmental services, apart from the two conventional instruments of financial measures and regulatory measures (Seneca & Taussig, 1974; Majchrzak 1984; Huppes, 1993). Consequently, many researchers on environmental policy, include the voluntary agreements or negotiation between government and firms as basic environmental policy instruments, along with regulatory instruments and economic instruments. (Dorfman & Dorfman, 1977; Callan & Thomas, 1996;Long, 1994; OECD, 1999; Field & Field, 2002)

5. Firstly, voluntary approaches may be better able to foster commitment to environmental improvement than regulatory instruments precisely because they are voluntary. It is more plausible when we think that the CP movement was started to overcome the limitations of the command-and-control approach of government. Secondly, it can be suggested that voluntary approaches might impose lower costs on government and industry than the command-and-control, regulatory approaches. Thirdly, from the industrial perspective, improved efficiency may be realized if voluntary approaches allow industry to search for, develop and apply environmental initiatives in a more flexible way. (Gouldson & Murphy, 1998b; OECD, 1999) Fourthly, voluntary approaches can often be enacted over a shorter

time frame than mandatory regulations because they do not have to go through the same governmental and legislative procedures (Gouldson & Murphy, 1998). Differently from other policy instruments, such as laws or fees where the relationship between the two sides is unequal and unilateral, voluntary approaches, especially, negotiated agreements, provide a new, more desirable environmental policy tool for stainable societies.

6 As the 'revisionists' asserted, for example, more stringent regulatory measures can be one way of exerting strong pressure upon industry to implement CP practices. (David Wallace, 1995) On the other hand, a policy switch from the regulatory approach to the voluntary approach alone can remove what is commonly known as the major impetus for innovation and has the possibility to lead companies to be free from assigning a higher priority to economic pressures of the short term than to the environmental opportunities of the medium to long term (Gouldson & Murphy, 1998).

7. Even though CP was started through the activities of UNEP, it was required to further develop the theory of CP through connecting it to other conventional sciences in line with recent theoretical efforts to link the CP approaches to conventional social science (See Yakowitz, 1992; Huppes, 1993; UNEP, 1994; Wallace, 1995; Baas, 1996; Gouldson & Murphy, 1998; Berkel, 2001, etc).

8. This researcher applies several conventional tools from economics, sociology, management, and ecology for identifying CP implementation systems. Conceptual linkages between these conventional sciences are useful in explaining socio-economic phenomena. Fox example, R.H. Coase, a economist, developed the 'Coase Theorem' by applying conventional legal property rights conceptions to solving the issue of negative economic externalities from environmental pollution (Coase, 1960), which provides theoretical insight into the efficiency of voluntary negotiation in an environmental conflict.

9. *Contextual knowledge* of CP here means external pressure or motivators on/for industry and business to implement it. Such contextual knowledge on CP motivates industry and business to adopt and implement CP. CP is likely to be adopted if it benefits the management. T*echnological knowledge* of CP informs industry and business of technical tools and practical resources to implement CP. If a company does not have any technological knowledge of CP, it cannot implement it due to technical problems. *Reconciliatory knowledge* for CP encourages and facilitates industry and business to drive the CP approach, because the process of CP cannot be traded within a general products and services market. It targets bridging the sustainability gaps between social demand for CP (contextual knowledge) and private supply for CP.

10. This thesis focuses upon discovering the cognitive structure of social cooperation for promoting CP activities on a long-term base. The research questions are associated with each specific research goal. Facing these research goals, the author had two different approaches for collecting relevant data from the industrial sector. One alternative question used was "Why did your company not implement CP?" The other one is "Why has your company implemented CP?" This thesis author took the latter approach. Although the overall statistics on the number of 'CP company is not known to this author, some data such as number of ISO 14001 certifications show that more than 99% of the enterprises throughout the world have not yet implemented CP practices. For example, even the number of ISO 14001 certified companies of Japan, which is the most registered country in the world, is far less 0.5 % of total Japanese enterprises including service and wholesale sector. Japan has 10,952 ISO14001 certified companies among 4, 8500, 000 enterprises in total (ISO14001, 2002 statistics; Kornevall, 2002). Therefore, it might be a more reasonable way to get data from success-story companies rather than from the general companies.

11. Two hundred fifty companies were selected for the motivation survey from UNEP database

for successful CP cases. (The satisfactory response rate was 23.6%.)

12. Facing these research goals, the author had two different approaches for collecting relevant data from the industrial sector. One alternative question used was “Why did your company not implement CP?” The other one was “Why has your company implemented CP?” This thesis author took the latter approach.
13. For example, even the number of ISO 14001 certified companies of Japan, which is the most registered country in the world, is far less than 0.5 % of the total Japanese enterprises including service and wholesale sectors. Japan has 10,952 ISO14001 certified companies among 4, 8500, 000 enterprises (ISO14001, 2002 statistics; Kornevall, 2002). Therefore, it might be a more reasonable way to get data from success-story companies than from the 99 % of ‘normal’ companies.
14. Although these data are not exhaustive, considering that UNEP has been one of the leading international organizations in promoting CP program, the data should be relatively valid and should provide valuable knowledge from the perspective of the CP supply side.
15. The UNEP CP Program has compiled data related to case studies, most of which dates from the mid-1980s to mid-1990s. Presently, the UNEP CP Program’s database on CP-cases contains 441 cases that have been reviewed for quality and completeness by UNEP. All are now available on the internet. The majority of the case studies are from Europe (51%), with North America (25%), and Asia (14%) following. (UNEP, 2003)

16. South Korea is grouped as one of the countries with a transitional economy, not a developed country, nor a developing country. Having 39% of the population in manufacturing, it has been famous for its high economic growth, currently 12th in industrial output in the world. For the last two decades, the average economic growth rate of South Korea was more than 8 %, which is one of the highest economic growth rates in the world. These simple statistics reveal that Korea is one of the most economically dynamic countries since the nineteen-sixties, mainly driven by the manufacturing industry.
17. This chapter attempts to conduct participatory evaluation on the program through the analysis of the survey results of the 1998 EFEs and 2002 EFEs. In the process of sustainable development policy the participation of practitioners and citizens is necessary (Ukaga, 2002), not only because they are the beneficiaries of the environmental policy, but also because they can be considered the experts on the specific policy (Scholz & Olaf, 2002).
18. From 1995, the starting year of the KEFC Program, until now, there have been several socio-economic events in Korea, which may have influenced their CP activities positively or negatively. These were Korea’s membership of OECD Group in 1996; the beginning of the Asian financial crises in 1997, Rio+5 Meeting in 1997, Korea’s socio-economic restructuring effort to overcome financial crisis in 2001. Even though this research is not in-depth, on the relation between the socio-economic events and CP, the author presents insights into the socio-economic characteristics from collected data and documents in light of the sustainable development strategy.
19. In general, triangulation was used to test the same findings through the use of several different research methods in many cases by other researchers (Earl Babbie, 2001, The Practice of Social Research, p.112, Wadsworth, Belmont). Based upon their experiences, this researcher, illustratively tested hypothesis 1 – for example - that the CP activity, as one of the public goods, has a characteristic feature of the collaboration among the environing social sub-systems such as government, community, the researcher did three analyses: (i) normative approach (Part II) (ii) questionnaire survey of successful cleaner production companies worldwide(Part III) (iii) questionnaire survey of Korean cleaner production program participant-companies (Part IV) considers the agreement of findings based upon the degree of data convergence of the results of interviews and documents with successful CP companies, which were designed from different points of view. If there is a good convergence of data,

support for the hypothesis along with its theoretical background, such type of triangulation could provide confidence and a useful approach for dealing with case study data (Yin, 1993; Stake, 1995).

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PART II. THEORETICAL APPROACH OF CLEANER PRODUCTION

Chapter 2. Contextual Systems of Cleaner Production

A sustainable society requires close cooperation between social subsystems. This author assumes that a society consists of four subsystems: industry, government, community and ecosystem. This classification is adapted from the Parsonian notion of social system in terms of a sustainable society. Chapter 2 explains normatively how each social system is related to Cleaner Production and how they can cooperate with each other for improving the environment.

2.1. Introduction – A model for a sustainable society

As a classical structural functionalist, Talcott Parsons [1] distinguished among four subsystems - in society in terms of the imperative functions they perform: the economy, the political system, the fiduciary system, and the societal community. The economy is the subsystem that performs the function for society of adapting to the environment through labor, production, and allocation. Through such work, the economy adapts the environment to society's needs, and it helps society adapt to these external realities. The political system or bureaucracy performs the function of goal attainment by pursuing objectives and mobilizing actors and resources to that end. The fiduciary system handles the latency function by transmitting culture (norms and values) to actors and allowing it to be internalized by them. Finally, the integration function is performed by the societal community (for example, the law), which coordinates the various components of society (George Ritzer, 1996).

The proper operation of these four parts is necessary for society to act smoothly as a whole. The interdependence of these parts is an important feature of functional analysis. These subsystems of society are shown in Figure 2- 1.

Figure 2-1: Sub-systems of capitalistic society

Economy	Bureaucracy
Fiduciary System	Societal community

Even though Parsonian theory is criticized by modern sociologists due to its lack of emphasis upon human creativity, culture-oriented determinism, and ideological conservatism, this theory of social evolution was developed in an environmental context (Hannigan, 1995). Furthermore, this systematic social organism theory fits well within the concept of sustainable development, which requires a holistic approach to environmental problems that harmoniously integrates society's sub-systems.

Parsonian theory on the social system was developed in the 1950s and 1960s, when the quadripartite classification reflected a well-developed and typically American capitalistic society. Parsons did not consider solving environmental problems to be an important social objective that needed to be addressed by his theory. [2] He believed, human beings were meant to cope with the environment, in whatever state, rather than to try to maintain and conserve it. Accordingly, one imperative function of the economy was to adapt to the state of the environment. (Waters, 1994)

In this sense, Parsons did not consider environmental ethics to be a fundamental function in human society. Parsons assumed that any society is composed of a series of subsystems, which differ in terms of both their structure and their functional significance for the larger society. As society evolves, a new subsystem can therefore, be differentiated (Ritzer, 1996). If this new subsystem is to yield a balanced, more evolved system, each newly differentiated substructure must have increased adaptive capacity for performing its primary function, as compared to the performance of that function in the previous, more diffuse structure (Parsons, 1966).

Reflecting upon the emergence of ecological issues in society using Parsons' differentiation theory, this thesis author adapted the Parsonian quadripartite categorization of social system to an environmentally friendly society seeking to implement CP and SD (Hereafter, the thesis author calls it 'sustainable society'): This includes the industrial production system, the government, communities and the eco-system, as shown in Figure 2-2. In order to focus on the research objective of this thesis, to develop CP policy, the author adapted the terminologies of Parsonian's four social subsystems to the context of CP policy. The next section addresses this issue further.

Figure 2-2: Sustainable Society: Adapted from Parsonian categorization and extended to 'A Cleaner Production Friendly Society'

Industrial Production System (Economy)*	**Government** (Bureaucracy)
Eco-system (Environment)	**Community** (Societal Community and Fiduciary System)

* Parentheses in Figure 2-2 refer to the corresponding terms of the Parsonian categorization of social systems.

Ecological considerations for the new typology of the social system

These four subsystems have several different properties according to the Parsonian quadripartite typology. Firstly, although they are not completely exclusive of each other, these four sub-systems represent respectively, indispensable functions of the modern society.

Secondly, different from Parsonian's classification, the term *eco-system* is used to replace 'the fiduciary system'. The current concept of eco-system is not an independent element within society, but rather exists as an integral part of the social world, interacting with the other three subsystems in many respects. For example, a number of environmental organizations and laws, in addition to international agreements on environmental issues have been formed since the 1970s, throughout the world. In the Korean case, the number of registered non-government organizations (NGO's) for environmental conservation was relatively few before the 1970s, but as of 2002 NGO's accounted for 480 organizations (KMOE, 2002).

Thirdly, 'societal community' has been changed into *community*. The fiduciary function is actually imbedded in the community and most fiduciary organizations such as universities, schools, etc. are actually working as part of a societal community [3]. Sometimes the fiduciary and societal community systems were treated as a single socio-cultural system in general sociological theory (Waters, 1994).

Fourthly, one of the most important features of the Parsonian classification is that each social

subsystem is responsible for maintaining social order and social equilibrium. He assumes that social order and equilibrium can be best maintained when each of the four structures is operationalized so that each helps the others to maintain 'common value patterns.' (Ritzer, 1994) In a sustainable society, it could be envisaged that social sustainability can be achieved when each of the four subsystems is functional and each cooperates with each other, in striving to achieve and maintain the goal of sustainable society.

Fifthly, one of the key differences between the ecological typology and economic typology is that the economic typology considers the eco-system as a given independent entity separated from the social system, while the ecological typology considers the ecosystem as a flexible dependant entity within the social system. Maintenance of the eco-system is also one of the imperative functions of society just as it also relates to the economy and government (Teubner et. all, 1994).

Finally, the main practical purpose of this adapted classification of the social system, based on established social system theory, was not to conduct in-depth research on the structural-functional theory in sociology, but to use it as an analytical tool with a focus on cleaner production policy, within a broader social context.

This thesis author assumes that these four, new sub-systems of society are the major influencing systems of cleaner production and that if these sub-systems work together in an environmentally sound way, society can move towards a new sustainable societal order. In the next section, this thesis describes briefly and normatively the relationship of each sub-system to cleaner production based within a broad social context.

2.2. Four contextual social subsystems of cleaner production and their interaction

2.2.1. The industrial production system

Cleaner production is a set of conceptual and procedural facets within the industrial production system. However, most conventional economists, from Adam Smith to present-day economists, explain that environmental issues are one factor that may cause market failures. According to economic theory, the quality of the environment is not a private good which is bought and sold in the market, but rather it is a public good or a public 'bad'.

> A private good is one where my consumption precludes yours and where I can exclude you from 'eating my bread'; a pure public good is one where the consumption is non-competitive and non-excludable. So, most private goods are market goods under a capitalist system, while pure public goods are generally collective. These characteristics lead to difficulties in production by private firms. That various environmental problems have the property of a public good explains why government is involved in its "production." (Samuelson & Nordhaus, 1987a; Taylor, 1998, Economics)

As most economists explain, "production" of environmental quality is not a primary function of the industrial production system, or in other words an activity to be taken up by 'industries or businesses'. Markets are not an effective way to provide environmental services for the people. In this regards, over the last three decades, governments have generally undertaken regulatory measures to minimize environmental externalities resulting from industrial production. Due to these efforts, pollution levels of certain conventional pollutants are well below what they would have been in the absence of such efforts, especially in OECD countries (OECD, 2001). Nevertheless, the results have been disappointing relative to the initial goals of establishing a cleaner and safer environment (Goodstein, 1995)

According to the 2002 Johannesburg Declaration on Sustainable Development:

> "The global environment continues to suffer. Loss of biodiversity continues, fish stocks continue to be depleted; desertification claims more and more fertile land, the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating and developing countries more vulnerable, and air, water and marine pollution continues to rob millions of a decent life." (2002 Johannesburg Declaration Preamble 13)

Here, a fundamental question can be raised regarding the industrial production system within society: 'Is it enough for only industry and business to comply with governmental regulatory programs in achieving sustainability goals?' As explained in Chapter 1, it is a widespread belief that the market or economy does not inherently provide an effective safeguard against environmental degradation (Farmer and Teubner, 1994). Furthermore, the effectiveness of the regulatory approach is limited, for many reasons including the complexity of dealing with the environmental issues at stake (Eban S. Googstein, 1995) and non-flexibility of its reactive approach (Gouldson & Murphy, 1999).

In this sense, the assumption that the environmental problems are just external diseconomies of normal economic activities, which cause market inefficiencies, is not enough to clearly explain environmental externalities. They might focus on economic aspects of the products and services, but do not reflect on the integrated aspects of the situation and the costs inflicted upon the natural environment, which are more difficult to quantify. The theory of externalities might explain why the production system has to take reactive action for environmental protection, but cannot clearly explain why industry also has to strive for more proactive actions beyond the mandatory requirements established by environmental agencies (Weizsacker and Schmidt-Bleek, 1994). With inadequate and insufficient industrial and business response to environmental problems, certain sustainable development strategies emerged from the late 1980s to the early 1990s as a new paradigm in environmental policymaking. These actions resulted in an explosive development of broad based environmental management tools and strategies for use by industry in meeting sustainable development objectives.

It still remains to be answered, however, which factors influence industry and business to act in an environmentally responsible ways? Despite conventional externalities theory, many theorists have put forth ideas on the driving forces among industry and business for undertaking improved environmental activities. For example, Peattie claims that it results from 'green driving forces' for environmental performance, which include, among others, specific disasters, public opinion, green consumers, internal pressures, competitive pressure, legislation, changing social values, ethical investments, media interest, pressure groups, rising costs of mishaps, scientific evidence, opportunities (Peattie & Ratnayaka, 1997). Van Berkel divides drivers for CP into internal drivers such as leadership, employee involvement, cost awareness, occupational health and safety program and external drivers such as environmental regulations, market pressure, public pressure, new technological opportunity (Berkel, 1996). Corral lists determinants of new environmental technologies, such as environmental risks, economic risks, market pressures, community pressures, regulatory pressures, technological capabilities, organizational learning, strategic alliances, and networks of collaboration (Corral, 2002). Classifications of these 'driving forces' for corporate environmental activities vary according to different views and criteria.

This thesis author presented a simpler, four-part categorization, based on the above 'sustainable society model', which influences corporations to take environmentally friendly actions in a structural and psycho-social framework. These relate to the compulsory motive, the financial motive, the communal motive, and the pioneering motive, all of which are described in subsequent sections of this chapter.

a. The compulsory motive

The compulsory motive represents the conventional rationale behind corporate environmental performance. Classical economists assert that the private market system often produces undesirable spillover effects on mankind's environment, which are not reflected in relative market price. It, therefore, follows that such a failure of the private market system caused by pervasive external spillover effects justifies governmental intervention in the private sector for environmental purposes (Seneca & Taussig, 1974). In order to combat external environmental diseconomies, governments in most countries have taken collective actions such as specifying environmental goals, initiating various regulatory programs, and monitoring environmental performance among polluters.

The compulsory motive thus aims to adopt CP activities because governmental regulation programs influence implicitly or explicitly companies to do so. Governmental regulations, which still work as a dominating drive for industrial environmental activities, can also encourage industry to initiate its own CP programme (UNEP, 1995).

The compulsory motive, however, does have inherent limitations and drawbacks in expediting environmentally proactive approaches of industry. First, the primary goal of governmental regulations is to make industrial polluters comply with established emission standards. Therefore, the company leader is likely to consider CP options because they are a means to keeping up with or ahead of regulatory requirements. The compulsory motive can be considered as the secondary mover for industries to undertake CP activities (UNEP, 1994). Secondly, regulations can encourage the use of expensive pollution control technologies, which often reduces the available budget to apply towards CP technologies (UNEP, 1994). Conventional compulsory programs ignore the incentives that firms might have to discover other, cheaper, cleaner production technologies (Taylor, 1998). By this argument, conventional regulations that are based on the application of established standards such as emission limit values may not be suited for proactive approaches of the production system (Gouldson & Muppy, 1998b).

In the light of enhancing ecological effectiveness and policy validity, it is widely suggested that a shift from conventional regulatory approaches to those that are more participatory and flexible are required (Miller, 1997; Gouldson & Murphy, 1998; Hoffman, 1997). For example, regulations based on the application of qualitative principles rather than those based on quantitative standards can be more appropriate tools for cleaner production (Gouldson & Murphy, 1998). In addition, other compulsory instruments such as taxes applied towards environmental pollutants, or energy use can significantly discourage polluting activities, while also creating indirect market-based measures for the development and implementation of CP technologies (UNEP, 1994).

b. The financial motive

The second motivation that can influence the private sector to implement CP is the financial motive. In this sense, the financial motive implies that CP can also yield profits, which are accounted for by conservative valuation criteria and on a relatively short-term basis. In order to avoid ambiguity of similar concepts, the monetary motive does not include the meaning of social benefits or ecological benefits. [4] Most CP advocates specify various elements for profitability, which CP activities can produce. For example, good housekeeping approaches enable the firm to conserve energy and materials in the production processes, the results of which can also enhance the quality of the environment. Most good housekeeping approaches are low or no cost and can be implemented rapidly, thus, have a very short pay-back periods.

Various kinds of CP technologies, which can also yield increased revenues, are attractive to industrial managers and are strong driving-forces for the private sector to participate in

environmental protection activities. As many advocates of CP have asserted, reducing pollutants at their sources through various CP approaches and technologies is different from general improvement in the productivity and profitability of the company. It is commonly emphasized that pollution can be more inexpensively addressed at its source than with expensive end-of-pipe technologies. This is due to the fact that CP options are usually less costly to implement, operate and maintain, because of the reduced costs for raw materials, energy, pollution controls and regulatory compliance (UNEP, 1994). This author calls this kind of behavior a conservative profit motive. When a firm assesses that a CP option is both environmentally sound and economically profitable [5], it is natural that they should adopt such a CP option. Some call this a 'win-win' strategy (Hoffman, 1997; UNEP, 1994). This assertion that industrial environmental activities contribute to increasing productivity and profitability is different from the assumption of classical economists. They state that industrial environmental pollution is a characteristic of external diseconomies, which are best addressed through collective rather than private actions (Samuelson, 1985). There do exist, however, many successful cases in the private sector, which are illustrative of the economic benefits behind CP activities. Thus, the monetary motive, or market forces, does provide some support for CP implementation (Goodstein, 1995).

In recognition of this situation, is it therefore, possible that most environmental pollution emitted from the industrial sector can be solved to a considerable degree by market forces without the compulsory intervention of government? The existence of CP activities in the business sector is, however, not yet so widespread (Hoffman, 1997). In most private sectors, only a small number of companies actively integrate social and environmental factors into business decisions (Financial Times, 9, 23, 2002). In Korea, the number of companies certified by government as being an environmentally friendly company is around 100 companies from approximately 35,000 environmentally regulated companies. [6] This figure does not exceed 0.5 % of the total number of environmentally regulated company.

If implementation of CP options can benefit industry both economically and environmentally, why have a majority of private companies not undertaken CP? Goodstein says that the principal market obstacle is the lack of a substantial profit advantage for CP technologies. The absence of large profits in cleaner technologies means there is little incentive for private firms to undertake the marketing efforts necessary to overcome marketplace barriers, which include poor information, small markets, poor access to capital, and short-time horizons on the part of investors (Goodstein, 1995). Therefore, it should be recognized that the financial motive does not work in an unconditional and natural manner. While it can be concluded that there is a potential financial motive for encouraging CP, supported by numerous successful cases, the financial motive of CP does not function and develop unless certain other conditions are satisfied. A company manager could decide relatively easily to adopt CP options, when the initial investment is minimal, the output from the new option is economically beneficial, and CP is in accordance with governmental environmental regulations. However, if the initial investment in CP practices costs more than the monetary gain from the activities, a company manager would be reluctant to initiate CP activities. In this context, our concern is how to generate the necessary conditions to encourage CP.

c. The communal motive

The third motive, which industry and business can use in pursuit of CP, is the communal motive. T. Parsons viewed industry and business as one sub-system of society. While this view reflects a classical economic viewpoint where each individual is led by an invisible hand and selfishly pursues his/her own personal good and thereby achieves the optional good for all, (Samuelson, 1985) Parsons is interested in viewing the social system as a system of interaction (Ritzer, 1996). His focus was large-scale systems and their relationships to one another. [7] He argued that

social systems must be structured so that they operate compatibly with other systems and benefit from their support (Ritzer, 1996).

As we apply the Parsonian systematic view to today's sustainable society model shown in the previous section (Chapter 2. 1), industry and business, representing a key sub-system of a sustainable society, have to operate compatibly with the present new demands of the community and the ecosystem. In other words, the industrial production system needs to differentiate its "adaptive capacity for performing its primary function" (Waters, 1994) under this new social context. Parsons regards such development as having a specific evolutionary characteristic, which drives it in that direction. The evolutionary dynamic is *adaptation*, which he defines as – "the capacity of a living system to cope with its environment." (Parsons, 1964; Waters, 1994) Aside from continuing its primary function to maximize profitability, industry and business's pursuit of the communal motive means they have to consider taking *an adapted and differentiated action* in light of sustainable development when *facing the new external demands of community and the ecosystem*. This directly implies mobilizing resources and changing the existing structure to accommodate this new direction. Furthermore, it implies that while industry may not be legally bound, nor financially motivated to undertake environmental action, there can be a universalistic or environmentally sound requirement shared between the private sector and the community, which encourages the production system to take appropriate action.

The communal motive comes from the interaction between industry and community. The process of this interaction, however, is not carried out to the point of economic profit taking, but rather towards achieving consensus or agreements between industry and community. From a normative point of view, the goal of the interaction between these subsystems is to maximize mutual benefits while minimizing costs in light of a holistic viewpoint. The sort of social equilibrium that is achieved by mutual compromise differs from the economic equilibrium achieved by the market. In an ideal market, neither the consumer (the demander) nor the supplier can influence the market price. The price, that is a sort of social equilibrium, is decided by 'invisible hand' in the market (Taylor, 1998). The communications of a need for a cleaner society is happening beyond the market. In the 1960s, T. Parsons thought that the economic system had a function to adapt the environment to society's needs (Ritzer, 1996), but many environmentalists now think that the economic system should serve the function to adapt society to the needs of the eco-system (O'Riordan, 1981; Hoffman, 2000). As the industry's environmental performance changed, the objective of adaptation also changed. With economic development being one of the most challenging goals of society in the 1960s, environmentally sustainable development has become one of the most pressing objectives for today's society. Therefore, in order to avoid the 'Tragedy of the Commons', the economic sub-system, along with that of government, must help to co-develop a longer-term community interest with community members that goes beyond the selfish, short-term profit framework (O'Riordan, 1981). It is for this reason that society, as a whole, expects industry and business to adopt 'the communal motive' for sustainable development activities, to include cleaner production technologies.

The process of communication between industry and the community, however, is not as logical and systematized as the market place. Nonetheless, in the case of cleaner production approaches we can envisage various types of communication processes, sustainable development messages and modes of compromise or agreement between the production system and the community.

Even though many theorists have been championing cooperative and negotiable actions for sustainable development in overcoming the inherent problems of the 'command-and-control' approaches and economic incentive approaches, (See, Coarse, 1960; David Wallace, 1995; Alan Miller, 1999; Jongh 1999) such cooperative environmental action requires the establishment of

certain preconditions as well as political supports in order to be effective and successful. A good environmental compromise between different social sub-systems would not be achieved without the appropriate social conditions such as both parties' strong commitments to a 'good and clean community', sufficient information on SD options through continuous dialogue, adaptive governmental support, and a mature environmental ethic demonstrated by the community. In this sense, the industry's communal motive might form a pivotal part of the necessary conditions for driving CP approaches and sustainable development strategies.

Even though industry's communal motive towards the environment cannot be an inherent quality of the production system according to classical economic theory, recently a number of programs, tools, and initiatives have been developed that encourage industry and business to accept a large share of the social responsibility for environmental protection. (OECD, 2001; WBCSD, 2002; Financial Times, August, 19 - 23, 2002; UNRISD, 1997) While the driving force behind the name, background, objective, and methodology to each initiative or program is varied, most seek to find an appropriate way to change the behavior of the private sector in an ecologically sound manner without hurting the primary function of industry. Recognizing the classical economic view of industry, which suggests that corporations are in business to make profit and their social responsibility extends to increasing profits (Hoffman, 2000), this thesis researcher classifies the industry's communal motive for cleaner production into the reciprocal type and the endogenous type.

The reciprocal type of the communal motive is the case where a community agency, a community group and a firm, or a group of firms agree to promote CP practices according to some sort of mutual agreement. Voluntary agreements between firms and a local government or central government illustrate this approach. The endogenous type of the communal motive implies that a firm or a group of firms initiate a cleaner production program voluntarily without an explicit agreement with community groups. Certain companies take environmental stewardship very seriously and are among the most progressive forces for cleaner production implementation (Esty & Chertow, 1997). The latter case of voluntary initiative can occur for various reasons. To list several examples, some corporate leaders may undertake such action, because of an interest to preserve a good image or positive customer relations within their communities (Preston, 1997), due to concerns about community-specific environmental problems, or in response to demands from consumer groups, media, environmental activists, international environmental organizations, etc.

Recognizing the limitations of the compulsory or pecuniary motive, the communal motive can play a critical role in promoting CP within the private sector continually. Specifically, the communal motive makes it possible to maintain continual dialogue between different social sub-systems, which is instrumental in constructing effective environmentally sound knowledge and establishing social consensus for sustainable development. To ensure the sustainability of CP practice in a society, it is necessary to recognize those social conditions that are required for the communal motive, as applicable to the private sector, to take shape, while also understanding how this can be fostered by other subsystems such as government, local community or the international community. This issue forms one of the basic research questions addressed by this thesis.

d. The pioneering motive

The fourth motive to discuss is the pioneering motive of the production system. This motive can be described as an evolutionary step of the endogenous communal type mentioned above. In its application to a firm, this motive can help to solve the limitations and problems raised by the previous three motives by creating a new, CP pattern. The pioneering motive can open a new

dimension of SD at the workplace level. We can say that the spirit of the Schumpterian concept of creative destruction is embodied in this creative motive for CP and SD. Schumpeter emphasized the role of the innovator, which could take the form of the inventor, the developer, the promoter, or the person who recognizes technical improvements and succeeds in having them introduced (Samuelson & Nordhaus, 1987).

> 'The opening up of new markets, and organizational development that illustrate the same process of industrial mutation, that incessantly revolutionize the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism.' (Schumpeter, 1942)

The pioneering motive gives new stimulation for the corporate manager to take innovative actions for CP, which go beyond governmental regulations, economic considerations, and community pressures. Actually, the reality of environmentalism in the business context is becoming more complex than regulatory compliance or social responsibility reveal. Ecological issues in the private sector become transformed from an external aspect of the market environment to something central to the core objectives of the firm (Hoffman, 2000). Therefore, corporations are increasingly needing to meet the pioneering motive, or in other words to formulate an innovative and redefined perspective in addressing environmental concerns within society.

Over the last decades, we have seen numerous cases of innovative CP approaches (See, UNEP, 1997). For example, auto-manufacturers are continually exploring ways to introduce more ecologically sound and economically beneficial vehicles into our community (Hoffman, 2000). Under such a scenario, if a firm can succeed in developing a cleaner technology, which reduces pollution drastically and enhances the quality of the product, the company can achieve an ideal status of CP through technological innovation. This differs from the classical assumption behind external environmental diseconomy, which argues that a socially optimal pollution level can, in general, be reached, only by reducing the total output of product/pollution where the marginal social benefits equal the marginal social abatement costs (Seneca & Taussig, 1974, Samuelson and at al, 1987). The above case, however, could lead to the Schumpeterian innovation, bringing about both improved economic welfare and improved ecological welfare. With these ecological types of innovation in the private sector, community members do not face trade-off decisions between economic growth and environmental conservation, but rather can enjoy both, achieving an upgraded level of social welfare.

However, despite the inventiveness in companies and all the social benefits for our communities, the CP technologies that could solve serious environmental problems without shrinking industrial production activities are not being adopted as rapidly and universally as they should be (Preston, 1997). Goodstein and Preston enumerated various obstacles facing innovative CP practices. These include: (i) direct or indirect governmental subsidies which disadvantage innovative technologies; (ii) the current regulatory structure which is used to reduce the incentive for innovators to develop cleaner technologies; (iii) the absence of large profits in cleaner technologies; (iv) capital markets which shy away from long-term risk, regulatory uncertainty, and market fragmentation; (v) sunk costs from overcoming the lack of information, which are unrecoverable if the investment fails; and (vi) thin markets for cleaner technologies, which tend to dampen the rate of adoption (Goodstein, 1995; Preston, 1997; UNEP, 1994; Gouldson & Murphy, 1998). According to the CP cases, we can also envisage other types of obstacles.

Here, this author classifies the obstacles or external conditions facing CP as the '*cleaner production environment'* and calls the four types of motives for CP as *'cleaner production*

*initiatives'***.** The pioneering motive for CP is a proactive and voluntary driving force. This differs from the other three initiatives, which are relatively reactive or reciprocal. By contrast, the pioneering motive could face more obstacles in the process of implementation as shown previously. Therefore, we can assume that innovative CP cases could be cultivated not only with the pioneering initiative of the company but could also be based on the favorable conditions of the 'CP environment.'

e. Evolutionary dynamics of industry for cleaner production

Many developmental typologies of environmental management policy have been introduced by others with their own insights and viewpoints as follows:

- Incidental Measures → The 'responsive' period → The 'initiative' phase (Hilderbrand, 1996)
- Beginner→ Fire fighter → Concerned citizen → Pragmatist→ Pro-activist (Divakarla, 1992)
- Command and Control → Market instruments → Hybrid approaches (Long, 1994)
- Stage of indifference → The stage of governmental regulation → The stage of leading cooperation → The stage of eco-efficiency management → The stage of internalization of externalities (Park, 1996)
- Frontier ecology → Environmental protection → Resource management → Eco-development → Deep ecology (Billatos, 1996)
- Command-and-control approach→ Voluntary initiative → Reinvention efforts (Crognale, 1999)

Most share the perspective that environmental management has its developmental steps, while what is different is on which subsystem such classifications are focused or by what criteria they categorise its developmental steps. For example, the 'responsive' period termed the Initial stage (Philip) is similar to 'Fighter fighter' (Raju), command-and-control (Bill), the stage of governmental regulation (Park), and environmental protection (Billatos), what is different is some focus on governmental policy (Bill and Philip), and others on the behavior of industry (Raju and Park).

This classification, discussed so far, was made based upon four possible types of motives for CP within industry and business. Therefore, it is theoretical rather than practical. In reality, CP practices could be adopted due to mixed motives. However, when we consider the relationship between the CP initiatives and the CP environment, or in other words, CP needs and its obstacles, this thesis researcher assumes that each motive can be explained in evolutionary steps.

According to some educational behavioral scientists (Atkinson *et. al.* 1974) and etymological definition (Webster's New World Dictionary, second college edition, 1976) as well, motive means inner or intrinsic attitude or willingness to act in a certain way. Motive is different from motivation in that it is an *endogenous* tendency to do something rather than a situational incentive. In other words, *motive* means latent needs that make certain outcomes appear attractive, instead *motivation* is concerned with instigating effort or situational stimulation toward any intended goal (Robbins, 1996). Therefore, unsatisfied needs create tension that stimulates drives within the individual. The drives generate a search behavior to find particular goals that, if attained, will satisfy the need and lead to a reduction in the tension (Stephen P. Robbins, 1996). In this sense, Atkinson's assumption for achievement makes it clear to understand the motive-motivation relation (Atkinson, 1964).

Motivation= [Motive] x [Incentive or effort] x [Expectancy of success]

Therefore, it is inferred that where there is a motive, an incentive or effort is required to ensure

success. Where there is no motive, any effort or incentive towards a certain goal, is likely to be useless. The greater the motive, the higher the level of effort that is required (Stephen *et. al*, 1996). Consequently, we recognize that an intended performance can be driven well when a certain level of effort or incentive towards the goal is associated with an appropriately sized motive. When we apply this relationship to CP implementation, we can describe it that CP performance can be driven effectively when a certain level of effort or incentive is associated with the CP motives of firms.

The initial stage for CP comes from a compulsory motive or financial motive. In this stage, industry can rather easily adapt to the CP environment. Without external support, negotiation with other stakeholders, or reductions in production levels, cleaner practices are possible. Good housekeeping approaches and effective recycling methods belong to this stage. This stage serves to make the private sector understand the broader context of the complementary relationship that exists between industry and the environment. However, this level alone is not sufficient to result in the continuous implementation of CP within the company, nor does it satisfy increasing community demands for SD.

The communal motive for CP can be developed as a secondary step in the context of stressing corporate social responsibility for SD. Especially since the Rio-summit in 1992, there is a worldwide consensus that without fundamental change in all public and private sectors of society, the global community cannot reach the comprehensive goal of sustainable development. Therefore, political pressure on the production system from the ecological perspective comes not only from the local community, but also the national and international community [8]. Different environmental issues have different geographical scope. In this second stage, numerous kinds of tools, guidelines, policies, regulations, partnership programs, voluntary in-house programs, declarations, etc. can be initiated or developed in order to promote CP activities in the private sector.

Since the 1990s, various broad-based industrial environmental management efforts have been under way in both developed and developing countries (Callan & Thomas, 1996). The Environmentally Friendly Enterprise Certification Program (EFECP), having been driven by the Korean Ministry of Environment (KMOE), which is the objective of case study in this thesis, is one such example of environmental management efforts within this stage. Thanks to the environmental management movement that has occurred over the last decades, we can say that companies are shifting the emphasis of their activities away from reactive or curative responses to proactive or anticipatory approaches (Gouldson & Murphy, 1998). With the global emergence of such legally non-binding tools aimed at encouraging corporate environmental management, we need to evaluate their effectiveness and identify the problems that each specific program has faced. The evaluative effort is critical in developing a more effective and practical tool.

The pioneering motive is the final stage of the evolutionary processes, which an individual company can apply towards CP. Though the pioneering motive of firms is developed from the communal motive, the working mechanism of the pioneering motive is different from that of the communal motive in several aspects. First, in the pioneering stage, a firm is relatively *independent* of social pressures, which are not the case in the communal motive. Governments or communities can hope that industry and business will develop innovative CP technologies or designs, but they cannot press them to do so. Secondly, the pioneering motive for CP aims to create a new and substantial CP practice, which meets both economic and environmental demands. In this stage, companies must adopt CP practices as part of a central managerial agenda rather than being just that of an external or peripheral concern. This can require structural changes of the company and considerable initial investment for research and

development. The action plan can entail financial and technical risks, and in the worst case, can lead to poorer product quality and financial deficits. Therefore, in the pioneering stage, the roles of government or the community can be supportive, but are not necessarily. The final decision to undertake innovative changes remains with the corporation.

However, this kind of Schumpeterian creativity could become central to the strategic response for environmental protection as regulations become more flexible (Hoffman, 2000). Therefore, even though the role of government is only partial in the realization of the pioneering CP, the next-generation policymaking must pave the way for the rapid adoption of innovative CP technologies (Preston, 1997), which must become an integral element to corporate behavior in this age of SD. [9]

2.2.2. Government

Both classical economists and the public at large, have a conception that the government is a primary actor in providing good environmental quality for the community. In a modern capitalist society, the government has a responsibility to set social goals, integrate social subsystems, and to undertake efforts to solve those social problems, which the private sector and markets do not address. Environmental protection and sustainable development, largely aspects unaccounted for by the market, have become important goals of governmental policy. Towards this end, the government has effectively relied on various policy-instruments. In focusing on the types of policy instruments that governments have, the question is how they can be used more effectively and substantially to encourage CP.

Many environmental theorists describe various kinds of environmental instruments and categorize them according to academic viewpoints, policy criteria, or the social context. [10] Over the last two or three decades, textbooks and reports on environmental policy have shown how these instruments have evolved. For example, in the early 1970s, command-and-control approaches were the preferred regulatory method (Baumol & Oates, 1971; Seneca, 1974), however, by the late 1970s to early 1980s, economic instruments had gained increasing recognition and application (Samuelson, 1987; Musgrave, 1984; Gjalt Huppes, 1993). Evolving from this approach, a new transition began in the early 1990s, as many environmental economists and policy researchers introduced voluntary approaches in diverse fashions (Taylor, 1996; Callon & Thomas, 1996; Elliott, 1997; Field, 2002; OECD, 2000).

Considering that this thesis author has worked to develop a governmental policy mechanism for promoting implementation of CP, he classified environmental policy instruments according to five program types [11]: a) command-and-control program; b) economic incentives; c) voluntary agreements; d) knowledge-and-information systems; and e) public infrastructures. This typology is designed to cover current policy instruments exhaustively, and to facilitate their review according to the proposed criteria: enforceability, participation, and environmental effectiveness. Taken together, these three criteria evaluate how effectively policy instruments can contribute to achieving their policy goals, which corresponds with the objectives of this research. Further discussion is needed on a normative basis to describe the relationship between each policy program and CP. The following section discusses the merits and limitations of each environmental policy instrument in encouraging implementation of CP practices.

a. Command-and-control programs

Command-and-control programs are often said to be a barrier that discourages implementation of CP. Generally, regulations require specific pollutants and polluters to be regulated. In the case of specific polluters, regulators establish monitoring systems to check and control their activities, some of which are installed at the final process of production lines. Largely because of this

command-and-control approach, corporations have focused on having their environmental activities comply with these sorts of regulations using end-of-pipe, pollution control technologies in order to avoid penalties, fines, and other charges levied against them. These technologies have, however, dominated the types of compliance demonstrated by industry and business. As a result, CP approaches have been developed as an alternative to the end-of-pipe pollution control approaches.

However, the OECD report (OECD, 1995) states that environmental regulations are necessary in creating a demand for cleaner technologies. Stringent regulations have often been the "necessity" spurring cleaner technologies by specifying both the target and the technology to be used to achieve it (UNEP, 1994). In the previous section, this researcher referred to this sort of demands for CP as the compulsory motive.

Encouraging CP, however, cannot be a primary goal of the command-and-control programs, as these practices rarely satisfy regulatory requirements. In other words, normal regulatory actions can be taken under the conditions of at least i) specified and normally measurable legal standards, ii) established monitoring system, and iii) means of enforcing penalties or fines. Existing regulatory systems in most countries are not flexible enough to easily adapt to the varieties and dynamics of CP approaches. Therefore, existing command-and-control programs have an indirect and limited function in promoting CP, even though they are necessary.

In relation to the role of the regulatory approach to CP, we can envisage two practical options that address how we can maximize the effectiveness of governmental policy for CP. The first approach is to diversify regulatory programs so as to encourage cleaner production. The second approach is to link the existing regulatory systems to other instruments such as a voluntary agreement program in stimulating CP practices.

b. Economic incentive programs

Environmental economists have favored the idea of incorporating economic instruments into environmental policies (Field & Field, 2002). Conventional economists assert that economic instruments, represented in the form of taxes or subsidies among others, can help companies to internalize externalities by requiring the firm to pay for the external costs (i.e.. total social cost) through a tax, or by allowing the consumer to enjoy the external benefits (i.e. total social benefit) through a subsidy (Seneca & Taussig, 1974; Taylor, 1998).

While economic incentive instruments do have many advantages in bringing about environmental improvements, they are not without their faults. First, it is difficult to quantify the exact value of total social costs or benefits as contributed by an individual company (Musgrave, 1984; Callan & Thomas, 1996). It is thus, unrealistic to assume that most companies will reduce the quantity of production with a tax levied against them, or conversely increase supply when subsidized. Secondly, most companies do not have established accounting systems that monitor their environmental activities. Most environmental costs are clearly separated from non-environmental costs according to general accounting system. Thirdly, because economic incentive instruments do not have a direct monitoring system (Field, 2002) and the environmental improvement they promote relies on self-regulating behaviour on behalf of the firms, it is extremely difficult to monitor and evaluate the effectiveness of an economic incentive program. In order to make the instruments more useful and effective, government and industry need to overcome three inherent problems: the monetary valuation of environmental pollution to calculate the total social cost; the corporate environmental accounting system to recognize pure environmental costs of a company, and the monitoring system to evaluate economic instruments' environmental effectiveness.

c. Voluntary agreement programs

Generally, voluntary agreement approaches are defined as a range of mechanisms whereby firms make voluntary commitments to improving their environmental performance beyond legal requirements (OECD, 1999). The earliest voluntary agreements date back to the 1960s when the Japanese metropolitan authorities signed contracts with private firms. Since the 1980s, many European countries along with the United States have been adopting various voluntary approaches since 1980s, which address the limitations of both regulatory and market based approaches, to include inefficient public expenditures on regulatory agencies and difficulties in pricing environmental diseconomies, among others, as shown in the previous section (Long, 1994). While one might think that in a market-driven world, voluntary agreements on environmental improvement would be quite scarce, this is not necessarily true. There are many who believe that programs based on voluntary agreements can be used effectively (Field, 2002).

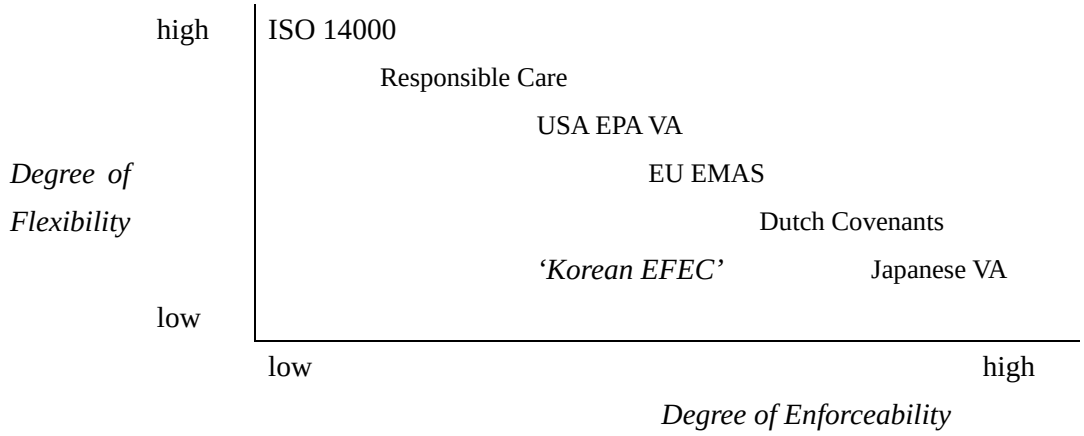
The 1991 Nobel Prize winner in economics, Ronald Coase, pointed out that two parties affected by environmental diseconomies, (for example, a confectioner that makes noise and a doctor who lives nearby) could effectively eliminate the externality, in this case noise, through voluntary joint negotiation. This would occur, however, only under the conditions that *property rights* of two parties are well defined and *transaction costs* [12] are small as compared to the externality itself (Ronald Coarse, 1960). In theory, the 'Coarse theorem', which states that negotiations can lead to an efficient outcome in the externalities situation (Taylor, 1998) can be applied to not only externalities between two individual private parties but also at a more macro scale between the government and the private sector or between the private sector bodies. Additionally, an agreement between two parties through mutual negotiation could be a legitimate and practical option, especially, when both government regulators and the regulated companies have practical difficulties in pricing social costs for environmental damage or in deciding shared environmental goal for social benefit.

Although voluntary agreements vary according to the relationships between negotiating parties, the styles of negotiation and the impacts they may have, when compared with regulatory or incentive program, they do have the potential to allow regulated companies to take the lead in determining their environmental actions (Wallace, 1995). Normally, conventional environmental regulations impose on industrial society a dense network of laws, regulations and administrative rules (Rehbinder, 1994). On the other hand, while economic incentive instruments have the potential to generate efficient outcomes, this is conditional on the existence of enough information to account for the direct and indirect impacts of all parties' involvement (Perman *et. al*, 1996). In contrast to these two approaches, voluntary agreement programs give the industrial partner considerable freedom to decide on the environmental countermeasure that best suits their needs. They can tailor the regulatory or social environmental burdens to the local situation by transferring the burdens to where they can be borne most cheaply or most efficiently (Elliott, 1997).

Both sides are free from the burden of deciding the optimal level of environmental responsibility that the firm undertakes in its production activities and the economic valuation of the social costs associated with environmental pollution, both of which are difficult to accurately assess. In providing industrial society with a wide and flexible action space, voluntary agreements provide a good framework for enhancing CP practices. In this sense, they achieve the goal of CP by continuously updating the production system in environmentally sound way rather than by complying with legally established emission standards. Neither legally-binding instruments nor economic incentive systems are flexible tools that can be easily modified. Companies that participate in voluntary programs, however, are not governed by external forces, but rather are allowed the freedom to design their environmental action plans

according to their needs and ideas. Such flexibilities in voluntary agreement instruments might enable many OECD countries to adopt such instruments in harnessing the potential benefits of implementation of CP approaches. In this sense, voluntary agreements appear to be part of a new attitude to the role which industry should play in meeting society's environmental goals (David Wallace, 1995).

Figure 2-3: Different types of Voluntary approaches



Because of their flexibility, the voluntary agreement approach has allowed for a wide spectrum of 'isotopes' and subsequent applications. Depending on the parties, we can classify these agreements into unilateral commitments, private agreements, negotiated agreements, and public voluntary programs (OECD, 1999). According to the style of the agreement, we can divide them into mediation, covenant, joint participation, agreement, certification, accreditation, voluntary regulation, etc. The most important aspect is how users design voluntary agreements adapted to the context of the country, while sometimes combining them with other policy tools. As an example, the Responsible Care Program undertaken by the Canadian Chemical Producers' Association was designed to improve the firms' environmental performance through voluntarily agreed principles and rules (OECD, 1999). Environmental agreements are also an important element of Japanese environmental policy, [13] and represent Japan's other type of environmental regulation. In Japan, industry has come to view environmental agreements as an indispensable prerequisite for coming to terms with local communities (Rehbinder, 1994). The Dutch model of negotiated agreements is also illustrative of another type of voluntary environmental regulation. Such agreements, which are defined by the National Environmental Policy Plan (NEPP) constitute the key instrument of Dutch environmental policy. These plans set stringent quantitative timetable for achieving pollution abatement targets for over 200 substances, with the intention to bring the national economy towards sustainability (OECD, 1999). [14]

Different from Dutch and Japanese's negotiation types, public environmental accreditation programs have also been widely developed in the European Union and in the United States. Within these accreditation programs, participating firms agree to standards, which have been developed by public bodies such as environmental agencies. In general, the scheme defines the conditions of individual membership, the provisions for compliance, the monitoring criteria and the evaluation of the results. Examples of such accreditation programs are the European, Eco-Management and Auditing Scheme (EMAS) as well as voluntary programs established by the US EPA, such as the Energy Star Program, the Green Light Program, and the 33/50 program.

In Korea, the 'Environmentally Friendly Enterprise Certification Program' (Hereafter referred to as the EFEC Program or EFECP), is indirectly associated with the mandatory regulation program and can be categorized with such public voluntary accreditation programs. (See Figure 2-3)

In spite of their variety and broad use, voluntary agreement instruments also have their weaknesses and limitations. The overarching critical problem is how to monitor or measure the practical performance of participating companies. Voluntary programs cannot guarantee a defined level of environmental performance (Gouldson & Murphy, 1998). In an extreme case, when no company participates in such a program, one must ask how an environmental agency can be responsible for the entire environmental management of a country. Furthermore under such agreements, it is worth considering how participating companies go about improving their environmental performance given principles and guidelines. The ultimate success of many companies that bring about significant improvements in their environmental performance is often dependent on the integrity of the industry's self-regulatory mechanism (Gouldson & Murphy, 1998).

Accordingly, numerous environmental policy theorists advocate the need of a mixed model of industrial environmental policy, [15] which can be created through appropriate combinations of processes that are adapted to a company's policy needs and the environment (Ashford, 1993; Wallace, 1995; UNEP, 1994; Elliott, 1997; Gouldson & Murphy, 1998; Long, 1994; Perman *et al*, 1996; OECD, 2000). [16]

d. Knowledge and information programs

Although few environmental economists have introduced knowledge and information programs as a government instrument (Baumol & Oates, 1979; UNEP, 1994; Huppes, 1993), the role of government in disseminating and generating environmental information and knowledge cannot be underestimated. For example, we recognize that because of a lack of knowledge surrounding the social costs of a firm's environmental diseconomies, it may be difficult or impossible to adopt an appropriate economic incentive policy. Lack of sufficient information on the potential impacts of global warming or the health impacts of GMOs has made international trade negotiations very complicated. It is, in fact, information distribution and technical assistance that governments have pursued, to date (Goodstein, 1995).

As for the knowledge and information programs, governments have two main functions: the first is the production of environmental knowledge and information, and the second is its dissemination. As the overall steward of the natural environment, the government has an obligation to inform the public on the environment's well-being and the rules and policies that govern it.

In relation to CP policy, one of the government's more important functions is the generation of environmental information. Information can only be transformed into knowledge when one brings information into her or his thinking processes and utilizes it in decision-making processes. In this regards, we can envisage three types of knowledge: contextual knowledge, technological knowledge, and reconciliatory knowledge. Contextual knowledge relates to the knowledge of ecological and social situation on certain environmental issues. This type of knowledge can also assist in identifying environmental problems and social attitudes to the problem. Various kinds of monitoring systems, ecological or social surveys serve as tools for the generation of such contextual knowledge. In this regard, the contextual knowledge enables the public to recognize environmental problems and human efforts and to evaluate the state of their environment. It also contributes to reducing the uncertainty surrounding environmental problems. In addition to

assessing the state of the natural environment, many countries and international organizations have begun to develop comprehensive and standardized environmental and sustainable development indicators.

Technological knowledge refers to the knowledge of technical processes that change the production system in a more environmentally friendly manner. Specifically, the government must provide technological knowledge, which is information that the market cannot easily disseminate. These environmental technologies and devices have, to date, contributed significantly to solving various kinds of environmental problems. For example, when a CP technology is created through government expenditures, such as a clean engine or a cheaper recycling method, its use by the private sector does not require replication of the research and development costs (Baumol/Oates, 1974).

Reconciliatory knowledge, in this context, refers to the knowledge that can bridge the gap between two different perspectives in either reaching an agreement or building consensus. This new concept, as proposed by this thesis researcher, aims to find an agreement between two different environmental perspectives by adjusting a suitable way of thinking about both of them. As the author stated in Chapter 1, a similarity between sustainable development and CP is that they both aim to achieve economic values and ecological values, both of which can occur in a unified social activity. Economic activities and ecological activities are generally designed to maximize private and social benefits respectively, and that we do not have sufficient contextual knowledge on certain environmental issues, should be thought of as a normal social phenomenon that our societies have more than two different perspectives regarding the same sustainable development issue. For example, it is currently impossible to accurately calculate the expected temperature of the Pacific and Atlantic Oceans 100 years from now. In this case, despite the non-existence of related indicative information, people have not abandoned the negotiation processes for combating global warming.

In such cases where no single approach to ill-structured problems holds the promise of adaptive solutions, the most sensible route could be to look for a compromise between conflicting viewpoints (Miller, 1999). Because our understanding of environmental problems is, in itself, ‘a social construction that rests on a range of negotiated experiences’, rather than upon a fixed entity, the environment is a fluid concept which is both culturally grounded and socially contested (Hannigan, 1995). In fact, we frequently see that these kinds of environmental conflicts are compromised in political ways or remain in a chronically contentious state.

We can assume, however, that negotiations with sustainable guidelines and long-term visions can maximize the total social benefit of the case rather than being compromised by political groups without systematic research on wider possible options. Therefore, a successful provision mainly by government for this sort of reconciliatory knowledge could contribute to enhancing the state of public sustainability and the level of CP. If each sub-system in our society pursues its own profit using conventional power or political tools and without considering the life-supporting framework itself, [17] we would not reach an environmentally and economically ‘better-off’ point, but would rather face a much ‘worse-off’ social situation with regard to sustainable development. There is therefore the need that government as the provider of public goods develops a reconciliatory knowledge program in order to achieve various kinds of short-term practical issues as well as a long-term vision for sustainable development.

We can envisage many potential paths for reconciliatory knowledge, to include innovation, a long-term action plan, long-standing dialogue and roundtables, and interdisciplinary research for multiple scenarios based on SD guidelines. In this sense, reconciliatory knowledge is not a

fixed and independent knowledge. It is a desirable process for sustainable development as well as a long-term strategy for enhancing social sustainability. We can apply this reconciliatory knowledge approach not only to existing CP dispute cases but also to the fundamental dispute between the goals of the present capitalistic society and those of a society with sustainable development in the next generation. Therefore, the government's proper provision of reconciliatory knowledge could constitute a valuable component of the adaptive environmental policy.

e. Public infrastructure programs

Compared with the first four instruments, which are technical devices to influence polluters' behavior, public infrastructure programs are designed to produce direct governmental services, largely for the construction and operation of environmental facilities and projects (Baumol/Oates, 1977; Seneca & Taussig, 1974). The government can play the role of an investor in protecting the environment by properly managing public environmental facilities. The variety of purposes served by these outlays is enormous: wastewater-treatment plants, the disposal of solid wastes, reforestation, the designation and management of natural parks, etc. (Baumol/Oates, 1977).

There are two fundamental reasons for the inclusion of government investment in environmental policy. First, there is the possibility that the most efficient scale of pollution-control facilities may require bigger financial resources than the private enterprise is willing or able to provide. We can take, for example, the case of a large municipal wastewater-treatment plant, which can process liquid wastes at a far lower per unit cost than individual polluters were to individually build an operate such facilities, executively for their own usage. The money needed for such a plant, however, may exceed the amount a private enterprise in the area would willingly allocate without difficulty. Second, governmental investments are required in light of the fact that most environmental services contain public good's characteristics, which typically cannot be marketed by private sellers as no one is excluded from their consumption. For example, people will not pay a charge for breathing the air when they can have it without cost (Baumol/Oates, 1977).

Over the last three decades, public environmental infrastructure has constituted the physical framework for the command-and-control approach. Environmental infrastructure, such as air-quality monitoring systems and wastewater treatment systems can be said to be two symbolic signs of 'end-of-pipe' technologies. That said, regulatory legislation continues to dominate environmental policy in most countries. It must therefore, be considered what the implications might be if governmental environmental services work in competition with implementation of CP technologies. Historically, the idea evolved from efforts to overcome the inefficiency of the classical command-and-control approach, which is largely based on the governmental environmental structure and its monitoring system (UNEP, 1994). Nevertheless, the governmental environmental structure and its monitoring system do influence either directly or indirectly the implementation of CP in the private sector. For example, well-organized community recycling plants could encourage factories in the community to develop their recycling approaches.

f. Closing remarks – toward an evolutionary and adaptive CP policy

This thesis researcher has introduced five main instruments. All instruments can play a specific role, depending on the context in which they are to be used. There is no single policy instrument that works best in stimulating CP, as each tool has both strengths and weaknesses. The challenge is how to design and deliver environmentally effective and economically efficient regulations that minimize the costs of environmental improvement and protection.

Over the last two decades, the experience of environmental policy has allowed us to recognize that environmental policies do evolve with time (Esty & Chertow, 1997b; Crognale, 1999; McCormick, 1997; Etzioni, 1964). In many cases, the evolution of environmental policies has been driven or stimulated by a sort of socio-economic conflict between output-oriented environmental effectiveness and input-oriented economic efficiency. This division between environmental policy stakeholders might be a good reason why environmentalists use appeasing terminology, such as cooperation, harmony, synergy, win-win, combination, integration, incorporation, partnership, hybrid, etc. This social phenomenon reflects the endogenous nature of environmental issues that result from socio-economic complexities. [18]

Over the course of development of environmental policy, the movement during the 1990s towards cleaner production policy, specifically including many types of environmental management policy, represents a paradigm shift. This paradigm, is designed to work with rather than against the regulated community (Crognale, 1997), and tended to go hand-in-hand with the introduction of new style policy instruments mainly centering on voluntary approaches. This was largely, because voluntary approaches give industrial society a wide and flexible action space and accordingly facilitate social consensus. Numerous environmental policy theorists insist that the voluntary agreement approach could be a sufficient condition, but they cannot be the necessary condition for ensuring continuous implementation of CP.

Our concern is how to design and implement the optimal environmental policy through *appropriate combinations* of various policy instruments to encourage the production system, to most effectively adapt to different policy needs and environments (OECD, 2000). This leads to the question: ‘What could be the *guiding principles* for designing and implementing an environmental policy that is designed to foster continuous implementation of CP? Seeking answers to this question is the central objective of this thesis.

2.2.3. Community

a. Introduction

The ecological meaning of a community is ‘all of the population occupying a given area’ (Odum, 1971). This concept of community has a long tradition in Western culture, having originated with the Greeks and continuing through the Middle Ages to the present day. While there is a broad spectrum of community’ interpretations, this researcher further defines it in ecological terms as ‘the people, as a whole, living in a given area’. In this sense, the definition of community integrates both its people and their environment. Without either people or their environment, the community could not exist. Due to this interactive character of the community, environmental issues have been developed due to community concerns. Here, we need to recognize that a central consideration within the community is ‘community interest’ which is *attributable to the community as a whole and which does not involve a ‘mere’ addition of individual interests* (Musgrave, 1984). Community interests give rise to communal needs and aspirations, which are generated by and pertain to the group, as a whole. As a public good, environmental quality can be considered as one of the essential needs or aspirations of the community. Furthermore, within the community, various kinds of environmental amenities are provided, consumed and improved upon by the people of the community.

Here, this thesis researcher introduces two different concepts on the environment: the first is the inventory of environmental components of the community, and the second is the aspiration to environmental sustainability. An inventory of the community’s environmental components refers to a detailed assessment of present environmental elements, which can be represented as specific indicators and could be described qualitatively. On the other hand, the aspiration of the

community for environmental sustainability relates to the community's willingness to improve the present state of environmental sustainability. These two concepts are different from 'stocks and flows' concepts in conventional economics. 'Stocks and flows' illustrate the existing state of all resources. By utilizing the concepts of a community's environmental inventory and its aspiration for environmental sustainability, the current and desirable state can be identified, for which the people in the community strive. It is important to recall that while private goods are based on exclusive property rights, public goods do not have this characteristic, in general. Private goods can be owned legally and be used according to personal consumption preferences. As they are governed by market principles in which price fluctuates with availability, they are likely to last over longer periods of time.

In contrast, consumers of public goods cannot have a legal ownership over them, and must share them collectively with others who enjoy their consumption. They merely feel or taste or see or hear the present state of the public good regardless of its ownership, because they share the public good collectively in most cases. In this context, the suggested dichotomy between the inventory of environmental components of the community and the aspiration to environmental sustainability of the community, can give us useful points in designing and implementing environmental policies. It may be envisaged that environmental policy aims designed to increase the environmental inventory based upon the community's aspiration for environmental sustainability should be developed and implemented to help ensure that that community makes progress toward SD.

b. Three functions of community for environmental sustainability

The community has three functions in relation to the use and provision of environmental services as a public good. First, the residents of a community consume the amenities provided by each environmental component. It is recognized that differences do exist, namely between the spatial scope of environmental components according to type, the geographical range of consumers and the physical and ecological meaning of consuming environmental amenities. Nonetheless, the amenities of environmental components, which are provided for the people of the community as a whole, are considered as the primary rationale for modern environmental concerns. The provision of minimum levels of natural amenities, such as clean air and water, is a biological condition for sustaining human life systems, and living among a desirable level of environmental amenities is a constitutional right. Accordingly, it is a critical responsibility of government to secure and maintain a desirable level of such amenities. Furthermore, the provision of natural and environmental amenities is becoming an increasingly important resource for the economic well-being of a community. Almost without exception, communities throughout the world are explicitly or implicitly demanding more improved and more extended environmental amenities, despite differences in demand regarding the component, type, and the level of the current environmental situation.

The second function of the community is to improve its environment. While the community can, by itself, improve the state of the existing environment, the more important task is to influence government, industry and business to co-work with them to do so. The community desires not only a viable built environment, but an improved one as well (Hancock, 1997). Citizen support and concern for securing and maintaining common amenities can be a powerful force. There is some degree of citizen participation in any program a community undertakes, which is evident through expressions of support or opposition in newspapers, meetings, conferences, public hearings, and at the ballot boxes. Effective community participation requires knowledge of what is happening within their local community, what is being done to combat its deterioration, and what can be done to make improvements (Gallion & Eisner, 1975a). In Japan, for example, plant managers and plant workers normally live within the same local community. Due in large

part to the scarcity of land for human settlement, segregation between social classes is simply not possible. All are thus dependent on the goodwill of the local community and cannot easily evade social pressure exerted by people adversely affected by the facility (Rehbinder, 1994). Such mediation and negotiation can take place within the community group itself. Community groups are no less immune to these tendentious environmental issues than any other (Miller, 1999).

NGOs, academic group and media are playing a leading role in influencing lawmakers and government to take actions for community sustainability and empowering the public to promote the creation of an environmentally sustainable society. In particular, NGOs' influence on government policies and corporate operations has been noteworthy. NGOs exert their influence through diverse methods and channels such as scientific research, public protests, corporate alliances, press coverage and public opinion, using such mediums as science, policy, law, or economics. Due to this diversity, government and industry cannot easily appease the demands of environmental NGOs at the bargaining table (Hoffman, 2000). Moving away from strictly confrontational relations, the leaders of business and environmental NGOs are starting to work together in finding solutions that make both economic and environmental sense for the short and longer term.

The scientific research of chemists, biologists and others in the community is critical to the development of sound environmental policy. As an example, government decision-makers rely on the scientific community to study the health effects of human exposure to harmful contaminants and to identify population-specific sensitivities, such as the higher susceptibility of young children to lead poisoning. The role of science in policy development has grown in importance as environmental problems have become more complex (Callan & Thomas, 1996).
In addition, regarding a community's influence on the state of environmental sustainability, its duty is not just with respect to its own boundaries, but also extends to neighboring communities under the condition that policies within one community can impact the public interests of another in the current and in future generations (Gallion & Eisner, 1975b; Decision of US Supreme Court, 1926).

The third important function of the community is to evaluate the state of the communal environment. Just as the consumer evaluates the quality of a private good in the market, so do the people of the community evaluate the state of the community's environmental quality. In order to improve the environmental sustainability of the community, it is essential that all relevant stakeholders participate actively in assessing the given situation and in determining how to undertake improvements. Although not without potential constraints, to include time, budget, politics and habit toward top-down programming, participatory evaluation indicators can be used to ensure that various stakeholders work actively together in determining and controlling what is to be evaluated, the indicators to be used, the instruments for measuring the chosen indicators as well as the means of analyzing, interpreting, communicating and utilizing the findings. Thus, participatory evaluation is a powerful tool for enabling the people of the community to arrive at better environmental sustainability (Ukaga, 2001).

c. SD conflicts and development of participatory environmental policies

If we are going to create environmentally sustainable communities, we have to develop an holistic approach to government and governance, beginning with the recognition that all things are inter-connected. Individual sectors or departments can no longer capably respond to and meet people's needs for environmental improvements. Instead we must collaborate inter-sectorally to develop sustainable communities (Hancock, 1997). This is due to the fact that the environment is inherently a prime site of conflict between competing values and interests, and the organizations and communities that articulate those values and interests (O'Neill, 1997).

The industrial sub-system of the community can play a cardinal role in developing an environmentally sustainable community. According to Parsonian typology, it is the subsystem of industry and business (the economy) that performs the societal function of adapting to the environment through its production and allocation processes (Ritzer, 1996). From a sustainable society perspective, developing the production system of the community in an environmentally sustainable way forms a central part of the environmentally sustainable community. There also exist also diverse kinds of sustainable development conflicts in the area of CP. Normatively speaking, such conflicts originate from three dilemmas: a lack of knowledge on CP, different approaches to the issue of CP, and different values on the CP practice within the context of a shared recognition and evaluation on the issue (O'Neill, 1997).

How should we overcome these conflicts? When such conflicts derive from a lack of knowledge and information, government or local community agencies should provide relevant information and knowledge on how to solve the problem(s). There are many cases of corporations that have adopted CP approaches after having been sufficiently informed of CP ideas and previous successful examples. What is of more concern, however, are those cases between industry and government, or between industry and the community where each has both a different approach and a different ascribed value with respect to the end result. No subsystem seems reducible to other subsystems. It seems that there is no privileged canonical description of the process of reaching consensus. These cases contain problems of value incommensurability (O'Neill, 1997).

If we were to presume that government prefers only command-and-control policy, 'industry and business' are therefore, only influenced by a compulsory or pecuniary motive, and the perception that community groups advocate unrealistic environmental demands. In this context, there would be little open space to create an environmentally sustainable community. Consequently, a sustainable societal model, which is quite different from a conventional capitalistic society model as discussed in Chapter 1, would require each sub-system to move towards a new management style that is more adapted to the approach of SD. This style would emphasize "power with" rather than "power over", negotiation rather than directives, process rather than structure (Trevor Hancock, 1997).

As stated in the previous section, the consumption of natural environmental amenities, or public goods, is both physically and legally different from those of private goods. For example, if a chemical company developed a non-hazardous pesticide, the CP process would result in incalculable social benefits, which are far beyond the market price of the pesticide. Apart from its health and environmental benefits, this new pesticide could contribute to agricultural productivity and the local economy. It should be recognized that cleaner products or CP processes create external amenities for the community beyond the immediate users' value. Nevertheless, experience has shown that the current market system itself does not automatically give relevant corporations a sufficient motivation to adopt CP technologies, because the social benefits derived from CP are not commensurate to the company's increased value. Furthermore, the environmental sustainability of their products or processes does not guarantee an increase in profit turn-over. Conventional individualism, upon which classical economics is based, does not go hand-in-hand with the provision of environmental public goods. The market is not capable of providing such environmental amenities as clean air and water and beautiful landscapes. Classical economists refer to this as a 'market failure'.

With private goods effectively provided largely by the private market, the provision or improvement of public goods could and should be effectively carried out by public bodies such as governments and international organizations. In dealing with public goods including CP, we therefore, come to the issues surrounding the conventional market system, and the private and

public structures that govern it. We must also explore the proper ways in which public organizations can go beyond command-and-control governance and solve environmental sustainability issues in a more democratic and holistic way. As stated previously, command-and-control policies have been demonstrated to have diverse limitations. Specifically, the approach is seen as ineffective in encouraging CP. Therefore, the creation of environmentally sustainable production systems needs to be pursued holistically and in a participatory manner. We can furthermore, assume that the effectiveness of this approach is dependant on both the initiative of government and community groups in order to stimulate reform as industry and business alone are void of any compulsory drive.

Democracy is a process rather than a result; holism is comprehensive rather than narrow. The adaptive environmental policy model, which this thesis sets forth, is based on both participatory and holistic approaches for encouraging CP. The important aspect regarding this adaptive policy, based on the participatory and democratic approach, is that it deals only with the process and not the results. To overcome SD conflicts requires government-led, function-oriented, and consensus-based interactive processes in each step.

In summary, a sustainable society presupposes a sustainable ecosystem. As an indispensable public good, a sustainable ecosystem could not be provided and improved upon unless appropriate means beyond conventional market principles can integrate the work of all sub-systems within society in a participatory and holistic way. The adaptive environmental policy approach, proposed in this thesis, focuses on finding a way to integrate the work of all sub-systems within society in order to achieve environmental sustainability through a CP system.

2.2.4. Ecosystem

This thesis researcher has assumed that the ecosystem is one of the four sub-systems within society. According to the Parsonian typology, the natural environment is an entity outside of human society. Accordingly, mankind's objective was to adapt to the natural environment, but not to preserve or manage it. Natural environment is not, however, completely immune from human action. Beginning in 1970s, mankind's perception of the value of the natural environment changed dramatically, both in the academic community and in everyday life. The natural environment is no longer considered as existing outside of human society, and therefore, should be recognized as one of society's sub-systems, consequently this author has included it accordingly under the model of a sustainable society.

a. The value of ecosystems in human society

As an ecosystem, the natural environment can be subdivided into three perspectives: market value, human health or aesthetic value and ecological value (Elliot & Gare (edited), 1983). [19] The perspective of market value reflects the current economic viewpoint behind economic user value. Market value thus refers to a *replacement cost*, as economists would tend to use (Samuelson & Nordhaus, 1987). Since its existence, mankind has extracted various kinds of natural resources from the eco-system and has traded them in the marketplace, therefore, giving these resources market price commensurate with demand. This value represents the conventional viewpoint toward the natural environment. The human health or aesthetic value perspective refers to the value, which the natural environment provides for human health, to include among others - clean air, fresh water and a beautiful landscape. Aspects of this category do not in general have their own market price, but rather a social price, which is beyond the market pricing mechanism. Because this reflects human's subjective aesthetic values, its additional consumption does not impact others' consumption pattern. In this sense, aesthetic values are a characteristic of a public good. Ecological value refers to the value of the natural environment in the context of an ecological equilibrium. It includes 'nature's service' which

provides the system which all food and fiber and energy is being produced. The ecosystem also provides clean air, fresh clean water, etc. Generation of oxygen by forests does not have market or aesthetic value, but rather is of ecological importance. This value forms a central component of SD. Although these three classifications reflect different points of view rather than different realistic entities, the total value of natural environment can be measured by the sum of these value classes, which are based in human preference (Roger Perman, 1996).

Total value of a natural good = market value + health or aesthetic value + ecological value

Classical economists have traditionally valuated a natural good based largely on its market price. Such a valuation technique has contributed to the limited importance assigned to the health or aesthetic and ecological values of the ecosystem. Furthermore, this conventional view has likely thwarted nature's real value, leading to environmental deterioration and natural destruction. A shift from this conventional view of the natural ecosystem to a total value approach might be a prerequisite for building a sustainable society, as these three values do not always simultaneously coexist in a real world. In other words, people are unable to enjoy the market value of a natural good without excluding the aesthetic or ecological value of a natural good. For example, if a natural park with high aesthetic value is to be transformed into a dam for commercial use, its value as a natural park is lost. Thus while, there are many substitutes for the commercial use of a natural park, the recreation of a natural park is not easily duplicated or supplied elsewhere (Barkley & Seckler, 1972). On the other hand, the health or aesthetic value of a natural good is often linked with an ecological value, because the two values are based on the existence of the natural good itself. [20] The aesthetic value of a natural good does not always follow the same characteristics as ecological value. For example, while a colorful rainbow or beautiful stars have aesthetic values, they cannot be considered as having ecological value.

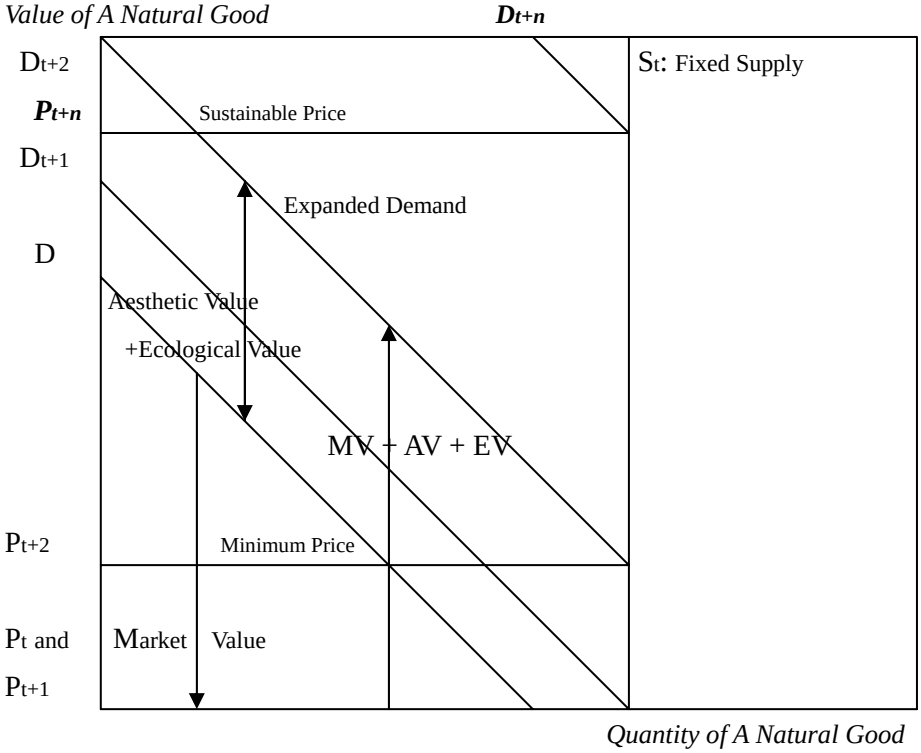


Figure 2-4: Hypothetical Value Trends of a Natural Good (Adapted from Paul & David, 1972)

According to economic theory, the value of a natural good is determinded by its demand which increases in income, and brings about social changes in attitude surrounding the environment, pollution, etc. As time passes and world populations grow, more people increasingly demand natural sites. By contrast, the supply of natural goods is fixed and alternative commercial uses for these goods generally grow with technological development. Therefore, especially in developed countries, these trends lead to a continual increase in the demand for natural goods (Barkley & Seckler, 1972). This situation is presented in Figure 2 –4.

As illustrated in Figure 2-4, the value of a natural good is flexible and dynamic depending on people's preference, overall pollution, and the effects of time. Different from a private good, the value of a natural public good ranges from P_t to P_{t+n}. Because aesthetic and ecological values are estimated in subjective ways (Rolston III, 1983) and the state of a natural good is changeable, the total value of a public good has a wide range of possible prices. Therefore, as the monetary valuation of a natural good is not precisely known, its actual price is generally decided by social negotiation or through interactions among stakeholders. The economic analysis of this point is consistent with a social constructionist's perspective on environment, which states that the understanding of environmental problems is in itself a social construction that rests on a range of negotiated experiences rather than being a fixed entity (Hannigan, 1995).

When applying the integrated or extended value approach to the natural environment, on which the sustainable society model of this thesis is based, identifying at least two kinds of facts are essential in designing and implementing environmental policy. As identified in the previous section, the first is the inventory of the existing natural ecosystem and the second is people's aspiration to an environmentally sustainable community. Without the reversal of ecological degradation and people's current environmental attitude, growth in economic activity will not be sustainable in the longer term (Hugh E. Williams, *et. al*, 1993).

b. Indicators of ecosystem health

In managing our environment, one of the most necessary initial tasks is to identify the present state of the ecosystem and our capacity to manage it sustainably for present and future generation. Toward this end, many international organizations and countries have been developing sustainability indicators that measure both the ecological state and national action to enhance sustainability. Some examples are shown in Table 2 – 1.

Table 2-1: Major Sustainability Indicators (summarized)

organizations	Components of framework	Indicators (examples)
OECD	Environmental pressure Environmental condition Social response	Economic growth, population growth,.. Concentrations of GHG, air emission intensities,.. Energy efficiency, pollution control expenditure,..
UNEP	Social aspects Economic aspects Environmental aspects Institutional aspects	Unemployment rate, urban population growth rate,.. GDP per capita, annual energy consumption,.. Annual withdrawals of ground and surface water, population growth in coastal area, use of pesticide,.. Potential scientists and engineers per million population,.
WEF	Environmental systems Reducing Environmental stresses Reducing human vulnerability Social and institutional capacity Global stewardship	Air quality, water quantity and quality, biodiversity,.. Reducing air pollution (NOX emissions per populated land area, etc.), reducing ecosystem stress,.. Basic human sustenance (daily per capita calories supply as a % of total requirements etc.), regulation/ management, eco-efficiency, information, etc. international commitment, global-scale funding.

< Sources: OECD, 1998, Environmental indicators towards sustainable development, UN, 1996, Indicators of

Sustainable Development Framework and Methodologies, New York, World Economic Forum, 2001, 2001 Environmental Sustainability Index. >

Although sustainability indicators are varied according to different perspectives and the international community has still not established a standardized indicator system, the process of identifying the present state of the ecosystem, national efforts for environmental sustainability are essential elements in designing and evaluating environmental policies.

c. Cleaner production and the ecosystem

Although natural ecosystems cannot be created by human technology (Barkely & Seckler, 1972), managing the production system in an ecologically sound way is closely related to the ecosystem's sustainable development. In general, the ecological system supplies raw materials for the production system, and in turn the production system discharges air, water and other pollutants, back into the ecosystem. Therefore, efforts to adopt and develop CP practices are able to reduce human environmental pressure that is exerted on the ecosystem. The ecological benefits of CP are different according to the patterns and intensity of cleaner production. These differences are discussed in Section 2.2.

2.3. Closing Remarks

2.3.1. The social system in the creation of a sustainable society

Section 2.1 explains four relevant sub-systems of CP under the sustainable society model, relating to the production system, government, community and the ecosystem. This thesis author assumes that these four subsystems are fundamental and essential structural components of society. While this classification is adapted from the well-known Parsonian conventional sociology and the quadripartite typology, this study has differentiated and simplified the classification in order to apply it to the model of environmentally sustainable societies. The basic difference in the new classification is the inclusion of the ecosystem as one of the sub-systems of societies. Accordingly, the ecosystem is no longer seen as having an external existence outside of human society. Thus, the sustainable society model takes a broader view, and integrates the four aspects of society in order to develop and promote a more effective CP policy.

This author has given considerable attention to the evolutionary steps of each social sub-system and its adaptation process to a more upgraded level of the environment. This study assumes that without these changes in attitude or political development within each sub-system and consequently, within society as a whole, it will be very difficult for a community to become a sustainable society. For example, the attitude of an industrial manager can evolve from a compulsory or pecuniary motive into a communal motive, and subsequently into the pioneering motive.

In this broad social context, this author explored the elements of a desirable CP policy, recognizing that i) CP approaches began as complementary strategies to overcome limitations of the conventional collective measures; ii) successful CP activities inherently require participation of all subsystems within society; and iii) the theory of environmental externalities from neo-classical economics cannot fully explain why industry must strive for CP or an environmental management system.

2.3.2. The importance of dialogue, negotiation and cooperation in a sustainable society

Section 2.1 serves to explain why the role of dialogue, negotiation, and cooperation are important in designing and implementing cleaner production policy. First, a natural good has a

wide range of values. Valuation processes are varied according to different perspectives and actors. The market is not capable of providing public goods. Therefore, more dialogue, negotiation processes, and cooperation are required in order to achieve a social consensus or equilibrium. This process is a central feature of the Dutch approach to environmental policymaking, whereby, in various long-term environmental policies (i.e. NEPPs), they acknowledge the centrality of the process of consultation and dialogue with the stakeholders in government, in industry and in society, at large (Gouldson & Murphy, 1998). Secondly, in the context of SD, many ecological activities have a complex structure that take a much longer time to accomplish than those of an economic nature. In other words, an environmental activity is completed only after having gone through all required processes, starting with government's initial guidelines, through polluters' mitigation plans, and ending with prevention of the problems at their sources or the installation and operation of appropriately designed, constructed, operated and monitored treatment process in appropriate facilities. On the other hand, a unit of economic activity is completed when a buyer pays for a good or service by exchanging money with the seller. When the buyer resells the good or service to another person, this is legally considered as a different and unrelated economic activity from the first.

However, with regards to ecological activities, it is normally unclear when it begins and when it has ended. This is mainly because i) most ecological activities are characterized as mixed goods, and ii) in many cases, environmental policy's goals cannot be achieved by one person or organization, but require the collective actions of multiple actors. Many different persons or organizations are involved in processes of a unit of ecological activity. This process also requires the voluntary support of various individuals and organizations, whose contributions are significant. These are basic reasons why a successful environmental policy requires cooperation, negotiation and mutual trust amongst all relevant parties. These characteristics of environmental policy are shown more strongly in the CP approachse than in the command-and-control approaches.

2.3.3. Toward the evolutionary and adaptive policy model for CP

Just as industry and business are the central actors for providing private goods, government is the central actor for providing stewardship frameworks and guidance for public goods including ecological conservation. Recognizing that the provision of good environmental quality, as a public good, is characterized as having multiple targets, flexibility in its goal, and requires both negotiation and cooperation in its provision, the conventional command-and-control approaches can be considered as limited in their capacity for contributing to sustainable development. More specifically, if we are to establish the CP approach as one of the essential components of an environmentally sustainable society, a different approach must be taken.

Based on such a quadripartite sustainable society model, this thesis author takes a broad and systematic approach to exploring an environmentally sound and technically effective governmental policy for encouraging implementation of CP. This researcher has identified and proposed a variety of assumptions on the characteristics of each subsystem of sustainable society in furthering this study. These are summarized as:

(1) Industry and business have four kinds of motives for adopting that include: the compulsory motive, the financial motive, the communal motive, and the pioneering motive.
(2) The government has five policy instruments for CP: command-and-control programs, economic incentive programs, voluntary agreement programs, knowledge and information programs, and public infrastructure programs.
(3) In managing the ecological sustainability of the community, the fundamental variables

are: maintaining an inventory of the ecosystem and the community's aspirations to ecological sustainability.

(4) Under the sustainable society model, the ecosystem is a subsystem of society and needs to be evaluated through use of an authorized sustainable indicator system.

These suggestions can be different depending on the perspective and discipline taken. In this regards, this researcher emphasized the conceptual network between suggested ideas and conceptual arrangements of governmental policy.

This thesis author has developed an adaptive and evolutionary sustainability policy model for CP under the proposed sustainable society model. By definition, 'adaptation' has two meanings; ecological adaptation and sociological adaptation. Ecological adaptation means '*a change in structure, function, or form that produces better adjustment of animals or plants to their environment'*, and sociological adaptation means '*a gradual change in behavior to conform to the prevailing cultural patterns.*' (Webster's New World Dictionary, 2nd college edition, 1976) An organism must change its behavior, function or structure to integrate into its environment. An adaptive organism has not lost its identification, but changes gradually to live under the new conditions.

Likewise, the core characteristic feature of adaptive policy is that the policy can be adjusted to the evolving policy-environment in order to achieve the desired goals. Adaptive policy is thus, similar to organic policy. Adaptive policy has a system that allows it to reach a sustainable goal, while experiencing continuous, dialectic changes throughout its life cycle. Different policy actors assume significant roles at each stage (Miller, 1999b). Mutually supportive interactions amongst social subsystems, optimal instruments and tools can be mobilized in the policy development and implementation processes. Adaptive policy does not have a fixed instrument and fixed policy-elements. Adaptive policy can also be explained as an ecologically upgrading process. Therefore, the new sustainable societal model stresses the interaction between subsystems rather than the self-maintenance of the sub-system itself, flexible negotiation rather than formal social rule, and the evolutionary development of the system rather than a static social equilibrium.

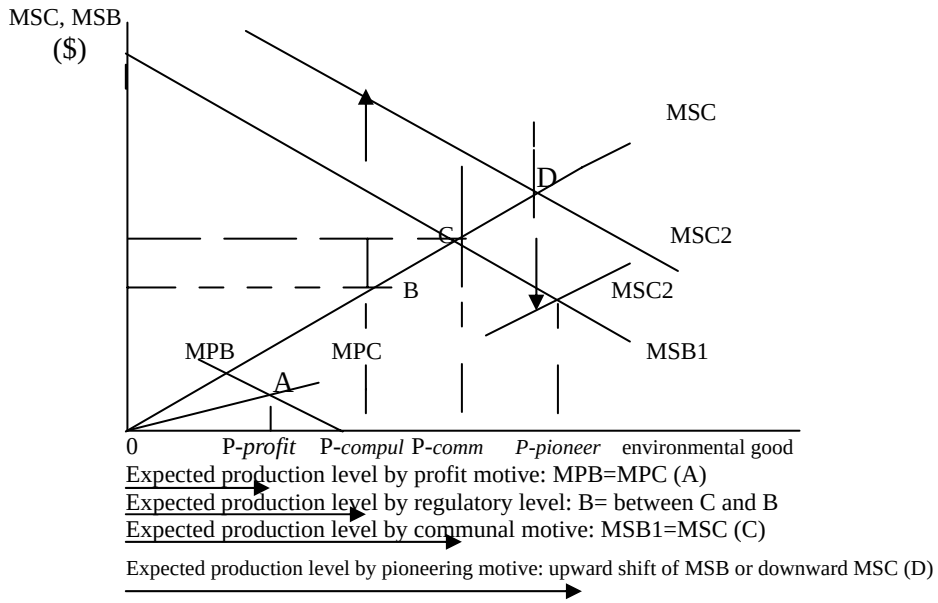
NOTES

1. T. Parsons(1902 – 1979) was the most important American sociological theorist. His written works were widely cited and used by sociologists. His works are exemplified in his analysis of four action systems – behavioral organism, personality, social system, and cultural system. In recent years, the popularity of the functionalists has begun to wane, as its limitations have become more apparent. To many critics, functionalists such as T. Parsons unduly stressed factors leading to social cohesion at the expense of those producing division and conflict and he emphasized that functional analysis gives societies qualities they do not seem to have as well. (Giddens, 1997)
2. His views on economy and government were heavily influenced by Adam Smith. He asserted that no external power source is needed to maintain order; the society that governs least governs best. (Ritzer, 1996)
3. According to Parsonian theory, the function of the fiduciary subsystem is to transmit culture such as norms and values to actors, which they then internalize. Schools and families play such a role.
4. Social or ecological benefits have a very wide range of monetary evaluation methods. Numerical monetary valuation of an environmental activity can vary according to time, space, and valuation criteria. This researcher views the issue of social benefit from a

sociological perspective rather than from an economic perspective.

5. Economic profit means the profit calculated by the conservative accounting method. In contrast, end-of-pipe processes always cost much to build, to operate and always treat the results of inefficiencies within the production processes that should be eliminated at their sources. Thus, end-of-pipe approaches always result in costs in materials and energy wasted within the processes as well.
6. The number of ISO 14001 certified companies in Korea is 880 out of approximately 110,000 manufacturing and construction companies in Korea. Generally, companies from Asian countries, including Korea, have a relatively strong willingness to be certified by ISO 14001 standards (ISO, ISO Survey 2002, KSB, Korean Statistics, 2002).
7. Ritzer comments that Parsons did not take interaction as his fundamental unit in the study of social system, but rather, used the status-role complex as the basic unit of the system.
8. Political pressure from governmental or international agency is usually driven from the recognition that the production processes are placing incredible pressure upon all facets of the ecological system upon which social systems are totally dependent.
9. While this researcher classified CP motives into four types, these four motives are basically explained in terms of classical economic theory. Figure 2-5 shows the theoretical explanation of the CP motive. In this explanation, it is assumed that the expected production level of environmental goods by governmental regulations is higher than that by a private company based solely upon its profit motive, and lower than that by community, based on its aspirations for sustainable development. In general, if we consider the characteristic of mixed goods which CP activities have and the aspirations of community to have higher quality of environment, such an assumption may reflect the evolving societal reality.

Figure 2-5: CP Motives Explained from the Economic Perspectives



10. Instead of the term ‘instrument’, they use various terminologies such as strategy(Barry, 2002), approach (Samuelson, 1987), program (Donald, 1997), remedy or solution (Taylor, 1998).
11. The thesis author does not differentiate between the terms ‘program’ or ‘instrument’ and

prefers to use both of them, mainly to provide more focusing upon flexibility of governmental policy.

12. Transaction cost refers to the time and effort needed to reach an agreement.
13. Environmental agreements usually between firms and local governments have been a widely used policy tool in Japan since the 1960s.
14. These "covenants" are linked to a permit system, which in order to operate defines detailed emission standards for each industrial site. This system is administered and monitored by local bodies (OECD, 1999).
15. Many prefer a mixed model, comprised of voluntary agreement instruments and regulatory instruments (Donald 1997, Wallace 1995, Gouldson 1998). Gouldson and Perman argue that minimum environmental standards are complied with by mandatory regulation and environmental innovation policy needs to be encouraged through voluntary programs.
16. An OECD 2000 report on sustainable development states 'It should be clear that there is no single best instrument. Generally, policy instruments should be combined with one another to benefit from synergistic effects. A combination of standards with economic instruments is particularly useful since it combines effectiveness with efficiency.' (OECD, 2000)
17. We know this assumption from the Hardin's example of the 'Tragedy of the Commons'.
18. Although we are likely to insist that the two criteria, environmental effectiveness and economic efficiency have to be pursued at the same time, the government may emphasize the former criterion while the private sector may choose the latter (Field & Field, 2002).
19. Classifications of value on the ecosystem are varied according to different criteria. For example, David Pearce classified the value into five dimensions: direct use value, indirect use value, option value, existence value and bequest value (Perman 1996, p.253). By contrast, Rolston suggests five categorizations as values of nature: natural value as an epiphenomenon, natural value as an echo, natural value as an emergent value, natural value as an entrance, natural value as an education (Rolston III, 1983).
20. Some call them existence values.

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Chapter 3 The Structure of Cleaner Production

Chapter 2 described the four contextual subsystems of society that are helpful for encouraging implementation of CP. This Chapter 3 focuses on the theoretical aspects of CP. The researcher views the CP activities from an interdisciplinary perspective in order to understand it in a broader social context. It is important to acknowledge that CP activities should not be construed only from a technological point of view. CP policy in a sustainable society must be designed to achieve social, environmental and economic improvements in the industrial production sector (UNEP, 1994). This perspective facilitates the development of an adaptive and evolutionary policy and clarifies the concept of CP in the conceptual context of environmental management.

3.1 The technological perspective of CP

As is evident from the definition of CP, 'the continuous use of industrial processes and products to prevent the pollution of air, water and land, to reduce wastes at source, and to minimize risks to the human population and the environment', the technological and non-technical emphases form the bases of the CP strategy.

Assuming that CP activities are conducted in the industrial workplace and are designed to prevent pollution at the source, there are five generic types of CP: good housekeeping; on-site recycling; process modification; material substitution; and product design as shown in Figure 3-1 (UNEP, 1994). These are based on the inputs-processes-outputs array of the industrial workplace.

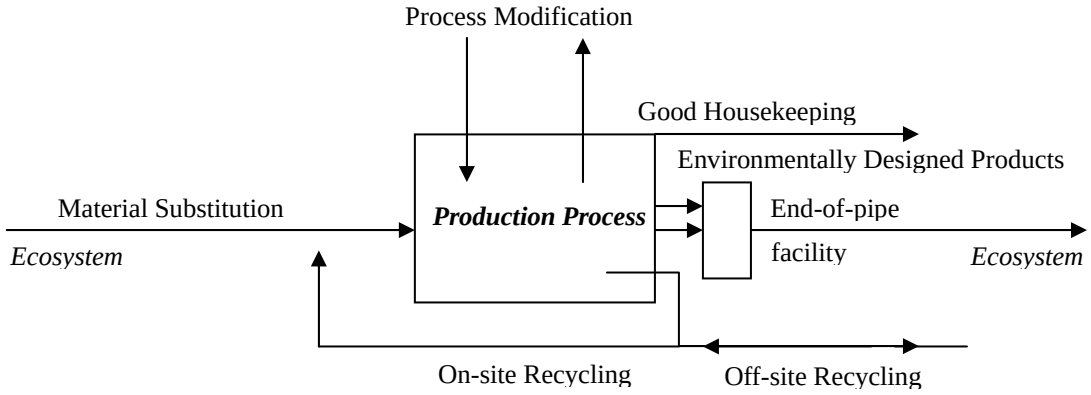


Figure 3-1: Technological structure of cleaner production

Although, there are several other types of classification according to different criteria, this generic and technological typology of CP can clarify the technical identification of CP compared with other environmental management terminologies such as ISO 14000 series and consequently, it helps the theoretical development of the CP approach. We need to add to them the end-of-pipe technologies and off-site-recycling processes. As shown in Figure 3-1, end-of-pipe technologies must be essential parts of environmental process technology. We need to acknowledge that both the CP technologies and the end-of-pipe technologies are to be utilized to enhance the industrial environmental sustainability. Meanwhile, although the off-site-recycling approach is not considered as CP technology, this approach also needs to be developed as one of industrial environmental technologies, in a broad sense.

a. The good housekeeping approach

Good housekeeping, also referred to as good operating practices, implies procedural, administrative, or institutional measures that a company can use to minimize waste and emissions. UNEP (1994) enumerates the practices of good housekeeping as follows;

- Reduce raw materials and product losses due to leaks, spills, drag-out, and off-specification products;
- Improve monitoring of operations and maintenance of all facets of the production processes;
- Schedule production to reduce equipment cleaning- for example, formulate light before dark paints so that vats do not have to be cleaned between batches;
- Improve management of inventory of raw materials and products;
- Train employees in cleaner production.

Many of these measures are used in industry largely to make operational efficiency improvements and to implement good management practices. This approach can be implemented in all areas of the production processes (UNIDO/UNEP, 1995). Good housekeeping refers to internal environmental improvement methods rather than to interactions with the external environment. In that sense, the approach is in line with corporate efficiency or productivity improvement movements such as TQM (Total Quality Management), which are environmentally-oriented. Therefore, compared with the other CP technologies, good housekeeping methods have fewer obstacles in the way of CP. In addition they can be implemented with little cost (UNIDO/UNEP, 1995) and can be carried out supported by the 'financial motive.' As a result, good housekeeping approaches can be assumed to be the initial stage of CP strategy in the developmental stage of CP. Therefore, in order to encourage good housekeeping practices, government or CP drivers need to provide corporations with appropriate information and successful cases of CP. They also need to provide training on how to do thorough 'waste reduction audits.'

b. The internal recycling approach

All residuals of the production process have only two possible ends. One is discharge to the environment, while the other is recycling in a broad sense (Billatos & Basaly, 1997). On-site recycling or reuse refers to the return of a waste material either to the originating process as a substitute for an input material, or to another process as an input material (UNIDO/UNEP, 1995). Although there are various definitions to describe recycling, the following are common (Billatos & Basaly, 1997):

- Reuse of products in the same capacity for which they were originally manufactured (e.g. to reuse bottles, pallets, crates)
- Processing of residuals to produce the same raw material used in the initial manufacture of the final products (e.g. to recover nickel-plating solution by using an ion-exchange, to recover dye-stuffs from waste water by using ultra-filtration system in textiles)
- Alteration of the residuals to a completely different kind of material (e.g. to change cellulosic fibers in paper residuals to protein by using bacterial action)
- Recovery of energy from the residuals (e.g. to generate steam for the production of electricity by incinerating the solid residuals)

Compared to good housekeeping approaches that seek to reduce or minimize the loss of raw materials or products in the processes, the recycling approach are designed to change used materials or wastes into economic and valuable materials or products. However, assessment of recycling options is not as easy as for the good housekeeping approaches, because the company needs to consider not only technological issues but also the social, economic and ecological

issues. Although the social benefits of recycling is the value of the recycled material plus lower overall disposal costs minus the cost of collection and processing (Billatos & Basaly, 1997), the costs of a recycling option are often more than the benefits. This is due to the fact that the process of recycling also requires human, financial and technological inputs in order to make usable ones. Therefore, in order to perform an economically beneficial and ecologically sound recycling practice, not only industrial manager but also government and community groups need to work together according to their own roles. This means that the industrial manager requires not only the financial motive but also the compulsory or communal motive to improve the company's recycling technologies and practices.

c. The Process modification approach

The process modification approach refers to process and equipment modifications to reduce waste and emissions, preliminary within the production setting (UNIDO/UNEP, 1995). Although this approach is also called technological change, process technology changes (UNEP, 1994), low-emission process technology changes (Kemp, 1993) manufacturing process improvements (Billatos & Basaly, 1997a), the technology approach (Berkel,1996), processing efficiency technology (Geiser, 2001), avoidance technologies (Preston, 1997), these are all based on improvements in environmental process technology. This approach has a varied spectrum of process technology from minor changes that can be implemented at low cost, to structural changes of the production process involving large capital costs. In this sense, this can be considered as an essential type of CP. These include the following (van Berkel, 1996; UNEP, 1994; UNIDO/UNEP, 1995; Billatos & Basaly, 1997):

- Change of structural production processes: application of an alternative production technology to produce the same product which is more environmentally sound (e.g. to use an electrostatic spray-coating system instead of liquid paint spraying systems.);
- Modification of equipment: Upgrading or replacing the existing equipment with more environmentally efficient equipment to reduce the process related waste and emission generation (e.g. to use mechanical cleaning devices instead of liquid cleaning approaches.);
- Changes in process conditions, such as catalysts, flow rates, temperatures, pressures, and residence times to reduce or minimize waste and emissions and to save energy.

Advances in such environmental process technologies not only enhance the environmental efficiency of the production process, but also contribute to improvements of the environmental quality of the community. During the last decade, the chemical industry has reduced its emissions of noxious materials by 50 percent while doubling its output. For example, more than 10 percent of methane transported via Russian pipeline, previously leaked into the atmosphere, where it contributed to the greenhouse effect. [1] In Western Europe and the United States, the comparable loss of methane in transport pipelines is about 1 percent. In addition to the obvious environmental gain from adopting cleaner process technology to detect and fix leaks, it provided a pure value-added economic output of 10 percent without digging new wells (John T. Preston, 1997).

Despite the private economic, environmental and social benefits, such technologies that could solve serious environmental problems are not being adopted as rapidly and universally as they should be (Preston, 1997; Goodstein, 1995). There are a variety of obstacles that can discourage the adoption of these process modification approaches to CP, even though they are environmentally superior, cost-effective technologies.

Firstly, compared to improved housekeeping approaches or the internal recycling approaches

that mainly occurred inside the company, the process modification approaches are often processed in the market by external technical providers rather than by internal technicians. For the company, this can require substantial capital investment. In other words, this approach is influenced considerably by the process technology market, but also by shareholders of the company. Therefore, from the point of view of the demander, if the change of production process causes a larger increase in cost than the benefit, the company would be reluctant to adopt new cleaner process technologies

A second substantial barrier arises from the typical governmental policy system: (i) current subsidies are tilted in favor of existing, end-of-pipe, pollution control technologies. These subsides range from R&D funding to price supports, to tax credits, to efforts on behalf of industry by state and federal agency personnel (Goodstein, 1995); (ii) our current regulatory structure "undercharges" polluters and reduces the incentive for innovators to develop or adopt cleaner technologies (Preston, 1997); (iii) the capital market's inadaptability to changes in the environmental regulatory system. We can summarize the situation as follows:

<Given situations>

- The adoption of improved process modification technology is not forced, in general, by governmental regulation;
- The process technology modifications may require considerable funds beyond the average amount, which a corporation is willing or able to pay;
- The possibility of successful management of the process technology is uncertain not only technologically, but also economically;
- Local community groups or the international community continues to pressure industry and business to adopt CP approaches.

In this situation, the compulsory motive or the pecuniary motive of a corporation, as stated in the previous section, is not enough to push them ahead with such structural changes of the production system in an environmentally sound manner. In order to upgrade the level of CP options such as structural change of the production system, much stronger internal motives for CP like a communal motive or a pioneering motive might motivate leaders of companies.

Along with the internal motives, external pressures from local community groups, the international community or governmental programs need to be associated with the sustainable willingness of a corporation in order to harness the higher levels of CP.

Within such a context, it is likely that the process change of cleaner technology will be gradual and rather slow, despite the strong public call for it, due to the various reasons (Kemp, 1993). But, even though a society is pursuing a gradual and evolutionary approach, a problem is still left on how industry and government take proper measures to improve industrial sustainability through cleaner production? In other words, the question of how can we develop a policy or a strategy to bridge the '*sustainable development gap*' or the '*sustainability gap'* must be raised. [2]

d. The material substitution approach

The material substitution approach refers to one of the CP techniques to accomplish CP by reducing or eliminating the hazardous materials that are used in the production process (UNIDO/UNEP, 1995). This approach is also called, the 'changes in raw materials' or the 'cleaner inputs approach' (UNEP, 1994). The following practices can be used as general types of this approach (Berkel, 1996; UNEP, 1994):

- Use of less hazardous or more environmentally sound raw materials or parts: for a particular production process (e.g. to substitute water-based ink for chemical solvent-based ink in printing industry, or to reduce phosphorus in waste water by reducing use of phosphate-containing chemicals, or to use woods or metals instead plastics in furniture industry to reduce plastic wastes, to use organically grown natural cotton instead of conventional produced cotton in the textile industry);
- Use of more environmentally efficient auxiliaries: selection of process auxiliaries with the longest service lifetimes or the highest environmental efficiencies (e.g. to replace water-based film-developing systems with a dry system in the textile industry, to use reusable desert dishes instead of single use dishes in hospitals);
- Use of renewable or recycled materials: utilization of renewable materials instead of non-renewable materials or increase of the recycled material content of products and auxiliaries to reduce waste (e.g. to use paper-coated cups and plates instead of plastics in the food industry, or to use recycled fibers in the paper board industry);

This approach also has a wide range of CP applications from creating a new material to increasing the use of recycled materials. However, considering that this approach belongs to the production process modification in a broader sense, which influences the quality of products considerably, it is assumed that this approach requires a much stronger driving force than the process modification approach. This cleaner material input approach would be the most effective option in the light of pollution prevention, because in general it does not require secondary treatment. Therefore, in order to encourage this approach, not only strong motivation by the company but also relevant support of government and community may be required.

e. The product design approach

The products design approach refers to changing products of manufacturers or service-providers into more environmentally sound ones. This can be considered as one of CP options, because this approach enables producers to improve or eliminate the use of manufacturing processes that generate waste and pollution by designing their products so as to reduce or eliminate those inputs or processes that generate more wastes or harmful by-products. It is important that ‘designing products for the environment’ integrates environmental concerns of the society into the product development process, that is in the design stage, in order to reduce at the source, the quantity of materials and energy resources used and the toxicity of the wastes generated.[3]

This approach focuses on cleaner inputs and outputs in the production processes. In contrast to the dominant criteria for design and manufacturing in the past, such as product performance and ease of production, the changing nature of design for environmentally sound products, ensures that systematic internalization of environmental requirements in the design stage can lead to less waste, more efficient methods of production, and strategic opportunities for product development (Billatos & Basaly, 1997). The product design approach can be divided into three categories according to the environmental function (OTA, 1992): [4]

- Design for waste prevention: This refers to activities by manufactures and consumers that avoid the generation of waste in the first place. Examples of design for waste prevention include reducing the use of toxic materials, increasing energy efficiency, using less material to perform the same function, or designing products so that they have a longer life.
- Design for remanufacturing and recycling: This refers to activities that make products that can be remanufactured and recycled. For example, the author envisions one model of plastics management in which virgin plastic components are reused repeatedly until the plastic is finally utilized as an energy source. Design for remanufacturing or

recycling can be beneficial from both an environmental and a business point of view. They can reduce virgin material extraction rates and wastes. It can also divert residual materials from the community waste system, relieving pressure on overburdened landfills.

- Design for easy composting and safe incineration: Apart from recycling and remanufacturing, designers can facilitate composting by making products entirely out of biodegradable materials. For example, starch-based polymers are inherently biodegradable, and easily composted. Also, products could be designed for safe incineration by avoiding the use of heavy metals and chlorinated organics and brominated organics.

In many cases, the function of products can be significantly enhanced by the inclusion of features that result in less energy use and less waste and pollution during use throughout its operating life (Billatos & Basaly, 1997). Therefore, an environmentally creative product-designer can ensure a company and a community many new profitable opportunities for environment, because environmentally sound designs of new products that reduce energy and materials yield immediate positive results for them. For example, the use of the lithium battery in place of the nickel-cadmium battery reduces the problems associated with the disposal of batteries containing heavy metals that contaminate landfills (Preston, 1997).

Considering that product design is a process of synthesis in which product attributes such as cost, performance, manufacturability, safety, and consumer appeal, etc, product design may be very industry-specific and company-driven process. Also, the design process may not require such large capital expenditure compared to production process modification. This means that to many companies, the eco-products design approach could be adopted in line with the company's inherent decision-making processes. Therefore, it seems that corporations, in many cases, do not need special strong external stimulation to drive this type of CP, because products are the most essential substance of industry and design of the product is therefore a critical determinant of a manufacturer's or service-provider's competitiveness in the market. In addition, it can give the company good potential opportunities for challenging themselves to integrate their profitability and environmental demands of the society (Billatos & Basaly, 1997).

Nevertheless, we need to recognize that many health and environmental laws passed by governments influence the environmental attributes of products (OTA, 1992). Government regulations typically influence the design process by imposing external constraints and requirements, which many manufacturers comply with. Although products are designed under the framework of the market, a good designer must consider not only basic product-attributes such as cost, performance, manufacturability, safety, and consumer appeal, but also product-constraints such as energy efficiency targets, tamper-proof packaging specifications, toxicity of constituents, specific waste management technologies, and even local conditions under which the product may be used and disposed,[5] most of which are given by the contextual social subsystems such as governmental regulations and social pressures of their community.

f. End-of-pipe technology

In general, end-of-pipe technologies for controlling air, water, and waste are not classified as CP technologies. Rather, most CP advocates consider them as counter-productive for transitioning to CP systems. Because CP is designed to reduce wastes and pollutants at their sources and to not wait to treat them after they are produced, they have inherently different impacts than the end-of-pipe approaches. (UNEP, 1994). Nevertheless, the end-of-pipe technologies still make up the largest subgroup of environmental technologies measured by current market revenues (Preston, 1997) and most existing environmental regulations, especially those designed to

regulate water pollution, air pollution, and waste management, are based upon end-of-pipe technologies.

We need to recognize that CP approach promoters do not claim that end-of-pipe technologies will not be required any more, but CP activities will lead to a reduced need for end-of-pipe technologies and may, in some cases even eliminate the need for them together (UNEP, 1994). Considering that typical end-of-pipe technologies are municipal wastewater treatment systems, dust-collecting systems, and incinerators, the two approaches can be complementary, even though they are sometimes competitive. Therefore, in managing the environment of a community, we need to take comprehensive measures which consider not only CP approaches but also the end-of-pipe technologies, because end-of-pipe environmental facilities must form an indispensable and basic part of the entire environmental management system of the production system as described in the previous section 2.2.1.

3.2. The policy considerations for CP from the economic point of view

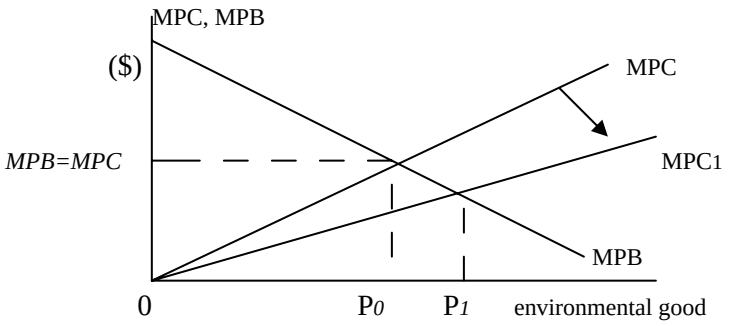
Introduction

In analyzing environmental issues, the well-organized economic tools are used to give us good insights and directions. Especially neo-classical economic theories such as the one of marginal cost theory (MC) or marginal benefit (MB) contribute in a great extent to clarifying the causes of the phenomena and formulating new environmental policies. The research tries to view briefly the CP activity and its policy from a point of neo-classical economic theory.

Under the context of the MSB (Marginal Social Benefit) -MSC (Marginal Social Cost) relationship or the MPB (Marginal Private Benefit) –MPC (Marginal Private Cost) relationship, three typical scenarios related to CP options can be envisaged theoretically according to the level of capital investment or financial risk (see Figure 3-2, 3-3 & 3-4):

(i) Risk-free option: When a CP option causes the existing MPC to pivot downward to MPC_1 without additional fixed cost;
(ii) Risk-acceptable option: When a CP option causes the existing MPC to pivot downward to MPC_2 with acceptable fixed costs;
(iii) Risky option: When a CP option causes not only the existing MPC to shift up to MPC_3 with considerable fixed and variable costs which can raise internal managerial conflicts, but also causes the existing MPB to shift up to MPB_1.

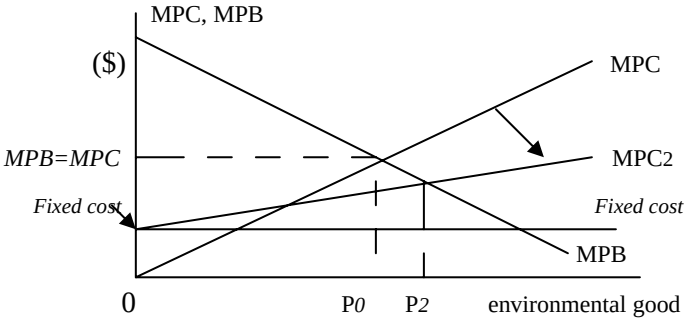
(i) Risk-free Option (Figure 3-2)



This scenario shows an environmentally stimulated change in a firm's production system that results in a change in the position along the MPC curve in a cost-saving and environmentally sound way without investing fixed costs for CP. Many good housekeeping approaches, many

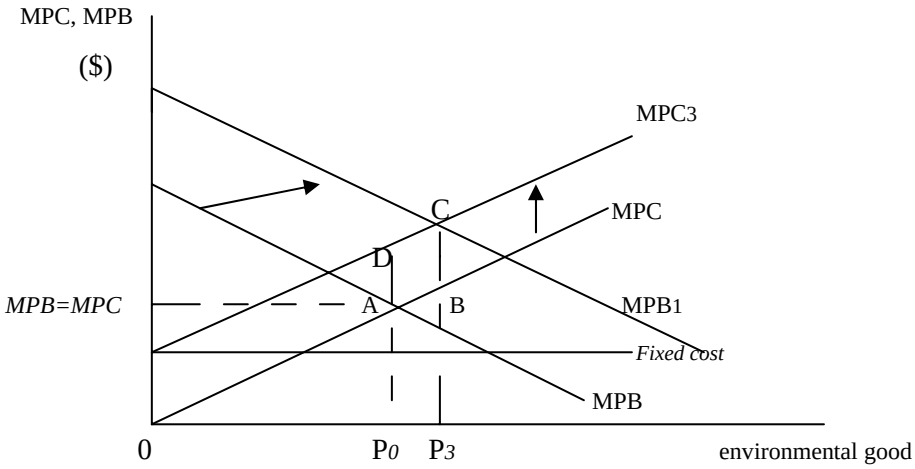
internal recycling approaches or some product design approaches could be included within this cluster. Although many CP advocates used to call this pattern a 'win-win' strategy, this researcher calls it 'the initial model of CP'. It can be assumed that if the role of government would be focused, in this case, on providing relevant information and an effective dissemination program on CP, their promotion policies would be more effective.

(ii) Risk-acceptable Option (Figure 3-3)



The second scenario shows a more developed level of CP, for which a firm changes its production system with the investment on a voluntary basis. If the firm holds the compulsory motive or the financial motive for CP, it is likely to be reluctant to adopt the more developed level of CP, because it requires a kind of structural change of the production system and consequently it has a greater managerial risk. But, if the firm holds the communal or pioneering motive for CP, it might have a willingness to adopt this type of CP investment. This scenario changes the position of the firm along the MPC curve in a cost-saving and environmentally sound manner, except during the initial stage, when the firm invests in CP changes. It is assumed that many process modification approaches, new material substitution approaches, and higher level of recycling approaches or products-design approaches belong to this scenario. It is assumed that as long as the role of government is concerned, in this category, the effective instruments which encourage substantially firms to adopt CP could be provision of technological information, environmental loans, eco-labeling, and certification for an environmentally friendly company, etc.

(iii) Risky Option (Figure 3-4)



The third scenario shows a pioneering level of CP approaches being followed by the company, because its leaders consider long-term CP investment plans are integral to their overall future. Thus they are willing to invest in development and implementation of a cleaner technology innovation plan, which requires considerable fixed costs or variable costs or structural change of their existing production system towards sustainable development. Figure 3-4 illustrates this case.

This model shows that due to innovative investments in CP, not only MPC but also MPB are shifted to MPC_3 and MPB_1 respectively. This means that even though the company spends considerable money on developing CP technologies, gains are also increased significantly, commensurately with their investment. For example, if an auto-manufacturer succeeded in producing electronic cars in an economically efficient way, or a chemical company developed an ecologically sound pesticide, both cases would result, not only in economic benefits but also society would benefit from human health and ecological improvements.

If we consider the social benefits it brings, such a case would be very positive. However, in the real world, it is assumed that a corporation, as a profit-maximizer and cost-minimizer, would not have a strong willingness to conduct such significant and long-term investments in CP. Also, a government, as a central regulator, could not force the private industrial sector to conduct such high-risk investments, because it is beyond the economically effective point P_3 in the Figure 3-4. [7]

Negotiation between industry and government for CP implementation

By contrast, from the perspective of government, as an environmental good provider, such a high-risk environmental investment should be encouraged and continued because it can also produce highly-qualified social benefits. This researcher calls it ‘a recommendable mixed area of the private sector and the public sector’, which is shown as ABCD in Figure 3-4. In the process of environmental policy making, the mixed area has an important meaning, because not only does it show the policy-maker a goal of environmental policy, but also it indicates that in the area of CP or sustainable development policy, cooperation between industry and government is necessary in order to achieve continuous development of CP beyond the level of compulsory motive or financial motive for CP. It is also assumed that in the mixed area presented in Figure 3-4, the policy-compromise between the private sector and the public sector or negotiation between government and industry is possible in order to maximize the social benefits of CP (Taylor, 1998). [8]

3.3 The legal aspects of CP

As stated in Chapter 1, it has been widely asserted that the CP approaches in companies resulted from refocusing their efforts from ‘end-of-pipe’ to the process integrated approach. We need to reflect on the legal differences between the two approaches in order to clarify this assertion.

The ‘end-of-pipe’, ‘command-and-control’ approach, and ‘polluter-pays-principle’

Although, there are various kinds of approaches to implementing environmental programs in the production system, the pollution-control regulations that sought to clean up the eco-system such as air, water, and land by setting legal standards to control the environmental emissions from industries are still the central features of environmental policy in most countries (Baumol/Oates, 1977; Elliott, 1997; Gouldson & Murphy, 1998; Riordan, 2002). Many have called the pollution control statutes as the ‘end-of-pipe’ approach, because the process of mandatory regulations has usually been implemented by regulatory monitoring to check if the regulated company removes legally-required pollutants, normally at the end of the production processes, through ‘best available pollution-abatement equipment or techniques such as scrubbers in chimneys or

waste-water treatment systems.

The ‘end-of-pipe’ approach is usually begun by setting standards, which are relatively easy to specify simple ‘emission’ limits of certain pollutants from the regulated company. This is then commonly followed by a permitting stage where the regulatory authorities issue a specific license that outlines the requirements for operating. These generic pollution control processes are normally stipulated by laws and regulations, in many countries, by the central governments. So this approach is also widely known as ‘the command-and-control’ policy.

On the other hand, economically, the regulated company should pay the total costs for the pollution control process, because that is the minimum environmental responsibility of the regulated company, which is set by the central government. In general, it does not establish direct financial incentives or disincentives although some economic costs and benefits are normally associated with the measures that are needed to ensure compliance and fines can follow non-compliance (Gouldson & Murphy, 1998). In general, it is called the ‘polluter pays principle’. In this sense, we can recognize that the ‘end-of-pipe’ approach, the ‘command-and-control’ approach, and ‘polluter-pays-principle’ are derived from the same approach but are expressed from different perspectives, technologically, legally, and economically, respectively.

This conventional regulatory system has, despite its flaws, been remarkably successful in achieving measurable progress in cleaning up the environment in the developed economies during the last generation, especially in regulating large industrial polluters like power plants, refineries, chemical plants, etc. (Elliott, 1997). Considering the legislative basis to impose rigid environmental standards as a minimum responsibility of industrial polluters and the apparent reluctance of many governments to explore new approaches to environmental policy, mandatory regulations are the primary instruments applied by government (Gouldson & Murphy, 1998). However, it is widely accepted that the conventional regulation of enterprise based on a combination of governmentally, legally-binding command and control approaches combined with enterprise liability for damages caused to humans and to the environment has reached its limits.

Ineffectiveness of the command-and-control approach

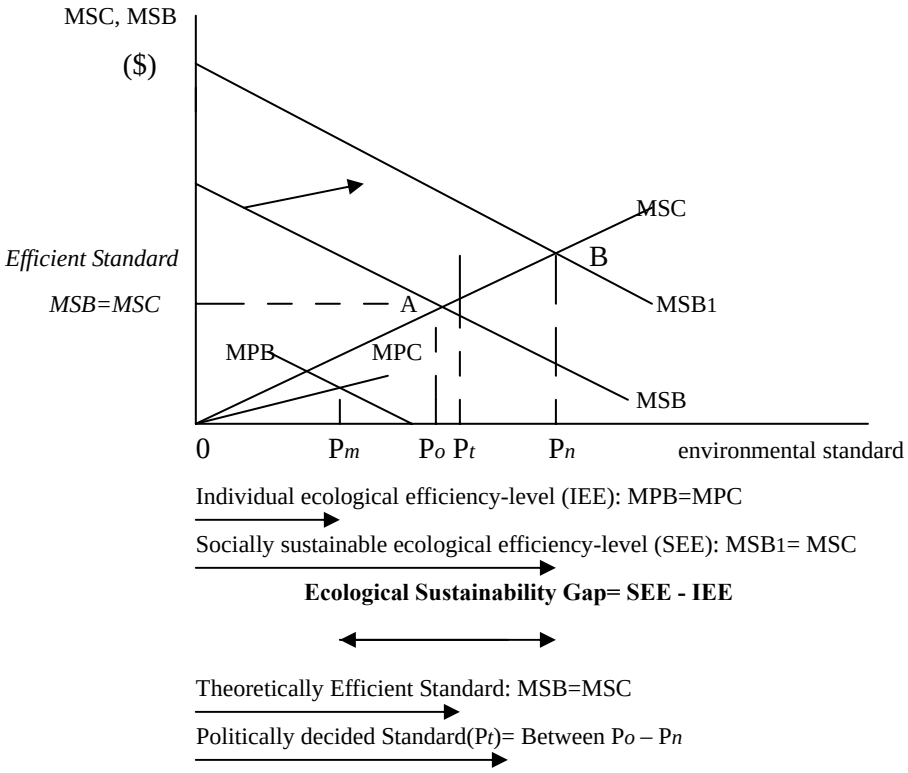
(i)Those factors relating to the impossibility of generating sufficient knowledge to provide an efficient level of regulation; in such a situation of imperfect information, it is highly probable that the government will unknowingly establish environmental standards at level other than the allocatively efficient one, even if that was the legislated intent (Callan & Thomas, 1996). In fact, this unresolved tension between scientific and administrative rationality has been hidden by unsatisfactory compromise, such as the administrative “prerogative” of standardization in the case of conflicting opinions between scientific experts (Karl-Heinz Ladeur, 1994). Accordingly, they should be reinforced by a procedural rationality, which allows the planning and modeling of a variety of operations and options (Karl-Heinz Ladeur, 1994). In a heterogeneous society differentiated into subsystems which each follow their own *eigenvalues* there is no alternative to the procedural compatibilization of different functional values, unless one accepts the risk of blocking the autonomy of the subsystems (Karl-Heinz Ladeur, 1994).

(ii) Policy factors relating to its inflexibility to be responsive to the diverse demands of the economic situation. First of all, the term ‘polluter pays principle’ which is one of the main presuppositions of the conventional regulatory approach is limited to reactive situations where pollution has been or is occurring. With the increasing emphasis on the pro-active strategy such as CP, it is becoming necessary to extend the scope of environmental policy on the industrial

sector, which needs to include the potentially polluting activities of the conscientious companies which voluntarily conduct their environmental concern in a proactive and non-polluting way (Leeson, 1995). By defining pollution as punitive, allowing certain amounts of pollutants to be released or generated and then punishing any excess, the central government used to operate with little incentive to develop waste reduction policies or to look for alternate production methods like CP. More progress could be made by rewarding companies that implement process modifications that eliminate or reduce use of toxic substances, and reduce energy and material's usage, rather than by continuing an adversarial, litigious approach (Buck, 1996). In addition, as we move toward an economy in which large industrial sources of pollution are less important, environmental regulators must tackle the problem of pollution in the agricultural sector, the service sectors, and consumer products (Elliott, 1997).

(iii) Finally the conventional regulatory approaches have not reflected the unprecedented scale of society's aspirations to environmentally sustainable development (Farmer & Teubner, 1994), because many environmental agencies decide environmental standards without reflecting the cost-factor of environmental pollution and the demand of the community for sustainable ecosystems mainly due to the lack of related information. If normal environmental standards cannot or do not reflect these two factors, such standards lack legitimacy. Figure 3-5 clarifies these relationships between environmental standards and ecological aspirations.

Figure 3-5: Upwardly Shifted MSB due to society's increased ecological aspirations



Although, a theoretically efficient level of the standard occurs at $P_{0,}$ the actual standard is established at P_t that is a certain point on the MSB curve. Our concern is when the MSB curve shifts upwards to MSB_1 because of increased aspiration to sustainable ecosystem. According to neo-classical theory, the efficient standard would occur at B. However, in the real world, it

might be difficult to set the standard at Pn, because from the point of the individual company, the efficient level of the standard is far less than the socially efficient one as presented in Figure 3-5. The regulators usually face strong resistance from industry against the stronger standards based on social aspiration to sustainable development.

Here, we can recognize that there is a gap between the 'individual firm's willingness to conserve the ecosystem' and 'social willingness to conserve the ecosystem', which can occur on the way to realizing an ecologically sustainable society. In Chapter 1, this researcher called this the 'sustainability gap'. We can reason that an environmental policy to bridge the sustainability gap by strengthening the environmental standard to the level of the point P_n (Figure 3-5), where the MPC and the new MSB curve intersect could not ensure efficiency of the policy not only theoretically but also practically, if it has the sustainability gap beyond the threshold of the individual firm's or the individual polluter's acceptability. [9]

In order to overcome such unacceptable sustainability gaps, government is required to shift its style of environmental policy from one of a protective regulatory policy to one of distributive policy. If the new paradigm reflects the major social sub-systems' environmental needs without hurting the other sub-system's essential functions, the policy could help to ensure provision of a sustainable ecosystem.

The social sustainability gap and the CP effects

The previous section addressed why it was difficult for environmental standard oriented policies to be dynamically adaptable to changing socio-ecological conditions. Consequently, such inflexibilities, which the national standard-oriented policies inherently have had, are not likely to result in sufficient ecological efficiency for bridging the sustainability gap between individual company's ecological efficiency-level (IEE) and the socially sustainable ecological efficiency-level (SEE).

In other words;

(i) When the standard is set at an individual company's efficient level (MPC=MPB), it cannot ensure that 'the sustainability gap' will be reduced, because it does not reflect the social needs for improved environmental quality;

(ii) When the standard is set at the socially sustainable level (MSC=MSB), it would face very strong resistance from industry and business. This is due to the fact that the provision of the natural ecosystem is a public good and is therefore, different from private products and the provider of an environmental good cannot have exclusive right to consume the environmental good. It can raise the issue of inefficient allocation of resources or over-investment in an economic sense;

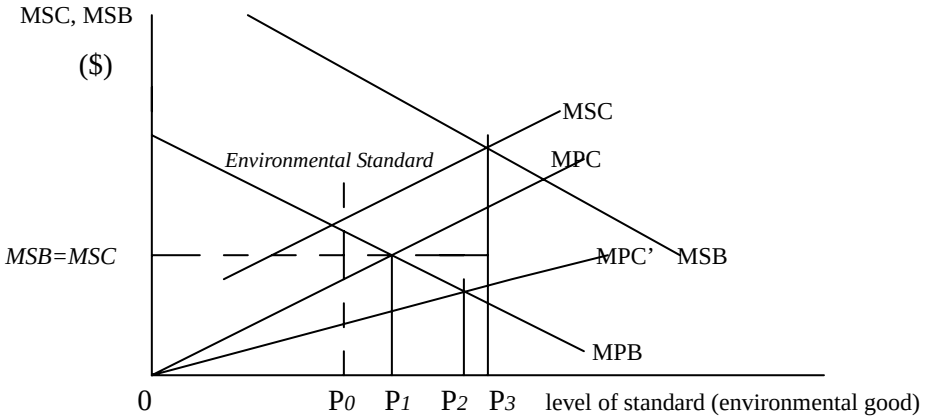
(iii) Even though the standard will be set at the theoretically optimal point between P_m and P_n in the Figure 3-7 which is a normal case in the real world, it also raises problems because it does not often consider community-specific or company-specific factors, nor does it address the community's increasing aspirations to sustainable eco-systems or people's preference for the aesthetic value of nature;

(iv) Finally, the legally-binding standards can not cover all the pollutants from the regulated companies, radioactive substances, mainly because of monitoring problems or unidentified threshold values of certain pollutants such as CO_2. Actually, the target pollutants of standards are usually focused on limited pollutants such as sulphur dioxide, dust, hazardous chemicals, etc. In general, the standard policy does not deal with waste reduction in the private company.

These drawbacks of standard-oriented policies have enabled many regulators to envisage the viability of developing and implementing a policy-paradigm situatively and cooperatively (Ladeur, 1994b). Consequently, many kinds of CP programs or various environmental management programs have been started in many parts of the world to overcome some of the problems of 'command-and-control' paradigm and to efficiently bridge the sustainability gap. This author shows theoretically, how the CP approach could contribute to reducing 'the sustainability gap' by overcoming many of the problems of the conventional policy approaches.

First, in an economic sense, the CP approach can apply a company's marginal cost curve to the environmental management program more usefully than the standard environmental regulatory approach does, because the CP approach is designed to catalyze and facilitate the internal driving forces, while the standard policy programs are implemented upon the company by external regulatory forces. It means that the CP approach can be conducted based on more accurate information on its marginal cost, which can make its performance foster the usage of a more effective levels of environmental investment. As already stated, under the environmental standard approach the environmental goal is given from the outside, in many cases without considering company-specific or community-specific factors. Figure 3-6 shows the relationship.

Figure 3-6: The efficient level of CP that reduces 'the sustainability gap'



Suppose the environmental standard is set at the point P_0. The standard does not reflect the efficient point of the company P_1, because the regulators tend to apply the same standard to all the companies without considering each company's specificities. In this case, the society has a relatively big sustainability gap. But, when a company implements CP practices, it can have a more efficient MPC curve (from MPC to MPC'). Thanks to CP, the company can provide a higher level of environmental good, which leads to reducing its sustainability gap from P_0P_3 level or P_1P_2 level to P_2P_3 level as shown in the Figure 3-6.

Secondly, even though an individual company adopts an appropriate CP option and manages it successfully, we cannot state that the society has accomplished the satisfactory level of sustainable development. This is due to two main reasons: one is that the accumulation of all the individual companies' provisions of environmental goods does not always satisfy the social demand for the environmental goods; and the other is that society's aspirations to a natural ecosystem or aesthetic natural value have a tendency to increase commensurately with the wealth of the society. In other words, regardless of the individual company's CP efforts, if the marginal social benefit curve shifts upwards due to their increased wealth or their change of

attitude towards the natural ecosystem, etc., the sustainability gap can become bigger.

In this case, it may be very difficult for government to take more stringent measures such as strengthening emission standards because individual companies are doing their responsibilities by adopting CP beyond the legally-binding standard. Nor can all the companies actually have the pioneering motive for CP. While the sustainability gap which can be reduced by the private sector's CP efforts, can be called the 'relative sustainability gap', this 'sustainability gap' which cannot be reduced by the private sector, can be called the 'absolute sustainability gap'. If the 'absolute sustainability gap' must be reduced to protect the welfare of the society, this researcher suggests that it should be reduced mainly by government or by the public sector.

Although in the real world, it is almost impossible to differentiate the 'relative sustainability gap' from the 'absolute sustainability gap,' such a differentiation would be useful to formulate CP policy. According to Figure 3-6, we have three kinds of sustainability gaps: P_0P_1, P_1P_2, and P_2P_3. We can envisage that the sustainability gap P_0P_1 might be caused by failure of governmental policy, sustainability gap P_1P_2 might be reduced by additional private sector efforts such as implementing CP, and finally sustainability gap P_2P_3 could be bridged by government's or the public sector's investments. In this context, we can reason that given that a society's aspirations to sustainable development or aesthetic values of natural assets is increasing, investments by the government and the public sector for CP are necessary.

Thirdly, by adopting the CP approach, the company can increase the comprehensive state of environmental quality of the company, because while the standard approach aims at reducing specific pollutant's emission to the environment, the CP approach deals with a broad range of environmental management practices such as recycling, cleaner modifications of manufacturing processes, cleaner changes of materials and processes, creation of environmentally sound produce and process design, etc, which cannot be covered by the conventional end-of-pipe approach. In this sense, we can recognize that CP approaches are different dimensions of environmental management rather than being an alternative environmental management tool against 'the environmental standard approach'.

3.4. The policy implications of the structure of CP

This author has analyzed the structure of CP from three different points of view: technical, economic, and legal perspectives, respectively. This analysis of the structure of CP suggests several important theoretical implications for developing CP policy. The following five implications are suggested as *essential conditions* for formulating adaptive CP policies;

i) The reduction of the 'environmental sustainability gap' as an operational goal of CP policy;
ii) The mutual framework for joint utilization of the command-and-control approach and the voluntary program approach;
iii) The functional cooperation of social sub-systems for CP improvement;
iv) The necessity of adaptive and evolutionary governmental motivation schemes for the continuous improvement of CP;

'Social sustainability gap' as a workable objective of CP policy

As we define the social sustainability gap operationally as the 'difference between social demand for ecological sustainable development and the practical responsibility or current situation of individual actors to reduce environmental pollutants or to conserve an ecological state', it is a relative conception. For example, in the least developed countries, one of the most urgent national goals may be 'poverty eradication' rather than environmental conservation. In

this case, the social sustainability gap in such countries is quite different from that of the developed countries. The degree and the types of the physical sustainability gaps between the current level and the desirable level vary according to the economic, sociological, ecological situations and the recommended standards.

From a policy-maker's perspective, the hypothetical intensity reflecting a community's aspiration to environmental sustainability, which could be characterized by an invisible social consensus, might be more instrumental than certain physical numbers on environmental situation. The social consensus could be obtained via social surveys on the environmental issue or by indirect relevant indicators. Such an approach could be a workable method for designing and implementing a SD policy, so that, in the long run, this hypothetical degree of social sustainability gap could go hand in hand with the physical level of sustainability in question in the community.

Therefore, although the social sustainability gap of a community may be an unclear conception and may not be quantifiable by numerical indicators, what is important is that reduction of the 'social sustainability gap' could be or does function as an actual goal of governmental policy for environmental sustainability. Therefore, design of CP policy is preceded by identification process of the sustainability gap, because if the sustainability gap in some targeted environmental field is not identified in a certain form, the legitimacy of CP policy could be weakened, which could lead to decreased policy effectiveness.

Therefore, under the current situation in which many countries have adopted CP programs, each government has to identify how large its sustainability gaps are on the targeted areas, in order to make their CP programs more effective.

Joint utilization of the command-and-control approach and the voluntary program approach

In light of the proposal for designing optimal policy on the industry and environment relationship, it might be useful to simplify a wide spectrum of policy instruments by segmenting them into two main prototype paradigms of industrial environmental policy: 'the command-and-control approach' and 'the voluntary program approach.' Many authors on environmental policy have emphasized that the former is associated with the conventional compulsory policy and the latter is closely associated with the new, flexible preventive environmental protection policies. We need to reflect on why the two approaches have been established as two central paradigms of environmental policy.

First of all, 'the command-and-control approach' goes hand in hand with the conventional police law concept (Ladeur, 1994) to protect human health and ecosystem from dangerous human activities, which are simultaneously supported by neo-classical economics' environmental externalities theory. The approach considers that certain environmental pollutants of manufacturing sites pose a danger to public health and to the community environment. They assume that the public sector has a prime responsibility for removing such externalities, where the 'polluter pays principle' is the guiding principle of this approach.

By contrast, 'the voluntary program approach' envisages that environmental protection refers to providing a public service to a community. It tries to find solutions through negotiation and social consensus between the regulators and the regulated companies. Therefore, improving environmental quality is not only the responsibility of government but also the responsibility of all relevant social sub-systems. In that sense, the approach considers industry and business as participants of the program rather than as polluters, where the program initiators and the

program participants share its goal and implementation processes. [10]

Secondly, the command-and-control approach presupposes the explicit existence of the environmental standards or legally established performance guidelines, which constitute the central contents of this direct approach. In general, *chemical or biological threshold values for the safety of certain environmental media* are the fundamental basis to determine the legal standard. In case of the ecological system, *the carrying capacity of an ecological system* to sustain a community could also be the fundamental basis for determining a standard value. [11] Conventional policy approaches presuppose that it is the imperative minimum role of government to protect or conserve the chemical or biological threshold value for the safety of certain environmental media such as air, river, etc or the carrying capacity of an ecological system. Therefore, the approach necessarily requires its monitoring system to examine the polluter's activity exactly and reactively in order to ascertain if the company is fulfilling the minimum environmental standards. (Baumol & Oates, 1976).

On the other hand, the voluntary program approach is designed to achieve flexible environmental goals which are usually a shared vision between the program initiators and the program participants rather than explicit and specific environmental standards (Ladeur, 1994). Such visions could be interpreted or applied by the program participants according to their economic, technological and environmental specificities. Therefore, the program managers are trying to adapt themselves to a variety of settings through communication and negotiation (Gouldson & Murphy, 1998).

Thirdly, the command-and-control approach guarantees the accountability and effectiveness of a standardized level of environmental quality. The rule of law and the fear of punishment have done much to advance environmental progress, despite all the drawbacks (Gordon & Coppock, 1997). Therefore, some resistance by the private sectors to governmental compulsory intervention is, in many cases, not primarily a question of political reforms, but is a problem of the corporate survival mechanism.

In contrast, under the voluntary program approach, the objective, emission or performance guidelines and the evaluation methods of the program are decided through negotiation between the program initiator, the program participants and other stakeholders. Therefore, a successful voluntary program would require more effective knowledge and technologies which encourage environmental innovation in the private sector. An environmental policy for a voluntary program would be induced to produce more knowledge about the private sector itself and to reflect upon this knowledge (Farmer & Teubner, 1994). It may not be so difficult to reason that the voluntary program approach is the appropriate policy tool for encouraging CP.

This researcher argues that the relationship of the two policy paradigms is complementary rather than competitive in that environmental problems differ extensively by country and community and in their forms and impacts, but also our understanding of nature and environment is undergoing a transformation along social settings and age (Hannigan, 1995). Therefore, when a government initiates a CP program, it may be required to identify the existing command-and-control policy-framework before starting the new CP program. This author believes that arrangements of this kind of complementary relationships between the existing command-and-control policies and a new CP program may be a sufficient condition for increasing the effectiveness of the new voluntary CP program, along with identifying the sustainability goals of the society. Several normative reasons for that can be suggested as follows;

(i)If the two different policy paradigms are implemented without establishing certain

relationships with each other, the government or the regulated companies may duplicate their efforts. For example, in the metal refining industry, environmental regulations can require the company to install an expensive fume collection and cleansing equipment, whilst the CP program could recommend the cleaner substitution of process materials so as to avoid generating the noxious fumes at their sources and thus, obviating the need for any type of end-of-pipe investments such as installing fume collection and cleansing equipment.

(ii) The regulator can suggest appropriate objectives of the CP approach or they can change the existing command-and-control policies on a long-term basis, by recommending adoption of CP approaches. For example, the voluntary program can be of value where an imperfect budgetary process denies the public sector funds necessary to carry out the popular will or they can be helpful in instances where the command-and-control policy is difficult and other policy approaches are ineffective (Baumol/Oates, 1977).

(iii) A wide range of specificities could not be controlled effectively by the mechanism of the command-and-control approach (Baumol/Oates, 1977). Also, when a government carries out a long-term SD plan, or faces unpredictable environmental crises, the command-and-control approach may not respond flexibly to such comprehensive sustainable development issues or provide the appropriate environmental contingency plan.

Functional cooperation of social sub-systems for CP

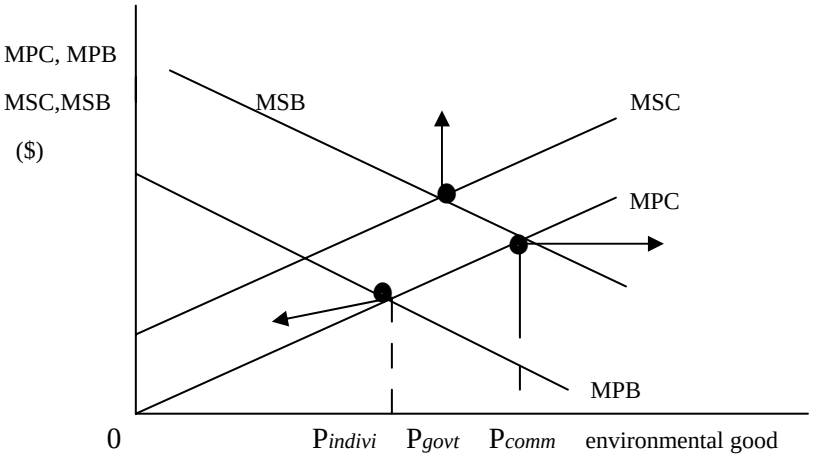
In the previous section, we recognized that the environmental policy could be divided into two mainstreams. One is the command-and-control approach, which aims at achieving and maintaining the minimum environmental threshold-standards for human and environmental health or the optimal carrying capacity of an ecosystem. The other is the voluntary program approach, which aims at developing, continuously, the state of the environmental quality of a community through communications and negotiations between the program initiators and the program participants. Although, over time, the evolutionary phase of environmental policy has allowed policy-makers to gradually shift emphasis from the effect to cause of pollution (Gouldson & Murphy, 1998), this researcher assumes that the two paradigms are the fundamental framework of environmental policy, which could help to ensure that they maintain a compatible and complementary relationships between them.

The CP approach was developed due to the limitation of the command-and-control paradigm, but that does not mean that government cannot play a role in the CP regime, but that the role of government needs to be changed. As discussed in the section on ‘economic perspectives’, the most desirable provision of an environmental good occurs theoretically when the marginal social cost (MSC) of the environmental good intersects with the marginal social benefit (MSB) of the good. From the perspective of the neo-classical assumption for environmental good, the role of industry and business in the process of CP practices is partial, different from the role of industry and business in the market for private goods. Because the provision of an environmental social good is characteristic of CP activities, even though the steering actor for CP is the private sector, the CP implementing company requires many parts of relevant information, technology, and financial resources from external social sub-systems such as government or community for its continual improvement. The effective and efficient provision of CP depends on not only the environmental strategy of enterprise, but also many kinds of supporting programs of government, the existence of an environmentally sound social infrastructure, and the social aspirations of a community to environmental SD, etc. Therefore, such proactive environmental protection approaches can be achieved with a realignment of the broader policy framework so that environmental objectives can be integrated into non-environmental areas.

Does such integration of environmental objectives into non-environmental areas between different social subsystems work well? In general, in a heterogeneous society differentiated into subsystem in which each subsystem follows its own functional value (Ladeur, 1994), it is not easy for the different social systems to share each other's functional values and to find a harmonized level of equilibrium beyond their own function values. We can explain this phenomenon by typical MSB and MSC curves as shown in the Figure 3-7.

This figure shows that each of three different subsystems has its own preferred equilibrium point, different from the other subsystems. [12] Industry could prefer point A, where the marginal private benefit (MPB) curve intersects the marginal private cost (MPC) curve. A community could prefer point B, where the marginal social benefit (MSB) curve intersects the marginal private cost (MPC), because they want to get higher quality of environment without additional cost. Instead, government could prefer point C, where the marginal social benefit (MPB) curve intersects marginal social cost (MPC) curve, because the government recognizes that higher environmental quality requires more financial or psycho-social support.

Figure 3-7 Different directions of different subsystems for social equilibrium



A more important facet is the direction of each subsystem. Under the Type A situation (Figure 3-8), we cannot expect effective management of a voluntary CP program. Therefore, a society's sub-systems must change its mutual relationship from Type A to Type B in order to be galvanized into the voluntary program approach for environmental sustainability.

Figure 3-8: Two Types of Social Interaction for Environmental Sustainability

< Type A > < Type B >

There have seen many attempts and efforts to integrate environmental concerns into other social sectors especially since SD became a critical issue of our global society. We can envisage ways to incorporate activities of social subsystems into SD regime.

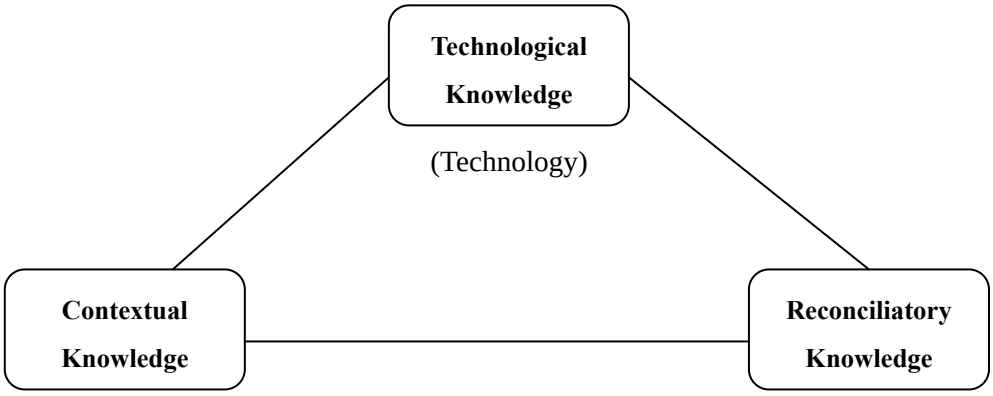
In this context, this researcher assumes that a continuous development of the knowledge system for environmental SD can facilitate the integration process of different social subsystems (See, Karl-Heinz Ladeur, 1994). If each social sub-system shares the environmental knowledge system rather than differentiates their functional goal and means, it might be easier for the society to implement such a voluntary environmental program.

To this end, a new knowledge system for CP, which is reorganized across the boundaries of conventional disciplines or specific social groups, would be helpful in improving the theoretical development of CP. Based on generic stages of problem solving approach in behavioral science (Allen Miller, 1997) and knowledge management science which puts stress on a learning or information-based organization for continual improvement (Garvin, 1993; Drucker, 1988) [13] as well as E. Odum's human-ecologic vision for a "spaceship economy" (Eugene P. Odum, 1971), [14] the knowledge system of CP has to include three necessary areas:

(i) Identification of contextual knowledge surrounding CP needs; [15]
(ii) Technological information of the problem and of CP solution approaches; [16]
(iii) Developing the social language to link CP needs and technical knowledge.

In the previous chapter, this researcher named these as contextual knowledge, technological knowledge, and reconciliatory knowledge respectively. [17] Figure 3-9 shows the relationship among those three knowledge categories.

Figure 3-9: Triangular Knowledge Cycle for CP Implementation



Although this classification is not a new suggestion, the 'triangular knowledge cycle for CP implementation' presupposes that the sustainable society model requires reconciliatory knowledge to play a catalytic role between the contextual knowledge and the technological knowledge. Many policy makers or economists used to ignore the role of such reconciliatory knowledge in solving the environmental sustainability issue. Now we are witnessing many kinds of flexible ways that function as reconciliatory tools such as new monetary incentives, changes of social images, temporal extensions, appropriate information services, etc. in implementing environmental policies. The objectives of these three categories of CP knowledge are separated from each other, but can be connected, work together, and synergized functionally towards a higher level of environmentally sound sustainable development.

It can be envisaged that if such newly reformulated knowledge beyond the specific social group and specific discipline is established and provided in the implementing processes of the voluntary program, it will facilitate reasonable communications between conflicting social sub-

systems on joint environmental SD issues, and as a result, the capacity of each social sub-system to understand the goal and means of environmental issues will be upgraded (Gouldson & Murphy, 1998), and consequently, they will contribute to converging on the social consensus or social equilibrium for a shared working strategy on the environmental issue in question. [18] In other words, such rearrangement of a sustainable development issue from three different and functional perspectives could form the basis of a conceptual model (Checkland, 1993) for the individual sustainable development issue to change the situation from an uncertain and unstructured one into a more clarified and structured strategy. Here, we can raise a question, 'who has a responsibility to generate each type of knowledge?'

Under the command-and-control paradigm where an environmental problem is considered economically as an external negative effect upon normal economic activities, government has extensive responsibility and powers to deal with most environmental problems (Seneca & Taussig, 1974). Government implements legislative regulations on various activities supported by congress and the police and the judicial system of the country. Economic incentives and production of environmental public services are also controlled and implemented by government. We can recognize that under the regulatory program, the three types of knowledge [19] are all generated under the responsibility of government.

However, under the voluntary program paradigm where an environmental program is viewed from the context of environmental SD, government cannot generate such necessary knowledge. [20] Mainly because the central focus of environmental management is changed from the legal environmental standard to the appropriate environmental knowledge, and partially because a sustainable society would not be satisfied with the minimum level of environmental quality, but it pursues continuous development of environmental quality of a community in question. Therefore, normatively speaking, the voluntary program paradigm requires functional division of environmental responsibility among social sub-systems such as government, industry and business, and community. Because it focuses on finding three forms of knowledge, which must be adjusted effectively and practically to support the development of a more environmentally sustainable society, each social sub-system has a wide spectrum of responsibilities according to their function, economic situation and environmental responsibility. [21] In this context, compared with the role of government under the command-and-control paradigm, we note that the voluntary program paradigm offers possibilities for external intervention by the government (Karl-Heinz Ladeur, 1994), changing its approaches from coercive and standard-oriented ways into more cooperative and knowledge-oriented ways. This approach also provides many opportunities for universities to provide educational/training and research inputs to provide knowledge, awareness, skills and new products and technologies.

It can be assumed, on a normative basis, that the voluntary program paradigm including the CP approach would be implemented more effectively when the three types of knowledge are sufficiently provided and each social sub-system establishes their division of environmental responsibility properly so as to provide at least these three types of knowledge for continuous efforts towards sustainable development. This thesis author hypothesizes that this division of social responsibility among the social sub-systems and their provision of the required types of knowledge forms the third condition for an effective CP policy.

The necessity of the adaptive and evolutionary motivation schemes of government for CP

As stated earlier, the adoption of the voluntary program approach does not indicate that the role or responsibility of government will be reduced or weakened. But rather, it requires government to change its policy pattern from standard-oriented and compulsory ways into knowledge-oriented and adaptive ones. Kuhn says that adaptive behaviour by living organisms that means

basically they are responding differently to different circumstances, leaving the organism in some way better off (Kuhn, 1975). Likewise, the adaptive and evolutionary environmental policy can be defined basically as ‘a flexible policy which designs and implements differently within different environing circumstances, leaving the environmental sustainability of a community in question in some way better off. [22]

When government designs and implements a flexible policy based on technological knowledge of the specific targets, the total social benefit from such an adaptive policy becomes better than the social benefit from a uniform standard (Callan & Thomas, 1996). Therefore, if a governmental environmental policy is designed to increase the adaptability of a voluntary agreement program, such as a CP program in some ways, it could increase the environmental effectiveness and economic efficiency of the voluntary program in question.

How can government design and implement the adaptive and evolutionary CP policy? Within the framework of *triangular knowledge cycle for CP implementation* (Figure 3-9), this researcher hypothesizes that when the three types of knowledge on CP are identified and developed, the adaptability of a CP program will be enhanced. The three types of knowledge are (i) contextual knowledge around the proposed CP program (ii) technological knowledge in the proposed CP problem solution approaches (iii) reconciliatory knowledge for the proposed CP approaches. In contrast with rigid commitment to the command-and-control programs, what is required here is sufficient flexibility, which enables relevant social subsystems to produce and to make use of the workable knowledge and a full range of available policy instruments so as to design and implement a CP strategy in adaptive and evolutionary ways.

First of all, an adaptive and evolutionary CP program must develop or identify why and how much the community, to which a firm belongs, aspires to CP. Considering generic assumptions of neo-classical economic theory that view the goal of entrepreneur as profit maximization and environmental pollution as negative externalities of industrial production, the environmental activities of the private sector are likely to be stimulated by external society rather than by internal requirements. In other words, external social groups normally motivate CP activities. In that sense, the CP program should start from identifying the demand by the community for CP. If a community achieved strong social consensus on implementing CP, it must be a good environment for industry to adopt CP. In spite of its necessity, if a community does not have such a strong social consensus, it could be envisaged that governmental CP programs should focus on a disseminating program in the initial stage. This process to identify the contextual knowledge on CP is the first step to enhance the adaptability of CP program. *This thesis author conducted a survey of CP implementing companies worldwide to identify their motivations for implementing CP. The results of this study may provide an example of contextual knowledge for CP. (See Chapter 5)*

Secondly, once there is a demand for CP activities, the firm needs to find variable technical options for CP, which meets the demand. As the typical pattern of CP practices, we included, good housekeeping, recycling, change to new, safer materials, cleaner processes, and cleaner products. Considering that CP is the behaviour of industrial organization, basically technological knowledge on CP options needs to be explored and developed in the industrial society. Under the command-and-control paradigm, the government often requests firms to use a standardized pollution control technology. But, under the voluntary program paradigm, such technological knowledge on CP might be developed and identified mainly by the firms themselves, reflecting their own specific processes and industrial circumstances. Such technological knowledge on CP options which, are generated by the firm, are the essential part of CP implementation.

To find environmentally effective and economically efficient CP options is a necessary process to increase the adaptability of CP program. Although, the central user and generator of the technological knowledge for CP must be the relevant private firm, the other social subsystem including government and certain social groups such as university researchers could support the generation of such technological knowledge. Because CP activity is characteristic of the mixed good, government and other social groups should support the generation of the technological knowledge. *This thesis author analyzed the UNEP documents of one hundred CP cases, focusing on their technological and economic data, which may provide an example of technological knowledge for CP. (See Chapter 6)*

Finally, a company usually contemplates and estimates its costs and benefits, its expectation value, sometimes its long-term benefit, before it adopts and implements a CP option. Such feasibility analysis for final decision-making is dependent on the very firm's decision-making mechanism and its own business circumstances.

Now, this thesis researcher supposes three typical and hypothetical scenarios which a firm may face in its adoption and implementation of CP. Actually, these scenarios would be possible, only if related information on the MSC (Marginal Social Cost) and the MSB (Marginal Social Benefit) of a CP option is available, under the following simplified definitions that:

(i) MSB = MPB(Marginal Private Benefit of the CP company from a CP option) + social benefit of the community from a CP option+ Existent value of protected environment from a CP option
(ii) MSC = MPC (Marginal Private Cost of the CP company for a CP option) + External Cost
(iii) The optimal level of CP: MSC = MSB

• Scenario 1: In case of MPC < MPB on a short-term base

The company expects that the planned CP option will give the company monetary benefit thanks to CP. [23] In this case, the company will willingly implement the CP option(s) willingly.

• Scenario 2: In case of Average Private Cost (APC) >> Average Private Benefit (APB)

In case that APC of a CP option is much bigger than APB of a CP, the company would not implement of a proposed CP option.

• Scenario 3: In case of MPB < MPC << MSB (or MSC)

This case means that the cost of the proposed option is more than the estimated benefit of the option, but which is far less than the social cost it causes. In the real world, many CP options may belong to this scenario. Especially, when a community –be it is at the local, or national, or global level – aims environmentally sustainable development, this scenario would be general. The gap between MPC and MSB was called 'sustainability gap' in this thesis.

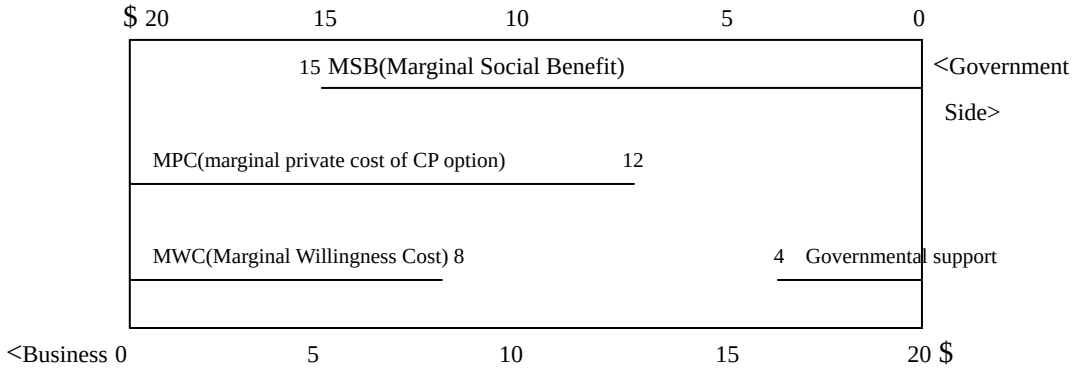
Facing scenario 3, the company can have three alternative solutions for implementing its planned CP option under the sustainable society model (see Chapter 2). These are:

(i) When the company extends its social environmental responsibility enough to accept the additional CP cost;
(ii) When government has an incentive program or a motivating scheme to seek to close the gap between MPC and MPB;
(iii) When the community takes appropriate measures such as the supply chain approach to influence the company to adopt the CP options.

In any case, it is envisaged that scenario three provides industry, government, and the community a wide range of possible options prior to implementing a CP option. In order to enable the continuous improvement of CP implementation, social sub-systems' efforts like scenario three are necessary.

It may be no difference which social sub-system triggers the implementation of a CP option, however, it is important that the other two social sub-systems should cooperate with the first motivator for implementing CP, as this thesis author suggested as hypothesis 3. This thesis is focused upon the initiative of government for CP among these three scenarios. Figure 3-10 provides an overview of scenario three.

Figure 3-10: Hypothetical negotiation on a CP option between government and a firm



This figure is very simplified from the hypothesized one, but it explains how a small amount of governmental support (In Figure 4 unit $) encouraged the company to adopt a CP option, which could result in an improved social benefit (In this figure 15 – (8+4) = 3 unit $). In Figure 3-10, however, if governmental support is less than 3 unit $, the company would be unwilling to implement the proposed CP. Although this is just a hypothetical example, such a case could occur in the real world. [24]

Here, the two fundamental research questions of this thesis are posed: the first one, "How can government and industry manage the negotiation process in an environmentally effectively and economically efficient way?" The second one, "By what ways can governments motivate more companies to adopt CP practices?"

In conjunction with these research questions, this thesis author hypothesizes that sufficient acquisition of well-organized knowledge on CP and its interactive utilization among the social sub-systems, is a necessary or sufficient condition for managing successful negotiations. Without such knowledge, the negotiations are likely to yield a less adaptive and less efficient environmental result.

Secondly, this thesis author also hypothesizes that evolutionary and adaptive use of diverse environmental instruments for encouraging CP is a necessary condition for motivating more companies to adopt CP practice with limited governmental resources. In case that marginal social benefits are larger than marginal social costs, the government's adaptive motivation scheme for the private sector should result in the implementation of CP options, which are the environmentally effective and economically efficient.

To this end, government, as well as industry, as two in the realm of negotiation for CP, should take a positive approach to developing the 'technological knowledge' and the 'reconciliatory knowledge' for a relevant CP option. The maintenance of such adaptability could become the necessary or sufficient condition for the continuous improvement of CP in the sustainable society model (See, Ladeur, 1994). *This thesis author analyzed a Korean government-oriented CP program so as to identify which governmental motivation schemes or policy principles may ensure the continuous improvement of CP* (See Chapters 8, 9 & 10).

NOTES

1. Recent detection, management and technical improvements have greatly reduced those losses in the Russian pipeline system.
2. We can depict this relationship as follows: [The sustainable development gap in CP = Driving forces for CP of the society - Resistive forces to CP of the society]
   In this context, it is recognized that there are two different forces: driving forces for CP and the resistive forces against CP, which are acting in opposite directions at the same time. In Chapter 1, it was called as '*sustainable development conflict.*' Table 3-1 shows the phenomena of the two opposite forces.

Table 3-1: Typical Driving and Resistive Forces of Cleaner Production

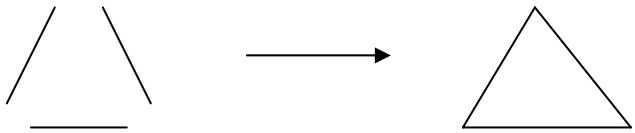
Sub-system	Driving forces	Resistive forces
Industry & Market	•Profitability of cleaner production •Growing demands for green products	•Lack of substantial profit advantage •Market fragmentation or thin market •Capital market's reluctance to accept the uncertainties
Government	•Voluntary approach to encourage cleaner production •Subsidies to encourage cleaner production • Technology-forcing regulation	•Control-oriented regulatory structure to reduce incentive for innovation •Subsidies of control technologies.
Community	•Local community groups' aspiration to industrial sustainability •International communities' resolution on cleaner production •Adoption of eco-labeling	•Consumers' lack of knowledge on cleaner production •Local government's will for local economic growth

3. But the idea of environmentally sound product design is not new. It was developed in the late 1960s and early 1970s in the United States, along with the explosion of environmental consciousness that led to the creation of the U.S. Environmental Protection Agency and to the passage of laws such as the Clean Air Act, the Clean Water Act, and the Resource Conservation and Recovery Act (OTA, 1992).
4. According to different criteria, different typologies can be made: these are (i) changes in quality standards, Changes in product composition, Product durability, Product substitution (UNIDO/UNEP manual, 1995); (ii) design for assembly, design for disassembly, design for serviceability, design for maintainability, design for recycling (Billatos & Basaly, 1997); (iii) design for alternative need fulfillment, design for product lifetime extension, design for minimal materials use and selection of most environmentally compatible materials, design for energy conservation, design for cleaner production, design for efficient distribution and logistics (Dutch Manual, 1994).
5. Designing a recyclable product is not beneficial if the infrastructure for collecting and recycling the product does not exist and if the system is not used to provide and to produce new products from the recovered materials. (OTA, 1992).

7. There are more and more examples of individual companies that are taking a much longer point of view and are incorporating 'Corporate Social Responsibility,' into their policies, strategies, R & D and investment activities.
8. In a world in which policy makers have perfect information on MPC, MPB, MSC, and MSB, they should chose an appropriate environmental policy including CP policy according to the efficient targets which economists generally recommend or advocate. In practice, however, policy makers may have little information about the marginal cost function or the marginal damage function, because the magnitudes of most of these functions are difficult to identify (Perman *et. al*, 1996). This may be primarily due to the fact that a firm may emit various kinds of pollutants and consequently, it will be expensive to produce all of the necessary information on the diversity of production and abatement technologies appropriate for all of its pollutants. Additionally, there is the challenge of the subjectivity of monetary valuation of environmental and social damages from each pollutant. In an imperfect information situation, it is highly probable that the government will unknowingly establish the environmental standard at some level other than the allocatively efficient one, even if that was the legislated intent (Callan & Thomas, 1996).
9. In general, it requires broad political processes to make existing standards more stringent.
10. The command-and-control approach can be designed to focus on reducing an public 'bad' which is considered as a dangerous action to public health or the minimum level of eco-system conservation (Karl-Heinz Ladeur, 1994), whilst the voluntary program approach could be designed to focus on producing a better public 'good' which gives a community more ameliorated environmental amenity than before.
11. The Financial Times of 23 August 2002, reported by Vanessa Houder that 'there is a growing gap between the efforts of business and industry to reduce their impact on the environment and a consequent worsening state of the planet. A growing world population and increasing affluence could make this sustainability gap into a chasm.'
12. Integrated Pollution Control (IPC) in U.K. is a more improved command-and-control approach. The main objective of IPC is not only to render harmless, but also to prevent, and minimize emissions of substances from environmentally significant processes of the regulated companies. This should account for those processes, which represent the greatest actual or potential threat to the environment or to health. It is illegal to operate without such an authorization, which outlines various requirements for the operation of the process concerned and not the management of its emission. To achieve its goals, the framework of IPC relies on the applications of a second principle, the best available techniques not entailing excessive cost (BATNEEC). According to the IPC regulations, BATNEEC requires the operator of an industrial plant covered by IPC to apply the most effective technology or technique for achieving BPEO (Gouldson & Murphy, 1998, pp.75-76).
13. P. Drucker argues that the command-and-control organization should be converted into an information-providing organization.
14. E.P. Odum proposed three necessary elements of human action for overcoming ecological problems: human values, and understanding, and technologies, which are basically similar to this categorization.
15. 'Contextual knowledge' here means economic, social, and ecological situation contextual CP demands.
16. The economic organization must be stimulated to produce more knowledge about itself and to reflect upon this knowledge (Farmer & Teuner, 1994, pp.4-5).
17. Knowledge, as defined here, is that organized-information can enable people to perform a knowledgeable action. Garvin insists that there is a link between learning and continuous improvement in organizations (Garvin, 1993, p.49, Goran & Ewa, 2001).
18. From the perspective of conventional policy decision-making theory, this approach is considered the mixture of the typical 'rational model' and Simon's 'satisfying model'

(Chung, Chung-Kil, 1999)

19. It can be said that under this regulatory context, regulatory commands of government and the consequent compliance of the firms would be a reconciliatory means, even if the firms are not as satisfied with it as they might be with other means.
20. Modern sociologists say that those who create and distribute this knowledge, scientists, economists, engineers and professionals of all kinds, increasingly become the leading social groups, replacing the industrialists and entrepreneurs of the old system (Giddens, 1997).
21. Under the voluntary program paradigm, experience of each social subsystem is recognized as a form of knowledge, which cannot be highly appreciated under the command-and-control paradigm. This kind of knowledge remains implicit in the regulatory rules and is nowhere available in a concentrated form, for it is possible only when it is associated with cooperative networks of action. The development of these new co-operative networks for the generation of knowledge could reinforce the momentum of the voluntary production of collective knowledge in an individual social sub-system (Ladeur, 1994, pp.319-320).
22. It is the same as the traffic rules that apply to all the passenger cars. In that sense, environmental pollution activities are legally considered as the dangerous external activities released to the public.
23. This thesis researcher terms this case as pecuniary motive for CP.
24. When something is incomplete, we humans tend to attempt some form of completion. A simple example from introductory psychology is when viewing a figure such as the following,



we “psychologically” seek to close the gap and complete, mentally what we believe to be a triangle (Burke, 1992).

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Chapter 4 System of the Sustainable CP Policy

4.1 The *Triangular Knowledge* for continuous implementation of CP

This thesis author assumed in the earlier section that CP is provided through social non-marketable mechanism, and that the appropriate generation and reciprocal links of knowledge are the necessary conditions for implementing CP program in an environmentally efficient and economically efficient. For example, where there is no verification of problems of global warming, and there is no proven causal linkage between human releases of carbon dioxide by combustion of fossil fuels, people will not make efforts to develop CP technologies and policies to reduce carbon dioxide emissions to the atmosphere.

The process of CP implementation can be considered a soft system to provide certain kinds of environmental quality for the community. The demand-and-supply of CP is, however, different from the traditional market of private goods. It is mainly because the supply of CP services is inherently an auxiliary activity to the main industrial production activity, and partially because most environmental amenities from CP activities are consumed non-competitively and nonexclusively (Musgrave & Musgrave, 1984). [1]

This thesis author hypothesized that if a government needs to manage the CP program environmentally effectively and economically efficiently, three types of knowledge must be generated and shared by the relevant actors in the sustainable society. In these 'triangular knowledge cycle model' of CP, '*the contextual knowledge'* identifies the demand for a certain level of CP knowledge in a certain community, '*the technological knowledge'* provides the substantial components of CP and finally '*the reconciliatory knowledge'* plays a role in reconciling the demand for CP and the supply of CP.

These 'triangular knowledge links' are not a new conception, nor a special theoretical framework. Rather, they are a statement about a knowledge network or networked knowledge to enable social subsystems to cooperate in implementing CP approaches. [2] Table 4-1 compares the *linked triangular knowledge* to other similar conceptual approaches. [3]

Table 4-1: 'Triangular Knowledge Cycle' and other conceptual similarities

Typical Problem Solving Approach	Human-ecological Approach (Odum, 1971)	Adaptive Behavioral Science Approach (Kuhn A., 1975)	Knowledge Management Approach (Ikujiro, 1991)	Triangular Knowledge Cycle
Problem recognition	Science (Understanding)	Detector (Knowing) *level of description*	Why-knowledge （Situation)	Contextual knowledge
Alternative generation	Technology (Skill)	Selector (Wanting) *level of explanation*	What-knowledge （Action）	Technological knowledge
Decision making (Policy)	Human value (Control)	Effector (Doing) *level of solving*	How-knowledge (Acting)	Reconciliatory knowledge (Policy)
(Implementation)				(CP-implementing)
(Evaluation)				(CP-evaluation)

In providing the mixed good of CP, appropriate and workable knowledge for CP can play a

significant role in facilitating implementation of CP. Development and inter-linkage of three types of knowledge – the contextual knowledge, the technological knowledge, the reconciliatory knowledge – are necessary requirement for designing and implementing an efficient and continuous CP implementation program.

As John Dewey stated, knowledge enables us not only to interpret the unknown things which confront us and fills out the partially obvious facts with connected suggested phenomena, but also helps us to foresee our probable future and to make plans of what is to be done accordingly (John Dewey, 1916). Likewise, when each social subsystem comes to have and apply appropriate knowledge of CP in the point of their function, they would understand their interrelationships with the environment and accordingly could conduct an adaptive action to their environment.

In this context, this author envisages that they would have preparedness to maintain the continuity of CP only if each social actor acts based on appropriate and rational knowledge on CP and the environment. Adam Smith (1776) presented an example of why and when *such reconciliatory knowledge* by government is required in facing the provision of the public goods in a free-market society.

"When the public services or the public institutions which are beneficial to the whole society cannot be maintained by the contribution of such particular members of the society as are most immediately benefited by them, the deficiency must, in most cases, be made up by the general contribution of the whole society (that is, the governmental budget)." (Adam Smith, 1776)

His logic can be applied to the case of CP. If there are fewer efforts of the whole society to bridge the gap between social benefit and individual costs in providing CP, a lower rate of CP implementation will result.

4.2. Development of evolutionary CP policies

1. The social division of responsibilities in building up the 'Triangular Knowledge for implementation of CP'

This thesis author describes how to incorporate the *triangular knowledge* into CP policies. Under the command-and-control paradigm, government drives the overall process of pollution control policy from setting emission standards to monitoring. Governmental commands and standards might be the guiding principles to generate the three types of knowledge. Where the growing concern of the people of a certain society about the harmful externalities of economic activity leads to control-oriented legislations on air pollution, water pollution etc. supported by political, administrative, economic organizations, real improvements are likely to be made. (See, Wallace, 1995; Samuelson, 1987). The environmental agency continues to establish new source performance standards for new industrial plants by laying out detailed technical specifications for the operation of newly constructed plants. They used to determine what is to be the best available technology or adequately demonstrated technology for the reduction of hazardous pollutants (See, Baumol/Oates, 1971; Crognale, 1999). Under the command-and-control paradigm, government plays a central role in generating and using the three types of knowledge. Major environmental concerns of other social subsystems such as community groups, manufactures are focusing on whether or not polluters are complying properly with governmental standards or guidelines.

Meanwhile, for further discussion on the '*Triangular Knowledge for implementation of CP*, it may be beneficial for us to reflect on the meanings of 'knowledge' in context of developing

adaptive and evolutionary CP policies. First, differently from data, information and experiences, which are more or less isolated particulars, knowledge is supposed to be the act or the ability which touches reality in an ultimate, intellectual fashion (Dewey, 1916). It is a perception of those connections of an object, which determine its applicability in a given situation. An ideally perfect knowledge would represent such a network of interconnections that any past experience would offer a point of advantage from which to get at the problem presented in a new experience. For example, a man who understands the machine is the man who knows what he is about. He knows the conditions under which a given habit works, and is in a position to introduce the changes which will readapt it to new conditions (John Dewey, 1916). Therefore, creating new knowledge is not simply a matter of processing objective information or data. Rather, it depends on drawing insights from reorganizing various experiences and information, making them available for the new situation (Ikujiro, 1991). Real knowledge enables us to adapt the environment to our needs and to adapt our aims and desires to the situation in which we live, finally to maintain the continuity or consistency of life by applying the old to the new (John Dewey, 1916).

Secondly, in this sense, the refined contextual knowledge on the relationship between a certain community and its environment enables the people to understand the relevant environmental issue and to build up shared aspirations for their environmentally friendly community, which actually motivates the demand of CP. The technological knowledge for CP in a company gives the company the overall outline to make plans of how can they act in the new situation which they are facing. Finally, reconciliatory knowledge for CP area presupposes the appropriate existence of contextual knowledge and technological knowledge for CP. Reconciliatory knowledge looks for ways to reconcile the demand of CP, which is normally dependent on the aspiration of a certain community for CP, and the technological options of a certain company.

In this sense, this researcher hypothesizes that, as a necessary condition for developing an evolutionary CP policies, the three types of knowledge for CP must be created and developed by adequate social subsystems or relevant organizations, not being dominated by government or the public sector. Considering the required function for each social sub-system (see Figure 2-2, Chapter 2), this thesis author assumes that the contextual knowledge may be created and developed mainly by people of the community, the technological knowledge may be created and developed mainly by companies or industrial organizations, and the reconciliatory knowledge may be created and developed mainly by governments or public agencies. Table 4-2 presents possible social divisions of responsibility in building up the triangular knowledge basis.

Table 4-2: A Typical Social Division of Responsibility for SD

	Command-and-control paradigm	Voluntary program paradigm
Contextual knowledge (Needs)	*Government* + Community	*Community*+ Industry + Government
Technological knowledge (Activity)	*Government* + Industry	*Industry* + Government+ Community
Reconciliatory knowledge (Policy)	*Government* + Industry	*Government* + Industry + Community

* Italic letters mean primary generator and user of knowledge.

Then, one harmonized cycle among the three different types of knowledge links may complete the knowledge for sustainable implementation of CP and work as driving force for fostering continuous improvement of CP implementation. In other words, under the '*voluntary approaches*,' where mandatory commitments do not function and where the market force does

not work well, the continuous cycles of such triangular knowledge links among social sub-systems may motivate and help to achieve continuous implementation of CP.

2. Mechanism of CP market (or program) as a mixed good

Although some economists have expressed doubts about the effectiveness and practicality of the voluntary paradigm, voluntary programs do have significant and useful roles to play when they are used in an appropriate way (Baumol/Oates 1977). We have had successful experiences of these voluntary programs as well (Gabriele Crognale, 1999) as presented in Section 2.2.2. Based on the social division of responsibility in the previous triangular knowledge links for CP implementation, this thesis author views a CP activity, as a mixed good which is demanded by the community, and is supplied by an industrial organization, and is facilitated and promoted by government. Because there is demander, supplier, and promoter, this researcher calls this system the market of CP programs. Figure 4-1 shows the relationship between the proposed 'Triangular Knowledge Cycle' and the mechanism of the CP programs (or CP markets as a mixed good). This illustrates that conceptual framework plays an important role in developing the evolutionary CP policies for a sustainable society.

Figure 4-1: Triangular Knowledge Cycle and Mechanism of Sustainable CP Programs

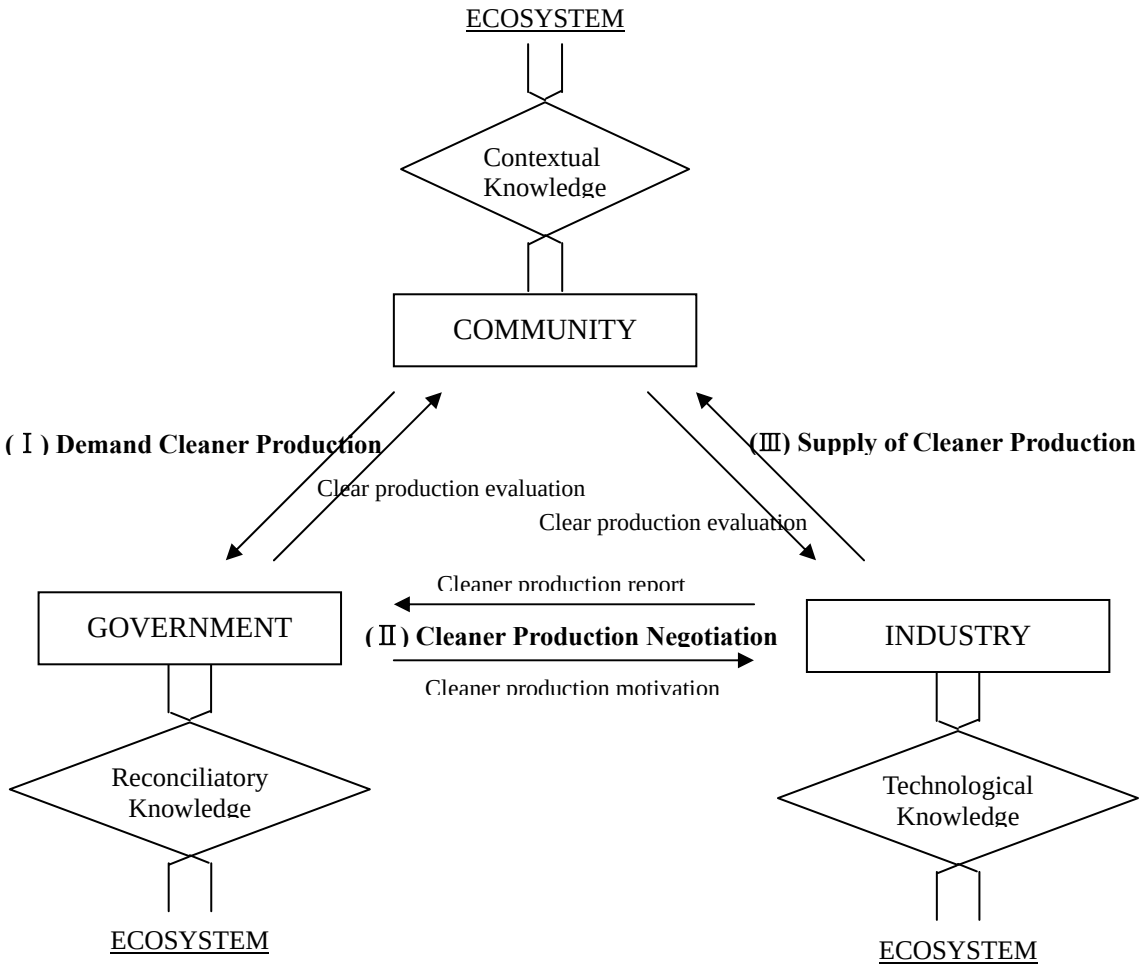


Figure 4-1 presents a simplified model for driving the evolutionary CP policy development process. As stated in Chapter 1, the thesis author assumes that a sustainable society is composed

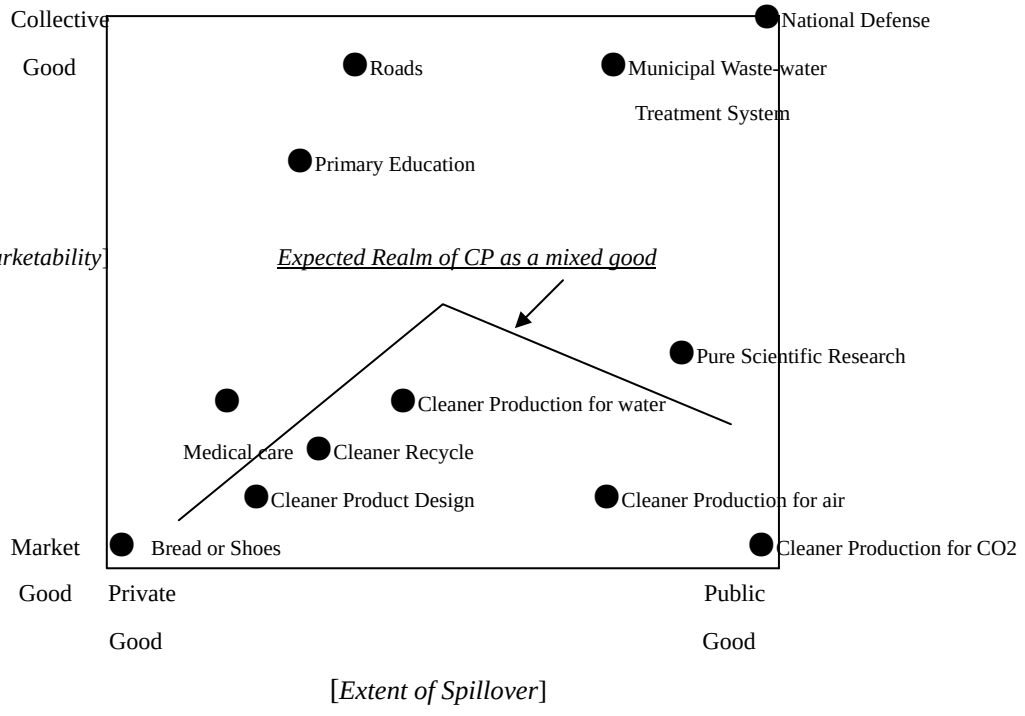
of four subsystems. This model supposes that the community works as a demander of CP (Corral, 2002) and the evaluator of CP, and industry works as the supplier, user and reporter of CP, while governments (or public organizations) serve as motivators, facilitators and educators of CP. Under the voluntary CP program, there are negotiation processes for the adoption of CP approaches between governments as a program providers and industry as program participants. Although, such roles can be changed according to the situation and political culture, this framework shows the most typical case in the context of the demand-and-supply relationships of CP as a mixed good. Three types of knowledge represent each subsystem's cognitive preparedness for CP activities, because knowledge is an actor's information for what is to be done (John Dewey, 1916).

The contextual knowledge of CP stands for the overall aspirations of a community to environmental protection through CP. Where there is environmental need, there will be an appropriate action for CP. The technological knowledge of a company means a company's technologically adjusted alternatives to CP, which are supposed to contribute to enhancing the quality of the environmentally protected ecosystem. The reconciliatory knowledge of government stands for governmental efforts to facilitate or catalyze potential CP options into being implemented through their governmental instruments and resources. Without governmental intervention, CP activities are also possible in the private sector. However, the possibilities of wide-spread implementation of CP might be limited, mainly due to the typical market failure of environmental good and enterprise's profit-maximization assumptions. Therefore, the provision of such knowledge for each subsystem might be a necessary requirement for promoting an efficient and continual CP program.

3. The different phases for developing and implementing evolutionary CP policies

Prior to developing an adequate CP policy model, it is helpful to reflect on the characteristis of CP as mixed (private and public) goods (Figure 4-2).

Figure 4-2: Different Features of Public Goods (*Adapted from Samuelson, 1985*)



From the viewpoint of the entrepreneur, CP is likely to be considered as an additional element of production activity rather than as an essential part of it. Due to these dualistic characteristics, the degree of "market-ness"(or marketability) of CP is relatively high, and the degree of "public-ness" (or public acceptance) of CP varies according to the type of CP (Figure 4-2, adapted from Samuelson,1985).

These dualistic characteristics of CP require government to take different actions from those for pure public goods such as national defense. A good CP policy should be adjusted to different situations of varied companies and different environmental demands of the community so that the planned CP program can be managed in an environmentally effective and economically efficient manner. In this context, this thesis author suggests that the basic process to form evolutionary CP policies will include the following three phases of adaptation to its policy environment.

Phase 1: Adaptation to CP demand
Government, as the facilitator or promoter, needs to identify the environmental demands the people of a community have and how their environmental needs can be met through CP, or through a mixture of CP and other approaches. Environmental concerns vary according to the community and the situations within the community. While noise pollution is normally the concern of local communities, global warming is of international concern. We should state that where there is an environmental problem, there is a need for an environmental policy.

Therefore, government needs first to identify how much the industrial and business sector contribute to increasing the pollution, in question. Then, government needs to identify what are the main motivations for companies to adopt the cleaner production approaches. This researcher terms the result of this type of cognitive activities as developing the '*contextual knowledge'* of CP. Theoretically, the contextual knowledge from a community provides government with the cause of environmental policy and influences government to decide the type and the depth of governmental involvement. If a government avoids recognizing the contextual knowledge of CP in a community, the policy may be started without clear and adequate policy goals.

Phase 2: Adaptation to CP Supply
In order to manage a CP program, government needs to develop policy instruments which integrate the environmental demand of the community into the technological and economic situation of industry. Government should identify and implement an appropriate mix of policy instruments that will promote the use of CP (Agenda 21, 1992, Chapter 30.8.).

Appropriate or well-organized motivation schemes of government are necessary for facilitating and promoting CP under the policy environment of CP. Development of such tailored motivation instruments for CP, which are adaptive not only to the requirements of industry but also to the aspiration of a community, will contribute to forming a CP market and for managing a good CP program. If a flexible and interactive approach to CP implementation that transfers information, technological knowledge, and required incentives to regulated companies is provided by government, then the capacity of regulated companies for innovative CP could be increased (Gouldson & Murphy, 1998). This is one of the hypotheses of this thesis.

In a democracy, it is essential to operate with a broad array of people in the middle who agree that there is a workable solution even though it is not optimal. It is necessary to learn to operate with support from alliances that represent a preponderance of public opinion, but certainly not a consensus (Gordon & Coppock, 1997). This is why certain strategies and mechanisms for negotiation must be developed in order to generate appropriate reconciliatory knowledge for

promoting implementation of CP.

Phase 3: Promotion of Sustainable Development
The third necessary condition for the continuous improvement of CP is that government (or public organization) must initiate or promote certain kinds of CP programs continually. This author envisages that government-based CP programs or any non-governmentally based environmental management program could function as a 'unit' market of the overall CP market in a broad socio-economic context as portrayed in Figure 2-28. In such a CP market which consists of many small and specified markets, CP activities would be traded between CP demanders and CP suppliers.

It could be envisaged that the more such CP '*unit-markets'* (or programs) exist, the more diverse types of CP that will be provided. Therefore, under an inherently limited situation of CP practices as a mixed good which is explained as an important market failure by many conventional economists, provision and on-going promotion of CP programs could be a necessary or sufficient condition for the continuous improvement of CP.

Different types of environmental problem require different solution approaches. Every environmental issue cannot be controlled only by the command-and-control paradigm. Government-based CP programs can contribute to forming good conditions for industry and business to implement CP practices in more effective and less risky ways, evolving their motive level for CP implementation into an upgraded level, for example, from the '*end-of-pipe motive'* level to the '*financial motive'* or the '*profit motive' level* to the *'pioneering CP motive' level*.

CP policy should be adapted and implemented according to the changing targets for preserving a sustainable and diverse natural ecosystem (Ladeur, 1994); this is so, because widespread adoption of CP approaches in business and industry is 'a key determinant in sustainable development' (Agenda 21, 1992, Chapter 30.3).

NOTES

1. Adam Smith (1776) explains why government must be involved in the provision of public goods as follows;

> The duty of government (the sovereign) is that of erecting and maintaining those public services and public institutions, which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature that the profit could never repay the expense to any individual or small number of individuals. The performance of this duty requires very different degrees of expense in the different periods of society (Smith A., 1776)

2. E. Odum argues that human value must control the interaction of scientific understanding and technology to ensure the right option. Eugene P. Odum, 1971, Fundamentals of Ecology, p.515, W.B. Saunders, Philadelphia
3. Habermas (A. Miller, 1997) introduced the notion of three cognitive interests for wisdom: these are technical knowledge, practical knowledge, and emancipatory knowledge. Goldkuhl & Braf (2001, Sweden) introduce many types of knowledge in the light of knowledge management: these are productive knowledge, performative knowledge, declarative knowledge, situational knowledge, procedural knowledge, motivational knowledge. Ikujiro Nonaka also argues the need of intellectual movement from 'tacit' knowledge to 'explicit' knowledge for the knowledge-creating company (Ikujiro, 1991).

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PART III DESIGN OF THE EVOLUTIONARY SUSTAINABILITY POLICY MODEL FOR CP

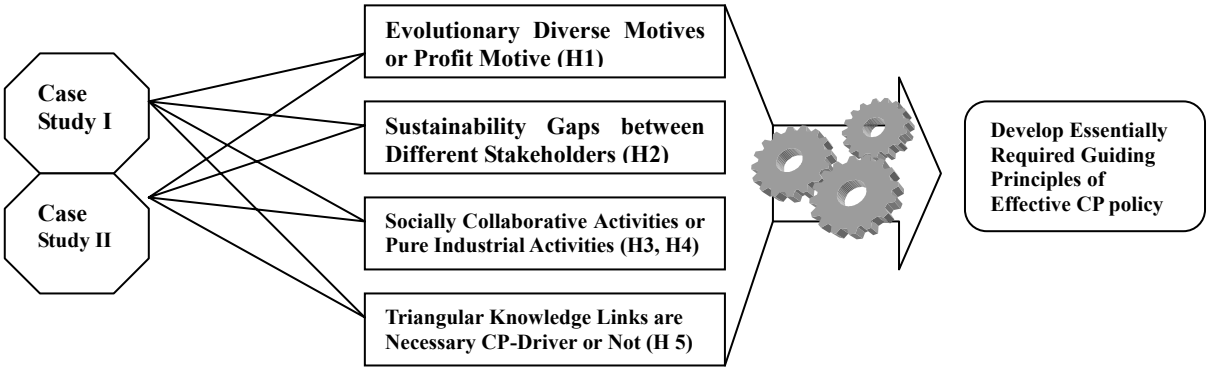
Part II presented the overall theoretical framework for the thesis. To summarize, a CP activity has the feature of a public good and effective adoption of CP by the private sector requires the collaboration between social subsystems surrounding a firm: government, industry, universities and the community. For a CP activity to be implemented in an environmentally sound and economically beneficial manner, it is suggested that the CP activity should be based on '*the triangular knowledge links'* among contextual knowledge, technological knowledge, and reconciliatory knowledge. These three types of knowledge represent the knowledge of CP demand, CP supply, CP market and CP program. One cycle of these three types of knowledge forms the necessary condition for continuous implementation of CP.

Part III presents '*an evolutionary sustainability policy model for CP*' based upon the results of two empirical studies within these triangular knowledge links to CP. The first is the study on CP motivators and the empirical patterns of CP activities that were derived based upon a survey of 59 private companies, worldwide which successfully implemented CP. The results of this motivation survey provide the *contextual knowledge* of CP and identify evolutionary stages of CP motives. Chapter 5 contains the results of the analyses of this study.

The second empirical study (Chapter 6) contains the results of the analysis of 100 successful CP cases from 1979 to 1998. These data were derived from the UNEP CP database. The study focused upon describing the *technological knowledge* of CP from a supply side perspective. The study identified the behavioral patterns of firms in implementing CP in terms of capital investment, payback period and eco-efficiency. It also presents the results of the analysis of the behavioral patterns of different CP-suppliers in terms of capital investment, payback period and eco-efficiency. These results clarified where the sustainability gaps exist in implementing CP.

Chapter 7 summarizes the major findings from these two empirical studies in relation to the theoretical framework of this thesis (Part II). The findings on the behavioral patterns of CP motivators and CP suppliers helped this thesis author to formulate an evolutionary sustainability policy model for CP. The author concluded this chapter by suggesting five guiding principles for a sustainable CP policy focusing on designing *reconciliatory knowledge* of CP. Figure 5-1 presents a hypothetical framework for an appropriate policy for the continuous improvement of CP, which is tested in Part III.

Figure 5-1: Five Hypotheses, Two Case Studies, and Five Guiding Principles in Part III



[Practical cases] [Behavioral Patterns of CP implementation] [Sound CP Policy]

Chapter 5 Analysis of the Motivation Survey

5.1 The Analytical Framework of the CP Case Study, Worldwide

This Chapter presents the results of an empirical study on the motivators for CP and behavioral patterns of CP activities that were derived by surveying 59 private companies worldwide, which had successfully adopted and implemented CP and which also answered the survey questionnaire satisfactorily. [1] Chapter 5 is divided into two parts: the first is the study on CP motivators, and the second is on the empirical patterns of CP activities. According to the framework of '*Triangular Knowledge Cycle'* (Figure 4-3, Section 4.2), the analysis of CP motivators provides contextual knowledge on CP demand.

A number of authors who have also analyzed the motivators for CP have provided important insights about which motivational factors influence industry and business to implement CP (Huisingh, 1988; Ashford, 1993; Robinson, 1997; Hoffman, 2000; Williams & Warford, 2001; Corral, 2002, etc.) Typologies on motivators (or drivers and determinants) of these studies vary according to different points and with some degree of overlap: on both internal and external factors (Huisingh and Williams), social, cognitive, and technological factors (Ashford and Corral), regulatory, international, profit, and social factors (Robinson and Hoffman). Most studies, however, provide qualitative explanations on the possible motivators for CP implementation rather than identifying the degree of importance each has as a motivator (Corral, 2002).

CP activities are largely motivated by some external or internal motivators rather than provided in the market by the invisible hand. It is useful in understanding the demander and the supplier of CP to compare the demand and supply curve of private goods with a corresponding construction for public goods, although that is unrealistic (Musgrave & Musgrave, 1984). However, since the benefits from public goods are available to all, consumers will not reveal their preferences by bidding in the market. Hence, a political process or voting system is needed to reveal societal preferences (Musgrave & Musgrave, 1984; Samuelson, 1985, Economics; Taylor, 1998). Therefore, it can be reasoned that the demand for CP is proportional to the types of CP motivators and their degrees of aspiration to CP (See Figure 3-11, Section 3.3.1). This analysis on motivators for CP provides meaningful knowledge to understand the actual demand for CP tools and technologies. Figure 5-2 illustrates the schematic framework of this study.

In analyzing motivators for CP, the questionnaire was designed to identify the three topics:
(i) How the three most influential motivation items for implementing CP are combined among fifteen items from three social sub-systems: industry, government, and the community in the real world? How this array of motivation items is changed if the respondents are asked for their views on their anticipated motivation in the future? Is there any difference in the array of motivation items between developed countries and developing countries? In the questionnaire, each social sub-system had five motivation items as presented in Table 5-1. Table 5-2 shows the composition of fifty-nine enterprise responses, presented according to country.

(ii) How important a role does government play as a motivator for CP, compared with other social subsystem? This researcher defined government-related motivational items in a broad sense, including international organization's activities and international laws.
(iii) How much does each motivational item influence a firm in adopting and implementing CP? Will the influence of each motivational item for CP continue in the future or change over time? Also, is there any difference in the degree of motivation between developed countries and developing countries?

Figure 5-2: Triangular Knowledge Links in CP Case Study Worldwide in this Thesis

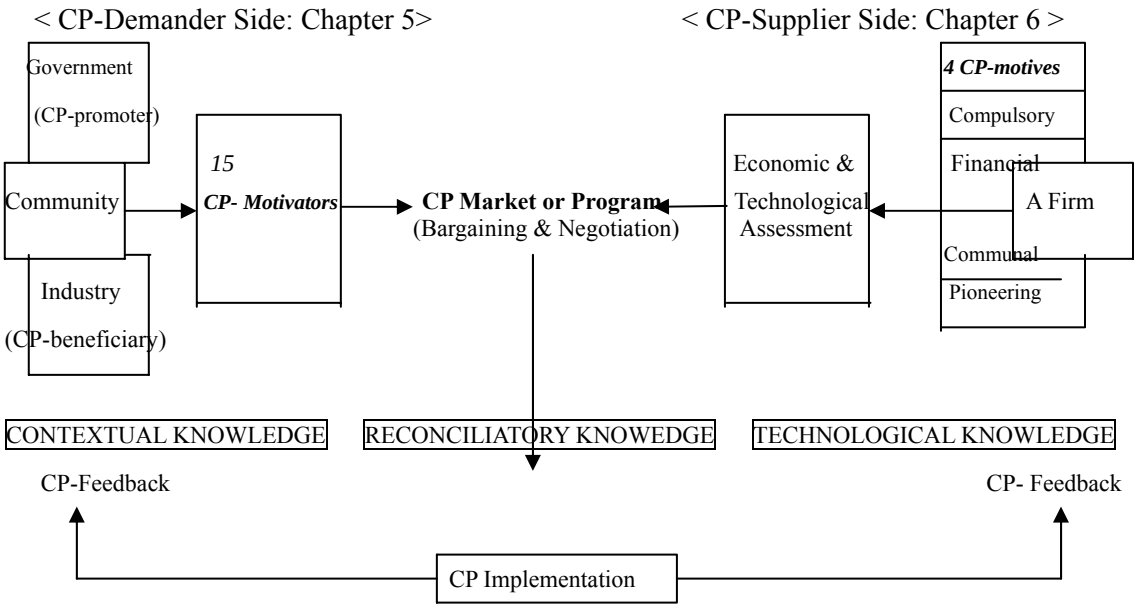


Table 5-1: Given Motivational Items of Three Subsystems in the Survey Questionnaire*

Industry-related Motivation Items	Government-related Motivation Items (including international governance)	Community-related Motivation Items
• Commitment of top manager toward CP	• Responsibility to meet government regulation	• Activities of NGOs and media
• Result of creative input by process engineer or production workers	• Guidance or economic incentive of government	• Having a good public image of being a 'clean company' to consumers
• Profit incentive resulting from CP application	•Internationally standardized environmental guideline (ISO 14001, etc.)	• Available CP information provided by environmental organization
• Demand from a labor union	• International law or convention	• Scientific report on hazards of certain pollutants
• Cleaner Production cases of other companies	• Compliance with a changing international trade order	•Partnership with consulting company for CP

*One open item was given to respondents. Only two respondents gave different answers out of the 15 suggested motivational items. One was reclassified as being an item that was similar to one listed among the fifteen motivational items provided. The other was left as it was.

Table 5-2 Composition of Respondent Companies by Country

Developed Countries' Group		Non-developed Countries' Group	
Group 1	Group 2	Group 3	Group 4
Developed Countries (Except France*) (18 companies)	France (17 companies)	Economies in transition and developing countries (Except Korea*) (15 companies)	South Korea (9 companies)
USA – 5, Denmark –3, Canada,Germany-2, Australia, Belgium, Italy, Japan, Netherlands, Switzerland – 1 respectively		China – 3, Brazil, Bahrain-2, Mexico, Poland, Czech Republic, Romania, Slovenia, Croatia, Taiwan, Argentina – 1 respectively	

* The researcher sent the questionnaire to a sample of 250 companies and received 65 responses. Among them, six respondents answered that they had not implemented CP. Due to the fact that this thesis author was living in France and in Korea, relatively more companies located in France and South Korea provided answers to the questionnaire.

5.2 Interaction among social subsystems in motivating CP

1. Purpose of the questionnaire

A survey was conducted to question leaders of environmentally successful firms, worldwide about the top three motivations for their companies to implement CP. As stated in the introduction, the questionnaire was designed to identify the motivation structure of environmentally successful companies. One of the important points in designing motivational items was to identify how much each social subsystem, - that is, government, industry, and community - works together in implementing CP. This is done by proposing to respondents, three groups of motivation items.

When a respondent to the question: 'What was the most decisive motivation for your company to implement CP?', selected their three top items, this revealed their main motivations from among the 15 items provided. Each of selected items was then reclassified as being from one of three social subsystem groups. (See Table 5-1) For example, each answer can be clustered into one of three motivation groups: company-related, government-related, and community-related motivation group. [2]

According to these criteria, seven types of motivational interactions for CP between companies, governments, and communities were found as summarized in (Figure 5-3), where answers of 59 companies were utilized.

Figure 5-3: 7 Types of Motivational Interaction between Social Sub-systems for CP

Tripartite motivational interaction of social subsystems for CP

■**Type A (company): Company-Motivation + Government-Motivation + Community-Motivation**

* *This means that three prioritized motivation items which a respondent company chose, consisted of one from company-items, one from government-items, one from community-items. This indicated that CP activity of the company was being implemented under the cooperation of company, government, and community. This analysis was designed to test Hypothesis 3.*

■**Type B: Government-Motivation + Community-Motivation**

* *This type refers to the company group in which the company-related motivation items were less influential in implementing CP. In this case, the company took a reactive position on adapting CP. This largely happened in developing countries*.

Bilateral motivational interaction of social subsystem for CP

■**Type C: Company-Motivation + Government-Motivation**

■**Type D: Company-Motivation + Community-Motivation**

■**Type E: All Government-Motivations**

**This type means that CP activities of a company were largely implemented due to governmental factors.*

■**Type F: All Community-Motivations**

Largely intrinsic motivational forces for CP implementation

■**Type G: All Company-Motivations**

**This type means that CP activities of the company were implemented due to the company's own decisions without being influenced by external factors*.

2. Empirical results on the interactions between social subsystems for CP implementation (Question I)

According to these categories, Table 5-3 contains results of the survey that indicate seven types of societal interactions for implementing CP in the private sector.

*Question I: What **was** the most decisive motivation for your company to implement cleaner production? Choose three items according to priority. (N=59)*

Table 5-3: Societal Interaction Patterns in CP Motivation (Empirical)

	Social Collaboration Types	Frequency*	Percentage (%)
Type A	Company + Government + Community	18	31
Type B	Government + Community	6	10
Type C	Company + Government	16	27
Type D	Company + Community	13	22
Type E	Government only	1	2
Type F	Community only	0	0
Type G	Company only	5	9
(total)		59	100

* Frequency means number of respondent company.

Table 5-3 indicates that 92 % of the respondent enterprises implemented CP under the influence of extrinsic motivation or through the mutual interaction with other social subsystems. Especially, firms of Type A and Type B (41%) implemented CP through the tripartite interaction (company, government or international organization, and the community).

These results support the point that the *triangular knowledge links between a firm, a government and a community* are important in stimulating implementation of CP. [see Hypothesis 3 & 5] To make it easier to understand, answers from some illustrative respondents are provided:

As presented in Table 5-4 and 5-5, respondent companies revealed various combinations of motivation-items. The three companies illustrated in Table 5-4 implemented CP through the triangular knowledge links between industry, government, and community. In contrast, the three companies illustrated in Table 5-5 show examples of Type E and Type G interactions.

Only four companies (14%) showed the same motivation styles, and 43 of the 51 respondent companies (86%) had its own motivation-items, which are different from each other. *The results of this survey revealed that private firms have great diversity of CP motivation styles.*

Table 5-4: Examples of CP Motivational Interaction (A-type and B-type)

Respondent company	The first three motivations for CP implementation
Type **A** firm 1 (Switzerland, service)	● Primary motivation: Profit incentive resulting from cleaner production application (Company-related motivation) ● Second motivation: Having a good public image of 'cleaner company' (Community-related motivation) ● Third motivation: Responsibility to meet government regulation (Government-related motivation)
Type **A** firm 2 (China, metal)	● Primary motivation: Guidance or economic incentive of government (Government-related motivation)

	● Second motivation: Partnership with consulting company for cleaner production (Community-related motivation) ● Third motivation: Profit incentive resulting from cleaner production (Company-related motivation)
Type **B** firm (France, Chemical)	● Primary motivation: Internationally standardized environmental guideline (Government-related motivation) ● Second motivation: Having a good public image (Community-related motivation) ● Third motivation: International law or legally binding agreement (Government-related motivation)

Table 5-5: Examples of CP Motivational Interaction (E-type and G-type)

Respondent company	The first three motivations for cleaner production implementation
Type **G** firm 1 (Germany, pharmacy)	● Primary motivation: Commitment of top manager towards cleaner production (Company-related motivation) ● Second motivation: Result of creative input by process engineer and production workers (Company-related motivation) ● Third motivation: Cleaner production examples from other companies (Company-related motivation)
Type **G** firm 2 (Germany, automaker)	● Primary motivation: Profit incentive resulting from cleaner production application (Company-related motivation) ● Second motivation: Commitment of top manager towards cleaner production (Company-related motivation) ● Third motivation: Result of creative input by process engineer and production workers (Company-related motivation)
Type **E** firm (Argentina, unidentified)	● Primary motivation: Responsibility to meet government regulations (Government-related motivation) ● Second motivation: Internationally standardized environmental guideline (Government-related motivation) ● Third motivation: Compliance with a changing international trade order (Government-related motivation)

3. Survey results on expected social interactions in the future for improving CP implementation (Question II)

While Question I focused on identifying the existing motivation styles for implementation of CP in companies, Question II focused on the expected motivation styles in the future for improving CP implementation. Questionnaire items were the same as for Question I. This second question was designed to compare the existing motivators to the expected motivation in the future for encouraging CP. Table 5-6 contains results sorted by the same classifications used for Question I.

Table 5-6 shows that 93 % of the respondents expected that CP would be implemented in the future under the influence of extrinsic motivation or through mutual interactions with other social subsystems.

It was also found that 39% of the respondents (that is the sum of Type A and Type B) expected to implement CP due to the triangular knowledge links between company, government or international organizations, and the community. It was found that the **future** 'interaction pattern of social subsystems for CP' is very similar to what they perceived it to be at the **present** time.

*Question II: Which strategies do you expect to play an important role in improving your company's CP-performance **in the future**? Choose three items according to priority. (N=59)*

Table 5-6: Societal Interaction Patterns of CP Motivation (Expected)

(Frequency : number of respondent company)

	Social Collaboration Types	Frequency	Percentage (%)
Type A	Company + Government + Community	15	25
Type B	Government + Community	8	14
Type C	Company + Government	22	37
Type D	Company + Community	8	14
Type E	Government only	2	3
Type F	Community only	0	0
Type G	Company only	4	7
(total)		59	100%

•

5.3 The role of government as a motivator for CP implementation

This section focuses on identifying the role of government in motivating industry and business to adopt CP by analyzing the result of the motivation survey. Table 5-7 and Table 5-8 show the array of CP motivation styles by social subsystems in both the present and future. The comprehensive results of the CP motivation survey demonstrated two facts:

a. that firms are central in implementing CP,
b. that social collaboration for CP between industry, government, and community is necessary.

These findings support Hypothesis 3.

[*Hypothesis 3*: *In implementing a CP practice, not only company-related factors but also community-related factors and government-related factors work together as joint determinants for CP implementation*.]

These data revealed that CP activities are not pure economic activities but a collective good which requires collaboration of related social subsystems. In other words, the survey answers from the 59 CP companies, worldwide, demonstrate that their CP activities did not work well without other social systems' (extrinsic) motivations.

Table 5-7: Overall array of cleaner production motivation styles (present)

	Primary ranking (A)	Second ranking (B)	Third ranking (C)
Company-related	49 %	45 %	47 %
Government-related	40 %	35 %	25 %
Community-related	17 %	20 %	28 %
	100 % (N=59)	100 % (N=60)	100 % (N=60)

Table 5-8: Overall array of cleaner production motivation styles (future)

	First ranking (A)	Second ranking (B)	Third ranking (C)
Company-related	49 %	34 %	44 %
Government-related	38 %	38 %)	37 %
Community-related	14 %	28 %	19 %
	100 % (N=59)	100 % (N=58)	100 % (N=59)

As indicated by Table 5-7, 34 % of 59 respondent-companies chose the government-related motivation items as their first-order motivation for implementing CP. Furthermore, Table 5-8 also shows that 37 % chose the government-related motivation items as their first-order motivation for CP. These data support Hypothesis 3.

[*A part of Hypothesis 3: Some government's factors could be the primary determinants of CP implementation.*]

In comparing the results presented in Tables (5-7 and 5-8), it is clear that the **present** and anticipated **future**, interactive motivation structure of firms between social sub-systems is not expected to change very much, however the respondents anticipate that the roles of government could become slightly stronger. Table 5-9 shows a small increase in the percentage of government-related motivation items.

Table 5-9: Change of Governmental Influence in the future

(* Number refers to average percentage of three ranking)

	Present	Future
Government-related motivation	31 %	38 %
Industry-related motivation	47 %	42 %
Community-related motivation	22 %	20 %

In comparing the data from the motivation survey, by country, it was found that there are some differences in the influence of government between the highly developed countries and the developing countries (including transitional economies such as South Korea and Mexico). (See Table 5-10.)

The data presented in Table 5-10 indicates that the influence of government in implementing CP is expected to increase in both HDCs and Non-HDCs. It was observed that the percentage of government-related motivation items (Non-HDCs' 44 %) exceeded the percentage of company-related motivation items (Non-HDCs' 39 %). It can be reasoned, based on these data, that in the non-highly-developed countries, CP will also be led by government and international organizations, in the future rather than by the firms themselves. Table 5-11 shows more detailed survey results on the expected motivations in the future, within Non-HDCs.

Table 5-10: Difference of Motivation between HDCs' and Non-HDCs'

(HDCs: Highly Developed Countries)

	Experienced Patterns		Expected Patterns (future)	
	HDCs (N=35x3)	Non-HDCs (N=24x3)	HDCs (N=35x3)	Non-HDCs (N=24x3)
Government-related items	25 %	39 %	32 %	44 %
Company-related items	50 %	42 %	46 %	39 %
Community related items	25 %	19 %	22 %	17 %
(total)	100%	100%	100%	100%

Judging from the data in this table, it is clear, that the higher percentage of government-related motivation items is due to the higher percentage of the respondent's third priority items rather than the percentage of their first or second priority selection. According to Table 5-11, slightly more respondent-companies in NHDCs selected company-related motivation items than

government-related motivation items as their first or as their second priorities for the future. Although, one must consider the sample bias caused by relatively few sample cases, where such results do not have statistically sufficient validity [See Note-Box below on *validity of the surveys with relatively few sample cases*.], we can see, that the respondents believed that the role of government is important for fostering corporate implementation of CP in both the HDCs and NHDCs. It is also clear that the importance of government is increasing in both the HDCs and NHDCs. [Hypothesis 4]

Table 5-11 Detailed results of the survey on NHDCs' future motivation priorities

(Number of respondent companies : Expected/Existing)

	No. of respondents to choose as first priority	No. of respondents to choose as second priority	No. of respondents to choose as third priority
Government-related items (N=31)	11/12 (- 1)	11/13 (- 2)	9/4 (+ 5)
Company-related items (N=27)	10/8 (+ 2)	8/9 (- 1)	9/13 (- 4)

Table 5-12 Detailed results of the survey on HDCs' future motivation priorities

(Number of respondent companies : Expected/Existing)

	No. of respondents to choose as first priority	No. of respondents to choose as second priority	No. of respondents to choose as third priority
Government-related items (N=31)	11/8 (+ 3)	11/8 (+ 3)	13/11 (+ 2)
Company-related items(N=27)	19/21 (- 2)	12/17 (- 5)	17/15 (+ 2)

5.4 Patterns of CP Motivations

The next concern about the motivation survey for CP was to identify each item's relative degree of influence on the firm's choice for implementing CP. In order to obtain insight into the reliability of patterns of CP motivation results, the answers were analyzed from the present and from the anticipated motivations at three levels of priorities. [3] In the questionnaire, this researcher did not use the scale of motivation such as 'agree strongly or disagree strongly and so on'. Instead, the researcher asked managers to select their first three decisive motivation items among 15 given items. They were also invited to provide other inputs via single open question. The questionnaire asked for their experiences rather their views.

Table 5-13 and Table 5-14 show the patterns of the 59 firms' existing motivations for CP (Table 5-13), and 59 firms' expected CP motivations. (Table 5-14)

- The first column refers to the number and percentage of companies that selected the item as their first-prioritized motivation item.
- The second column shows the number and percentage of companies that selected the top three motivation items among 15 given items.
- The third column shows the weighted number and percentage of companies by weighting the most decisive motivation with three points, the second most decisive with two points, and the third most decisive with one point.

*Question I: What **was** the most decisive motivation for your company to implement cleaner production? Choose three items according to priority. (N=59)*

Table 5-13: Experienced Motivation Patterns of 59 '*Green*' Companies for CP

Ranking*	**Motivation item****	Priority 1 (P1, %)	N=P1+P2+P3 ***(%)	Weighed Scores****(%)
1	**● Top-manager's environmental leadership**	31	20	23
2	**● Profit incentive**	15	13	13
3	**● Government regulation**	17	12	13
4	**● Good public image**	7	15	13
(Accumulated percentage)		(70%)	(60%)	(62%)
5.	**● International standardized guideline**	3	8	8
6	**● In-house engineer's Creative input**	0	8	6
7	**● Government's economic incentive**	5	5	5
8	**● Cleaner Production cases of other companies**	3	5	4
9	**● Scientific reports on certain pollutants discharged**	5	3	3
10	**● International environmental conventions**	3	3	3
11	**● Compliance with international trade order**	5	3	3
(Accumulated percentage)		(95 %)	(95 %)	(95%)
12	**● Partnership with consulting company**	2	1	1
13	**● Available CP information by environmental organizations**	2	2	1
14	**● Activities of NGOs and media**	2	1	1
15	**● Demand from a labor union**	0	1	1
Open-ended		0	1	1
Total		100 % (N=59)	100 % (TN=179)	100 % (TWS=355)

*Rankings in this column are based on the score of (P1x3+P2x2+P3x3)
** Suggested expressions are the abbreviations for motivation items (See Table5-1)
*** P1, P2, P3 refer to priority 1, priority 2, priority 3 motivators of the company in question, respectively.
**** **** Weighted Score: WS (%) = each item score (P1x3+P2x2+P1x1)/total score (355)x100

*Question II: Which strategies do you expect to play an important role in improving your company's CP-performance **in future**? Choose three items according to priority. (N=59)*

Table 5-14: Expected Motivation Patterns of 59 Companies for CP in the future

Ranking*	**Motivation item****	Priority 1 (P1, %)	N=P1+P2 +P3***(%)	Weighed Scores****(%)
1	**● Top-manager's environmental leadership**	22	15	18
2	**● Profit incentive**	19	15	15
3	**● Government regulation**	17	14	14
4	**● Good public image**	7	11	11
	(Accumulated percentage)	(64 %)	(55%)	(57 %)
5.	**●International standardized guideline**	3	9	9
6	**● In-house engineer's Creative input**	3	9	7
7	**● Government's economic incentive**	7	7	7
8	**● International environmental conventions**	5	4	5
9	**● Scientific reports on certain pollutants discharged**	3	4	4
10	**● Compliance with international trade order**	5	4	4
11	**● Cleaner Production cases of other companies**	5	3	3
12	**● Available CP information by environmental organizations**	3	3	3
	(Accumulated percentage)	(100 %)	(97 %)	(98 %)
13	**● Partnership with consulting company**	0	1	1
14	**● Demand from a labor union**	0	1	1
15	**● Activities of NGOs and media**	0	1	0
Open-ended		0	0	0
Total		100 % (TN=59)	100 % (TN=176)	100 % (TWS=352)

*Rankings in this column are based on the accumulated score of (P1x3+P2x2+P3x3)
** Suggested expressions are the abbreviations for motivation items (See Table 5-1)
*** P1, P2, P3 refer to priority 1, priority 2, priority 3 motivators of the company in question, respectively.
**** Weighted Score: WS (%) = each item score (P1x3+P2x2+P1x1)/total score (352)x100

1. The relative degree of influence of various CP motivators

Table 5-13 and Table 5-14 demonstrate the results of CP motivation survey through six kinds of data:

i) Distribution of the most decisive CP motivation item which was experienced by respondent companies;
ii) The simple sum of the most, second-most, and third-most important motivation items which were experienced;
iii) The weighted sums of those three motivation items which were experienced;
iv) Distribution of the most decisive CP motivation items which were experienced by respondent companies;
v) The simple sum of the most, second-most, and third-most motivation items which were expected by respondents;
vi) The weighted sum of those three motivation items which were expected by respondents.

Each motivation questionnaire item included two main components: 'an actor and its functional action or attitude for CP', such as 'guidance or economic incentive (action) of government (actor), or creative input (action) by the process engineer (actor) or production workers (actor). They were designed to survey the motivational interactions between social actors and industry, and to clarify methodologically conceptual uncertainties.

Top seven motivators

First of all, six different sets of data from the same 59 respondents companies (Table 5-13 & 5-14) consistently indicated that the major motivators for CP and their relative order of priority as motivators included the following major seven motivation items:

Table 5-15: Ranking of Seven CP Motivators

(Number in box: ranking among 15 items)

Motivators	WS1*	WS2**	SS1	SS2	P11	P12
1. CEO's environmental leadership	1	1	1	1	1	1
2. CP's profit incentive	2	2	3	1	3	2
3. Meeting government regulation	3	3	4	3	2	3
4. Having a 'green' public image	4	4	2	4	4	4
5. International EM guideline	5	5	5	5	8	9
6. Internal engineer's creative input	6	6	5	6	15	9
7. Government's economic incentive	7	7	7	7	5	5
(Total percentile)	81%	80%	81%	80%	780%	78%

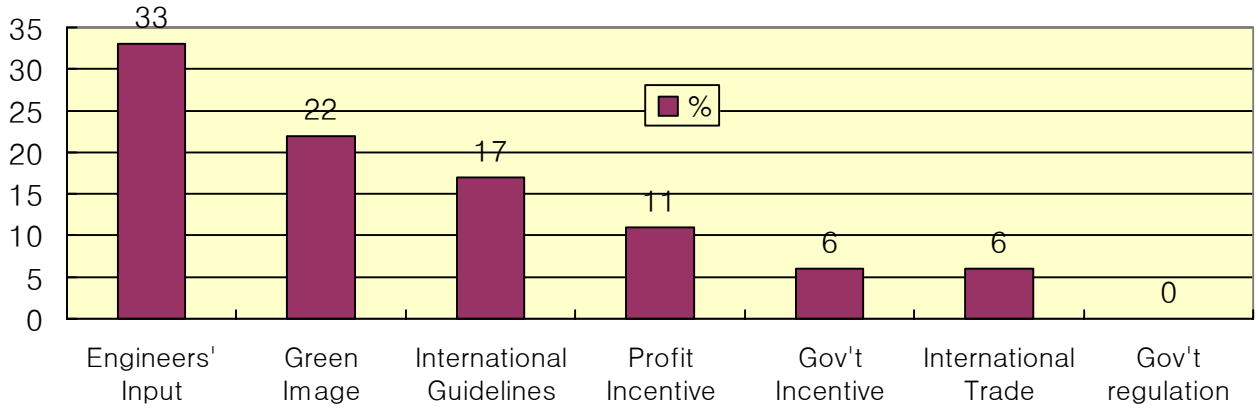
* WS refers to 'weighed score of P1+P2+P3', SS refers to 'simple sum of P1+P2+P3'
**WS '1' means '*experienced*' data, WS '2' means '*expected*' data.

Approximately 80 % of the 59 company respondents answered that CP implementation in their companies is motivated and will be motivated by those seven items. Especially, it can be noted, that both the WS1 data and the WS2 data in Table 5-15 show the same relative order of CP motivators.

Those six sets of data consistently indicate, with regard to 'commitment of the top manager toward CP', the 'CEO's environmental leadership', is the most powerful motivation among the fifteen motivator-items for CP implementation. Considering the normal decision-making process in a private company, such results are natural. However, reflecting that the decision-maker usually reviews available alternatives and the state of the operating environment, etc. before making final decisions (Arnold & Turley, 1996), it can be reasoned that the other six motivators are not less important than the CEO's environmental leadership and these factors are closely related to the top-manger's environmental position or commitment.

As presented in section 5.2, multiple motivators are linked for implementing CP, although the style of motivational interaction in each company is diverse according to their different contexts. It is helpful for understanding motivational linkages among the fifteen items if we identify the degree of motivational linkage between 'top-manager's commitment toward CP' and other motivation items. Figure 5-4 shows the distribution of eighteen companies' second-priority motivation item. These eighteen companies selected 'top-manager's commitment to CP' as the first-priority motivation item.

Figure 5-4: The Percentage of Company Respondents who selected the following motivational factors in relation to 'Environmental Leadership' item*



*Total number of companies to choose 'environmental leadership' as the first-priority motivation.
** This refers to the number of companies which chose the item in question as the second-priority motivation.

Due to insufficient sample size for this case study, it was not appropriate to conduct factor analysis. The data of the 59 companies presented in Table 5-16 indicate, that the 'top-manager's environmental decisions have the most positive relationship with the 'Internal engineer's creative input'. The 'green image of the company' and the 'international environmental guidelines such as ISO 14000 etc.' follow as motivational factors. It can be inferred from these data (Figure 5-4) that the degree of motivational linkage between environmental leadership and in-house engineer's technological input is relatively high. This trend is also supported (or *triangulated)* by the 'expected' data sets shown in Table 5-14. The data in Figure 5-4 permit us to draw the inference that profit-maximization, which is the typical assumption of classical economics is not the factor that a top-manger considers first in deciding upon his/her environmental investments on CP. A further interpretation from these data can be that the role of 'profit incentive' in implementing CP may not be a way of on-going capital accumulation for the firm, but may be important for reducing the firm's cost of environmental investment. This finding indirectly supports Hypothesis 6 that the pattern of CP implementation evolves.

On the other hand, based upon the data where the number of companies which chose 'top-

manager's commitment toward CP' as their first-priority motivation and 'meeting governmental regulation' as their second-priority motivation is zero among 59 companies, it can be inferred that when CP implementation in a company is initiated due to the environmental leadership of its top-manger, the degree of motivational linkage with governmental regulations is not so high as that with internal creative input or green image. It can be inferred from the survey results that when a top-manager decides to make environmental investments to implement CP, they consider firstly 'technological or technical inputs from their staffs', secondly, 'socially positive image of the company due to CP implementation, and thirdly, the potential 'economic profits.'

These results indicate that 'CP implementation,' is not a single-valued social function but rather is a multi-valued social function. In Chapter 1, this author asserted that CP implementation and SD are not pure economic activities but are a combination of economic and ecological values which have fundamentally different goals and methodologies. Therefore, any attempt to understand CP with a single-valued hypothesis or theory such as the profit-maximization hypothesis of typical neo economic theory or stimuli-response relationship of social behaviorism could have significant defects in its logic in understanding. Based on a multi-valued hypothesis on CP implementation, this author proposed that 'triangular knowledge links to CP' are a necessary condition for continual CP implementation. CP activities were assumed to be public goods that can help to achieve better environmental quality for the community and economic benefits for the companies and the communities.

The second-ranking motivator for CP, based upon the survey results, is the 'profit incentive resulting from CP implementation' (see Table 5-15, P11: 15%, P12: 19%, WS1: 13%, WS2: 15%). Although, many advocates of CP argue that CP practices are environmentally sound and economically beneficial to implementers; and thus it is often called as 'win-win' strategy, the findings of the research reveal that only 15 to 20 % of the CP practitioners think that the core motivation for CP is 'economic profit from CP activities'. These data indicate that more than 50% of the CP companies implemented CP in response to extrinsic motivations rather than due to intrinsic motivations. However, the fact that environmental activities in a company can also increase the economic benefits of the company can be a core motivation to encourage implementation of CP. That's why the profit motive is one of the most highly ranked motivation items in both the empirical data (WS1 13%, 2nd) and in what is expected to be the situation in the future. (WS1 15 %, 2nd)

The third-ranking motivator for CP from the survey was 'meeting governmental regulations' (P11: 17 %, P12: 17%, WS1: 13%, WS2: 14%). Ten companies among 59 respondents (17%) selected 'meeting governmental regulations' as their first-priority motivation in implementing CP so far. Also, ten companies among the 59 respondents (17 %) chose governmental regulations as their expected first-priority motivation for implementing cleaner production in the future. These data show that a significant part of cleaner production activities were actually motivated or initiated in order to meet government's environmental regulations. This fact indicates that the relationship between CP and governmental regulations is not always competitive. They could be a complementary relationship under certain conditions. In this sense, the emphasis presented in Section 3.4.2 that 'the establishment of complementary relationship between existing command-and-control policies and a new CP program may be a sufficient condition for increasing effectiveness of a new voluntary CP program,' is supported by these data.

One interesting observation is that four among ten companies (40%) which selected 'meeting governmental regulation' as their first-priority motivation chose 'top-manager's commitment toward CP' as their second-priority motivation. This is different from the behavior of companies

as presented in Table 5-16, where none of the 18 companies, which chose 'top-manger's commitment' as their first-priority motivation, chose 'meeting governmental regulation' as their second-priority motivation (Table 5-16). It can be inferred from these data that even though a company implements CP options in order to meet governmental regulations, internal consensus is also required. Table 5-16 shows the motivational linkages of the 'governmental regulation' item (ten companies previously mentioned) with other motivation items.

Table 5-16: Governmental Regulation's Motivational Linkage to Second-priority Items

Total	Environmental leadership	Gov't incentive	Green image	International guideline	Profit incentive
10*(9***)	4**(3)	3 (2)	2 (2)	1(1)	0 (1)
100%	40% (33%)	30%(22%)	20% (22%)	10% (11%)	0%(11%)

*Total number of companies to select 'governmental regulation' as the first-priority motivation.
** This refers to the number of companies which selected the item in question as the second-priority motivation
*** Data in parenthesis refer to '*expected*' data of nine companies which selected 'governmental regulations' as their first-priority motivation.

The fourth-ranking motivator for CP implementation is 'Having a good public image of 'being a *green* company' to consumers. (P11: 7%, P12: 7%, WS1: 13%, WS2: 11%). Four companies among 59 respondents (6.8%) chose this option as their first-priority motivation in their implementing CP so far. Twenty three companies among 59 companies (39%) selected this option as their second- and third-priority motivation. This was the most selected item among fifteen items for second- and third-priority motivation. Also, four companies among 59 respondents (7%) chose 'Having a good public image of 'being a *green* company' to consumers as their expected first-priority motivation for implementing CP in the future. Sixteen companies among 59 respondents (27%) chose this item as their second- or third-priority motivation. It can be inferred from these data that 'a public image as a *green* company' is also one of the important motivators for implementing CP. [4]

The fifth ranking motivation for implementing CP was 'internationally standardized environmental guidelines such as ISO 14000 series'. (P11: 3%, P12: 3%, WS1: 8%, WS2: 9%). Two companies among 59 respondents (3%) chose this option as their first-priority motivation for the past. Also, two companies among 59 respondents (3%) chose this option as their expected first-priority motivation for implementing CP in the future. Among fifteen items there are three items, which are related with international activities. The other two items are 'international law or legally binding convention such as the Montreal Convention' and 'Compliance with a changing international trade order'. The data show that these international items are one of the important motivators (approximately 12 to 16% in each data set.) This researcher considers those international items to be governmental activities in a broad sense. In fact, most international activities on environmental conservation are very closely related with agreements or negotiations among national governments.

The sixth ranking motivation for implementing CP is 'creative input by process engineer(s) and production workers'. (P11: 0 %, P12: 3%, WS1: 6%, WS2: 7%). No companies among 59 respondents (0%) chose 'creative input by process engineer(s) and production workers' as their first-priority motivation in their implementing CP so far. Two companies (3%) chose these internal creative inputs as their expected first-priority motivation for implementing CP in the future. However, fourteen companies (24%) chose this item as their second- or third-priority motivation. As stated earlier, one in three companies (33%) which chose 'CEO's environmental leadership' as their first-priority motivation chose 'creative input by internal engineers' as their second-priority motivation. It can be inferred from these data that a large part of CP could be implemented well when sound environmental leadership is connected with appropriate

technological inputs by corporate in-house staffs.
One interesting aspect of 'engineer's creative inputs' as a motivation item is that the data reveal that this item has the biggest gap between its percentage as the first-priority motivation (P1: 0%, 15th among 15 motivations)and its percentage as the second-priority motivation(P2: 12%, 4th among 15 motivations). At least two inferences can be drawn from these data. The first one is that there could be leading motivators and supplementary motivators. For example, 'top-manager's commitment to cleaner production', 'meeting governmental regulations', or 'profit-incentive of CP' could belong to the 'leading motivators group' and 'creative input of internal engineers' could be within the 'supplementary motivators group'. But, this classification may be theoretical and relative. The second one is that each company requires its own technological knowledge for implementing CP. In general, each company has its own manufacturing process and its own consumers and stakeholder, etc. In this sense, appropriate technological or technical inputs from internal engineers and staffs may be necessary for implementing CP implementation, forming an integral part of environmental innovation in the private sector.

Another interesting fact on this 'internal engineer's creative input' motivation is that twelve companies (86%) among fourteen companies which selected this item as their second- or third-priority motivation are from highly developed countries.

The seventh ranking motivation for CP is 'guidance or economic incentive of government'. (P11: 5%, P12: 7%, WS1: 5%, WS2: 7%). Three companies among 59 respondents (5%) chose 'government's guidance or economic incentive' as their first-priority motivation in their implementing CP so far. Also, four companies among 59 respondents (7%) chose this item as their expected first-priority motivation for implementing CP in the future. The survey results indicate that along with governmental regulations, these governmental guidelines and economic incentives appear to be one of important motivators for implementing CP. More that half (31 of the companies, 53%) selected these two governmentally-related motivations as one of their three most decisive motivations. It can be inferred from these results that governments play a central role in CP motivation. Fifty-nine firms in the sample also expected that this trend will be increased in the future. In the question of *expected* important motivations, 36 among 59 companies (61%) chose these two governmental motivations as one of their three most important motivations.

As discussed in Chapter 2, although the CP movement was started in order to overcome the problems of 'command-and-control' largely driven by central government, it is suggested from these results that governments also have significant roles to play in promotion of the implementation of CP. [Hypothesis 4] The CP motivational patterns indicate that what some environmental policy theorists' have proposed that a mixed model of industrial environmental policy should be created through a combination of the 'command-and-control approach' and the 'voluntary agreement approach,' may be correct. (N. A. Ashford 1993, D. Wallace 1995, E. D. Elliott 1997, UNEP 1994, OECD 2000)

Other motivators

Approximately 80% of CP activities were implemented due to the influence of the first seven motivational elements (Table 5-15). Additionally, Table 5-17 shows that the other 20 % of CP were implemented due to the influence of the other motivators. Although the frequency and the relative influence of those items as motivators are weak compared with the major seven motivators, they cannot be ignored for at least two reasons.

First because different environmental problems arise in different ways in different contexts,

(Hannigan, 1995) each company will have its CP context and consequently its own CP approaches. This statement is supported by the survey results that 86% of the respondent companies have their own unique motivational styles (See Section 5.2.2).

Table 5-17: Degree of Influence of other Peripheral CP Motivations*

(N=59, No. 16 and 17 are taken from self-proclaimed answers.)

Motivators	WS1*	WS2**	SS1	SS2	P11	P12
8. Competition with other company	8	11	8	8	8	6
9. International convention	9	8	9	8	8	6
10. Scientific reports	9	9	11	11	5	9
11. International trade order	9	9	10	8	5	6
12. Available CP-information	13	12	12	12	11	9
13. Partnership with consulting company	12	13	13	13	11	13
14. Labor union demand	15	14	13	13	14	13
15. Pressure from ngos and media	14	15	13	15	11	13
16. Eco-labeling	16	-	16	-	16	-
17. Eco-banking system	16	-	16	-	16	-
(Total percentile)	19%	21%	19%	21%	22%	22%

The second reason that is closely related with the first, is that due to company specificities of a company's CP implementation styles and selection of options are motivated by a specific set of motivator. Actually, as shown in Table 5-18, thirteen companies (22%) answered that their first-priority motivations for CP implementation were those items which do not belong to the seven main motivators. Respondent companies expected that the motivational pattern of the future would be about the same in this respect. (P12 data in Table 5-17 shows 22%.) [5]

Leading motivators, supplementary motivators, and special motivators

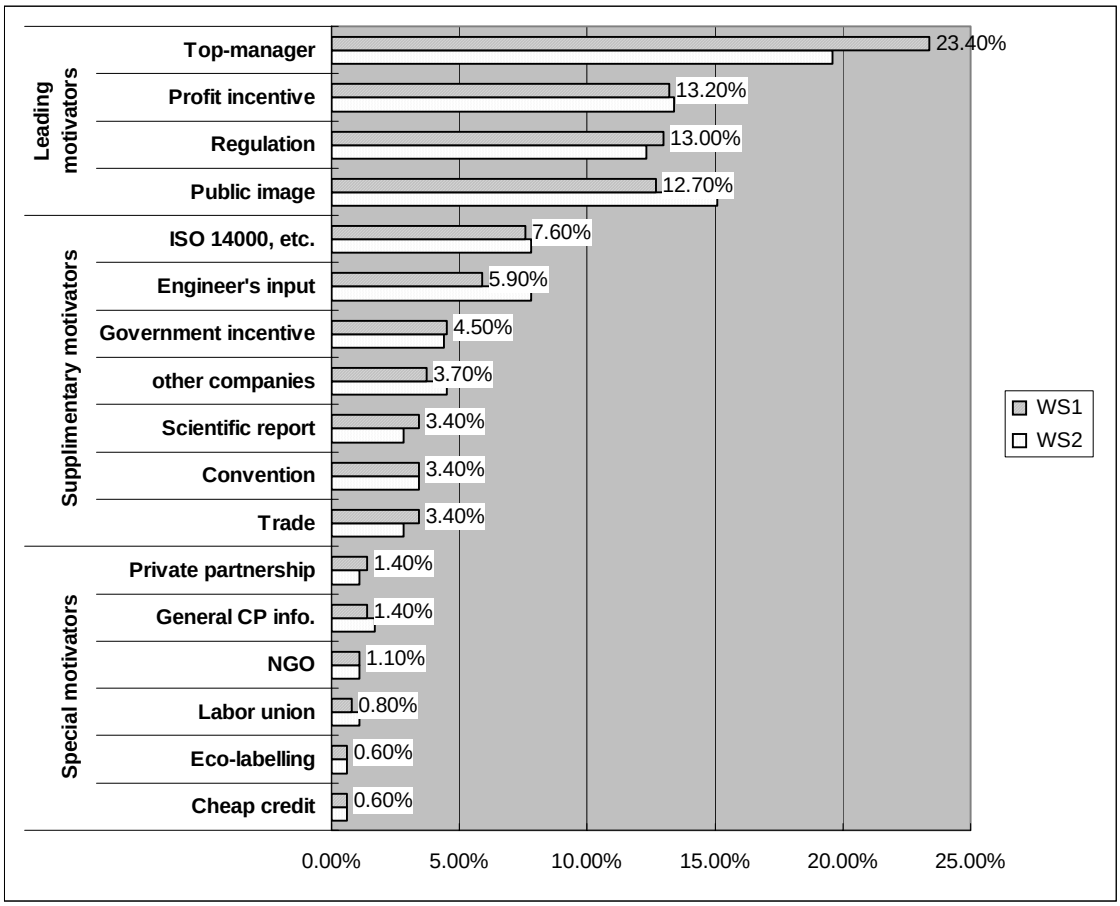
Finally, the results of CP motivational study, also indicate that there is a structural pattern of motivators in terms of degree of influence on CP. Based on the survey results, it is helpful to classify those motivators under three categories: 'leading motivator group' (more than 10% by WS1 index), 'supplementary motivator group', and 'special motivator group' (less than 3 % by WS1 index), respectively. Figure 5-4 shows the results of this categorization.

Figure 5-5 illustrates that the percentage of the four leading motivators is more than 60%, which means that more than 60 % of the firms were decisively influenced by these four factors in implementing CP. The expected data also reveal a similar pattern (see Table 5-14). Approximately 30% of the firms were decisively influenced by seven supplementary motivators such as corporate in-house engineer's creative inputs (6%), government's economic incentive (5%) in their implementing CP (Figure 5-5). Two companies were motivated respectively by a) 'demand from a labor union' (an Australian steel company), b) partnership with consulting company (a Croatian chemical company).

These results reveal that the 59 companies' CP activities were motivated largely by non-environmental factors such as profit incentive (13%), governmental regulation (13%), good public image (13%), rather than environmental factors such as scientific report (3%), environmental organization's CP information (1%), and pressure of NGOs and media (1%). It can be inferred that most firms did not pursue their CP activities as their primary goals. In addition, it can be inferred that when the top-manger's environmental decisions are made from a comprehensive context, extrinsic factors such as governmental regulations, (13%) and international standard guidelines (8%) are more influential than intrinsic factors such as profit-

taking (13%), and the internal engineer's creative input (6%).

Figure 5-5: Degree of Influence of CP Motivator (WS1: Present, WS2: Future)



* In this Figure, 'eco-labeling' item was separated from governmental incentive.

From these results, one can reason that in order for a society that seeks to encourage the industrial sector to implement CP continually, appropriate extrinsic motivators should be developed and utilized on an on-going basis.

When government, as the core promoter of CP, designs CP policies, it needs to recognize such structural patterns of CP motivators of their firms. From the results of the survey, one can reason that governmental policies could be more effective if they seek, first of all, to create or enhance the *leading motivators* of CP such as environmental leadership, the firms' economic profit, environmental regulations, and public environmental image. Then, it needs to design comprehensive and flexible motivation schemes to include *supplementary motivators* and *special motivators*, so that they may function synergistically to catalyze CP implementation and CP suppliers.

In conclusion, it can be inferred that the more kinds of motivational approaches that governmental CP policies utilize, the greater the efficiency of the CP policies will be. This will, in turn, lead to higher effectivity of the CP demand. For example, if a governmental CP policy influences only the public image motivator, it would not be as effective as a policy designed to influence the public image motivator, as well as the environmental leadership and the profit motivators.

This thesis author already identified in Section 5.2 that each motivator has its synergistic effects with other motivators in implementing CP. This process can be termed the 'contextual adaptation of CP policy to the CP climate'. If one views it in the framework of *triangular knowledge links to CP* (see Chapter 3 & 4), this can form a linkage between contextual knowledge of CP and reconciliatory knowledge of governmental policy.

2. Motivations for CP implementation

This thesis author now reflects on the results of an in-depth analysis on the relationships between intrinsic and practical motivations for CP implementation. In doing this analysis, the problem is that the sample size was not sufficiently large to produce statistically valid patterns. Therefore, the results of this analysis should only be used to provide an indicative suggestion of the directions larger samples sizes may reveal. However, considering that i) fifty-nine respondent-companies were actually implementing CP ii) they provided insights about their experiences rather then their opinions iii) the questionnaire asked them for their top three motivators for implementing CP, in light of both past experiences and future expectations; the results of the analyses do reveal meaningful patterns of the firms' environmental behavior.

To make the motivations clearer, this researcher reclassified fourteen of the fifteen motivational items into four groups, as presented in Table 5-18.

Table 5-18: 59 Firms' CP-motivation Tendency by Four Motives

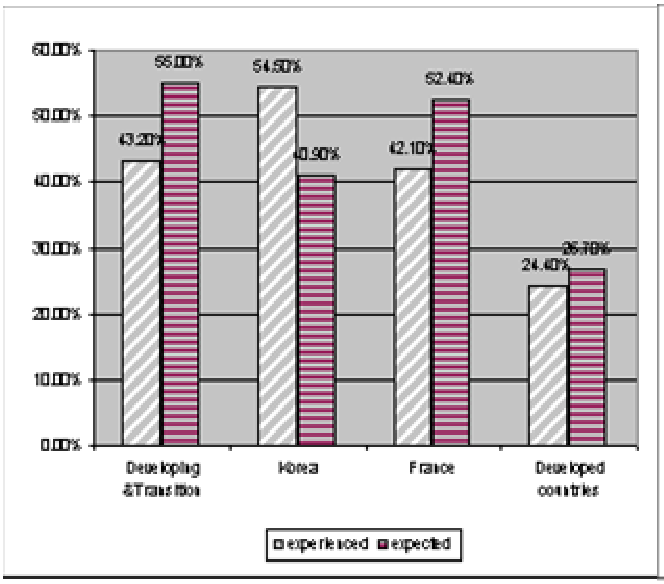
(No.= P1+P2+P3)

Motives	Motive-specific Motivations (operationally defined)	Total (Σmotive)	**Developing & Transition**	**Korea**	**France**	**Developed countries**
Financial Motive	•Profit incentive from CP-application	Experienced (N=36):	*12*	*7*	*5*	*12*
	•Competition with other companies	25%	32%	32%	13%	27%
	•Demand from labor union	Expected (N=36):	*9*	*9*	*4*	*14*
	•Cooperation with consulting firms	24%	23%	41%	10%	31%
Compulsory Motive	•Governmental regulation	Experienced (N:55)	*16*	*12*	*16*	*11*
	•Governmental guidance or incentive	39%	43%	55%	42%	24%
	•International guideline	Expected (N=65):	*22*	*9*	*22*	*12*
	•International convention					
	•International trade	44%	55%	41%	52%	27%
Communal Motive	•Public green image	Experienced (N=32):	*6*	*3*	*11*	*12*
		23%	16%	14%	29%	27%
	•Information of environmental agency	Expected (N=26):	*5*	*4*	*8*	*9*
	•Pressure from NGOs/Media	17%	13%	18%	19%	20%
Pioneering Motive	•Creative input from engineers	Experienced (N=19):	*3*	*0*	*6*	*10*
		13%	8%	0%	16%	22%
	•Scientific report on pollutants discharged	Expected (N=22):	*4*	*0*	*8*	*10*
		15%	10%	0%	19%	22%
(total)		Experienced (N=142) :	*37*	*22*	*38*	*45*
		100%	100%	100%	100%	100%
		Expected (N=149):	*40*	*22*	*42*	*45*
		100%	100%	100%	100%	100%

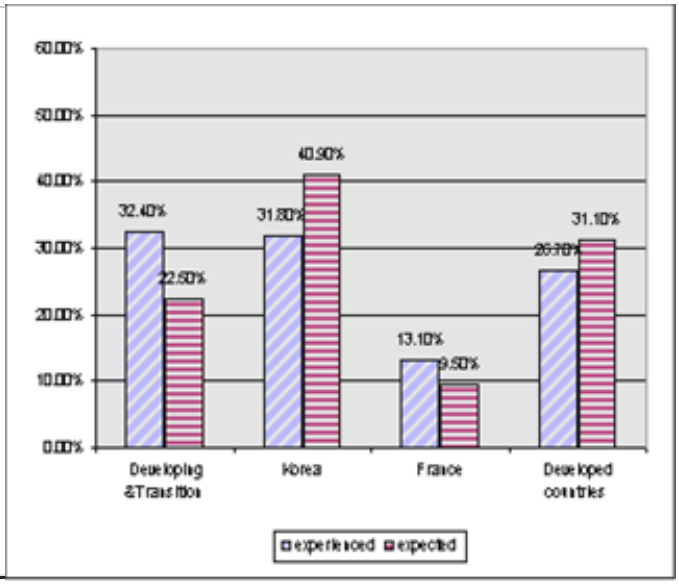
The item, 'Top-manager's commitment for CP' was excluded from the motive-specific items, because top-manager's CP decision in a company is not derived just from a profit motive or a compulsory motive. Normally, top-managers, as the final decision maker for CP, should consider various factors such as actual profit, consumer's response, available alternatives, and operating environment, etc. (John Arnold & Stuart Turkey, 1996) Except this item, the other fourteen items were assembled into the four groups and some items which were ambiguous were clustered into closer groups. For example, international CP guidelines such as ISO 14000 were clustered into the 'compulsory motive group' rather than into the 'communal motive group', because even though the enforceability of such international guidelines is much less strong than other compulsory items, the guidelines are designed to promote general guidance for environmental management rather than conserving any specific community's environmental resources. Also, the guidelines have sometimes been used as conditions for exclusion or inclusion within international trade or in the supply chain. According to these four motivation groupings, Figure 5-6 summarizes 59 companies' CP motivational feedback.

Figure 5-6: Variance of CP-motives by country (First bar: experienced, Second bar: expected)

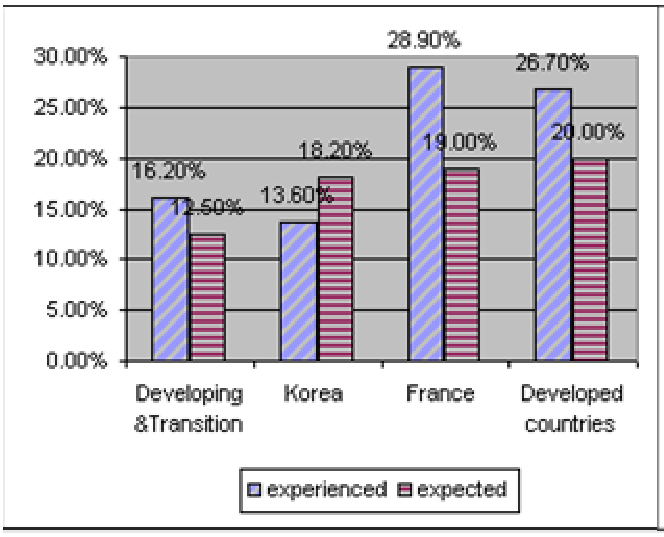
< Compulsory Motive >



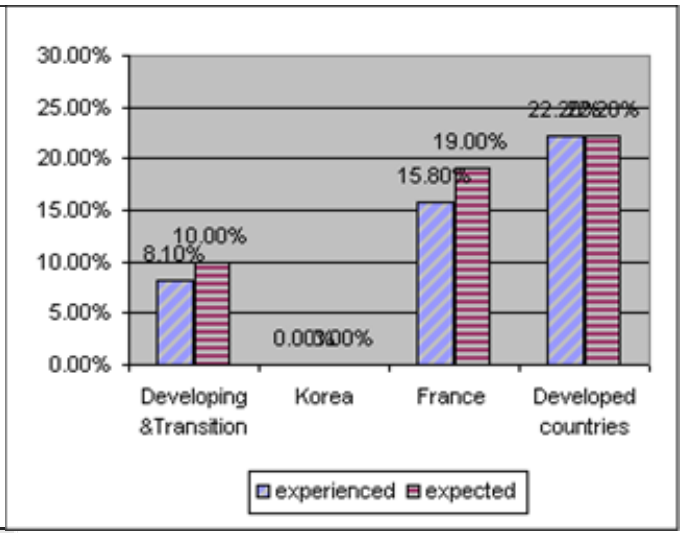
< Financial Motive >



< Communal Motive >



< Pioneering Motive >



Findings from the surveys in the light of motivational relationships

This researcher derived the following indicative findings from these results:
i) Overall, there is no highly dominant motive for CP in the private sector. The most influential motive was identified as the compulsory motive (39%) when it includes international factors. Respondent companies showed that the anticipated future influences of the compulsory motive are likely to be slightly stronger compared to the present (44%). The financial motive (25%), communal motive (23%), and the pioneering motive (13%) followed it. It is clear that the financial (profit) motive - which is the classical assumption of the market economy - is not an overwhelming one in implementing CP. This diversity of CP motives suggests that CP policies to encourage CP implementation must also be diversified.

ii) There are differences in degrees of influence among the four motives in different countries. This survey has four country-groups according to cases of respondent-companies [3]: Highly developed country group, developing countries and economies in transition, and the group that includes France and Korea. Figure 5-5 shows the results of these evaluations.

iii) It can be inferred from these data that each country has its own CP motivational pattern, and that the higher communal motive and the higher pioneering motive in the private sector will provide more environmentally sustainable conditions for CP implementation in the private sector than higher financial motives or higher compulsory motives will do, if it is assumed that developed countries are at a more advanced level of implementation of CP practices.

iv) It can be suggested normatively, that the communal motive and the pioneering motive for CP should be fostered more than the financial motive and the compulsory motives, because CP activities are designed to enhance the environmental quality of community-based goals. However, Figure 3-7 shows that the anticipated future roles of these two motives are not as influential as it was at the time the study was performed. The role of the communal motive is anticipated to decrease from 23% to 17% in the future. The role of the pioneering motive is expected to increase slightly from 13% to 15%.

v) In contrast, the role of the compulsory motive is expected to be more influential than at present. It is expected to increase from 39% to 44%. Considering the operational meaning of ‘compulsory motive’ in this analysis includes the international factors such as ‘ISO 14001’ and ‘trade condition’, these results indicate that extrinsic motivations are required to promote continuous implementation of CP practices in the private sector.

vi) Finally, approximately 14% of respondents answered that they have been and will continue to implement CP in an environmentally pioneering style. Although the percentage of this motive was relatively lower than other motives, the survey results indicate two meaningful data:

a) Twenty-two percentage of the respondent companies in the developed countries implemented CP driven by the pioneering motive, while eight percentage of the respondent companies in the developing countries did it. These results indirectly support Hypothesis 1 that CP implementation evolves from the compulsory toward the pioneering motive, assuming that developed countries are at a more advanced level of implementation of CP practices.

b) In both developed countries and developed countries, the role of in-house engineers’ creative inputs was slightly increased (from 0% to 3% in the top-priority item).

Therefore, it may be important to encourage the increasing role of the pioneering motive

internally as well as externally in order to achieve the continuous implementation of CP.

5.5 Summary of Chapter 5 - social demands for CP

1. First of all, it was found that corporate implementation of CP is generally motivated by mixed motivators or conjunctively linked factors. In fact, 92% of the respondent companies answered that their CP activities were decisively influenced by both company-related determinants and non-company-related determinants. It was inferred from these responses that functional cooperation between social sub-systems – in this study government, industry, and community for CP - are not a sufficient condition, but a necessary condition for implementing CP. These results strongly support the proposal of the potential usefulness of triangular knowledge links to catalyze and support continuous implementation of CP. [See Hypothesis 3.]

2. The respondents ranked the industry-related motivator group as the first (49%) among the three social subsystems. Government-related motivation group (34%), and community-related motivation group (17%) followed it. Ten companies among 79 companies answered that they had started their CP practices, first of all, to meet governmental regulations. When the top three motivations to influence a firm to implement CP were considered as the practical range of influence, the results revealed that 70% of the respondent-companies were decisively influenced by government-related motivators. Although CP was implemented on a voluntary basis, it was emphasized that government also played a necessary role in creating the CP demand directly and indirectly. [See Hypothesis 4.]

3. Six kinds of analyses of the motivation survey results consistently produced four leading motivators for CP (top-manager's environmental leadership, profit-incentive of CP, governmental regulation, public 'green' image) and seven supplementary motivators (international guideline, engineer's creative inputs, governmental incentive policy, competitor's CP implementation, scientific reports on environment, international convention, international trade order). Leading motivators were defined as those that received more than 10% support from respondents, supplementary motivators was designated as those that received 3-10% support from the respondent companies.

4. If one assumes, that firms have four kinds of CP motives: profit motives, compulsory motives, communal motives, and pioneering motives, the results of the survey reveal that their implementations of CP were driven by: the financial motive - 25%, the compulsory motive - 39%, the communal motive - 23%, and the pioneering motive – 13%.

The survey results also indicate that in the future, 68% of the companies sampled expected to undertake CP activities with a profit motive and a compulsory motive. This is larger than the existing pattern. It can be inferred from these results that more than half of firms have undertaken their CP activities to increase profits or to meet external pressure such as governmental regulations. The pioneering motive or the communal motive may be more encouraged for developing continuous CP innovation in the private sector. [See Hypothesis 1]

5. Overall, the survey helped this researcher to obtain insight into company motivations for implementation of CP and the relative influence of these motivations for their CP activities. It should be recognized that these motivations of social subsystems factors constitute components of CP needs and demands. The aggregation of these kinds of practical CP motivations led to the social demand for CP. The higher the CP demands increase, the more the CP activities will be increased. Therefore, the existence of such demands for CP contextual knowledge is a necessary condition for designing effective CP policies. [See Hypothesis 3 and 5]

NOTES

1. Some motivation items which are related to international organizations – for example, 'internationally standardized environmental guidelines (Ex. ISO 14000 Series,..)' - are considered within 'government-related motivation group', because they not only are extrinsic motivations for the firms, but governments – be they at the local, central, or international level – have a duty to provide and maintain those public institutions and those public works (including cleaner production as a public good), which have a nature that such activities are in the highest degree advantageous to society, even if the direct profit to the company is not sufficient to balance the expense. (Smith, 1776).
2. Although there is no objective criterion to conclude upon their successfulness, this study was based upon information collected from the companies included within the UNEP CP Data Base. Those companies reported that they were satisfied with their results of CP implementation from both their economic and environmental viewpoints.
3. A point pertaining to the validity of the surveys with relatively few sample cases is important to remember. This survey contained 59 usable responses from a sample population of 250. Therefore, it did not produce statistically significant quantitative data. However, this author used the triangulation method to reduce the sampling errors and to increase its reliability of the insights drawn from the data. In this case, comparison between the data of the existing pattern and those of the expected pattern or between the data of the first-order ranking and those of the second-order or the third-order ranking helped to increase this researcher's confidence in the inferences drawn. It can be called *data triangulation*, if three (or more) sources from different times, spaces, methods (survey, interviews, documents), observers, etc. all show similar patterns; then the data can be considered to provide valuable and validated results (Earl Babbie 2001, Robert K. Yin 1993, Robert E. Stake 1995).

   Considering that the respondent companies are world-wide firms which have been implementing CP and that they were questioned about their first three motivations for implementing CP, the results of 59 companies' responses would be strongly indicative of firms' behavior for CP, if the data point in the same direction. In this case, if we apply the 95 per cent level of confidence for categorical variables, the percentage sampling error is less than 9.8 percent (See, Kent, 2001).

4. Four companies, which chose 'green public image' as their first-priority motivation for implementing CP were all producing consumer-oriented products. (cosmetics, home appliances, textiles, and food)

5. For example, an Australian steel company answered that 'demand from a labor union' was the first-priority motivation for their CP implementation, and a Japanese electronics company chose 'scientific report on hazards of certain pollutants which the company discharged' as their first-priority motivator for CP implementation.

6. This grouping was not originally planned. It was made considering the response rate of each group during the process of data gathering. At first, the author considered three country groups of developed, developing countries and for Korea.

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Chapter 6 Suppliers of Cleaner Production – Analyses of Documented CP-cases

6.1 Introduction

This chapter presents analyses of documentary data on CP cases worldwide. The purpose of this chapter is to identify technological patterns of CP activities from a supply side perspective. These data were derived from documents of the UNEP CP Program. The UNEP CP Program compiled data related to case studies, most of which dates from the mid-1980s to mid-1990s. Presently, the UNEP CP Program's database on CP-cases contains 441 cases that have been reviewed for quality and completeness by UNEP. All are now available on the internet. The majority of the case studies are from Europe (51%), with North America (25%), and Asia (14%) following. (UNEP, 2003) Given the variance in economic strength between the identified countries and the industrial sectoral diversity, the sample is largely unbiased. [1]

Results presented in Chapter 5 illustrated the external context as it relates to CP demands, Chapter 6 is designed to identify the internal behavioural patterns of CP implementing companies based upon analysis of successful CP cases. While Chapter 5 presented an example of *contextual knowledge* of CP by analyzing the CP motivation survey' of what motivated company leaders to implement CP in their companies, this chapter presents examples of *technological knowledge* of CP from a supply side perspective. [2]

Within the framework of *Triangular Knowledge Cycle*, these data were reprocessed to focus upon identifying the practical aspects of implementing CP from the perspective of CP supplier. Identification of a broad spectrum of CP practices implemented by the companies provides useful knowledge for designing CP policies from an external perspective, such as that of government. Identifying the behaviour of environmentally friendly firms' CP practices is a necessary process for helping to design effective governmental policies. This is because it provides instrumental knowledge for external organizations, such as government, to understand the technological patterns of CP activities and provides insight into firms' willingness and limitation in implementing CP.

The data from 100 CP cases were analysed in an effort to determine the perspective of the CP supplier and to identify practical patterns of CP implementation. To this end, the data from these case studies were categorized according to the following five points: (i) technological types of CP, (ii) eco-efficiency (iii) initial capital investment (iv) payback period (v) CP supplier.

6.2 Technological types of CP

In Chapter 3 Section 3.1, five technological types of CP were described. These include good housekeeping, on-site recycling, process modification, material substitution, products designed for the Environment, and end-of-pipe facilities as a comparison type.

According to that classification, this section presents the results of the analysis by addressing (i) the types of technological approaches that were implemented by these 100 companies (Table 6-2) (ii) the changes that occurred in CP technological approaches 'before 1989', and during the periods, '1990 – 1993', '1994 - 1997' and '1998 –1999'. [2] (Table 6-3) and (iii) the changes in the average number of technical CP options that were implemented, during the above-mentioned periods. [3] (Table 6-4).

Table 6-2 shows data that the most frequent technological type of CP option was 'process modification' for CP and for CP option implementation under optimal conditions (38%). This was followed by 'On-site recycling' (24%), 'Good housekeeping' (19%), 'Material substitution' (14%), and 'Design of Products for the Environment' (5%).

Table 6-2: Technological CP Patterns of 100 Sample Companies

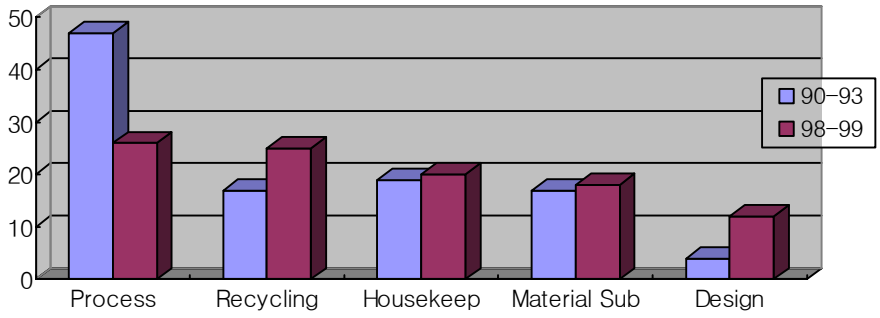
(Total)	Process Modification (PM)	On-site Recycling (RE)	Good Housekeeping (GH)	Material Substitution (MS)	Products Design (PD)
156 (cases)	59	38	30	22	7
100 (%)	38	24	19	14	5

The 'process modification approach to CP' is a typical technological pattern of CP. Approaches such as 'material substitution', and 'Design of products for the Environment' are also considered important CP options.

It can be inferred from the data that considering each technological type of CP is not directly associated with the governmental 'pollution control' system, there are various kinds of CP options within the private sector that ensure both economic gain from an environmental activity and environmental gain from an economic activity.

Meanwhile, such technological patterns of CP can also change according to time and the situation. Figure 6-1 shows how CP technological types have evolved from 1990-1993 to 1998-1999.

Figure 6-1: Change of CP Pattern between 1990-1993 and 1998-1999 (%)



According to Figure 6-1, the main types of CP techniques were the 'process modification approach' and the 'on-site recycling approach'. The data also shows that while the percentage of the process modification approaches is slightly decreasing, the percentage of 'Design of products for the Environment' approach is slightly increasing. The other categories, including on-site recycling, good housekeeping, and material substitution did not show meaningful changes. This indicates that technological patterns of CP in the private sector are developing and becoming more diversified over time.

Considering that the five CP types are technically independent of each other and are different from 'end-of-pipe' technologies, a trend has developed with time where the ratio between approaches is becoming increasingly balanced as firms grow to appreciate each technique's value in promoting CP.

The data in Table 6-3 support the argument that technological patterns of CP are diversifying and increasing, based on the five technological types, these data show the number of CP types that were implemented, on average within each company.

Table 6-3: Average Number of CP Technical Options in Practice per company*

(Numbers in parentheses refer to frequencies of CP- options.)

	1978 - 1989	1990 -1993	1994 - 1997	1998 - 1999
Average CP options Per company	1.2	1.36	2.32	2.47
(base)	(30 CP-options/ 25companies)	(68 CP-options/ 50 companies)	(58 CP-options/ 25 companies)	(136 CP-options/ 55 companies)

*(Data of 1978 – 1997: UNEP document, Data of 1998 –1999: Direct survey)

According to the data in Table 6-3, the number of technological types employed per company has increased over time. Considering that even if the 100 sample companies are environmentally sound companies recommended to UNEP and not normal companies randomly selected, the data still strongly indicates that CP approaches may have their own driving-force for upgrading the level of CP under certain condition. Although the data of Table 6-3 do not illustrate the causes for progressively increasing the number of 'implemented CP options' per company, [5] this positive development associated with the CP behaviour of these companies can be one of the important conditions for realizing a sustainable society.

6.3 Capital investment, pay-back period, and eco-efficiency for the CP options implemented in the companies studied

1. Capital investment

Firms' cleaner production activities require capital investments for whichever technological type they implement. The UNEP Cleaner Production database provides information on capital investments for each case. [6]

In general, capital investment varies according to each company's situation. This thesis author reorganized the data according to the five cleaner production technological types discussed previously. Assuming that a firm tries to invest its capital for CP in a manner that maximizes its benefits and minimizes its costs, average investment and standard deviation by each CP-type (Table 6-4) indicate the capital cost required for a firm to implement a cleaner production option.

Table 6-4: Capital Investment by CP-type

(Unit: 1000USD)

	Good Housekeeping	On-site Recycling	Process Modification	Material Substitution	Design for Environment
Average	29	142	251	609	2639
Standard Deviation	48	158	374	859	3162
Minimum & Maximum	2 - 146	2 - 500	4 - 1680	0 - 3000	156 - 6200

These data on capital investment for CP provide the basis for the following observations.

(i) According to the data, the cheapest technological option for CP, in general, is the 'good housekeeping approaches', while the most expensive technological options are the 'Design of the Products for the Environment' and 'material substitution' approaches. It should be mentioned that the 'Design for the Environment' approaches were apparent in only three cases; therefore there is some question about the validity of the data. On-site recycling and process modifications fell in between the least and the most expensive approaches in terms of capital investment. [7]

(ii) The process of CP implementation requires considerable financial resources regardless of the technological approach. For example, when adopting either good housekeeping or on-site

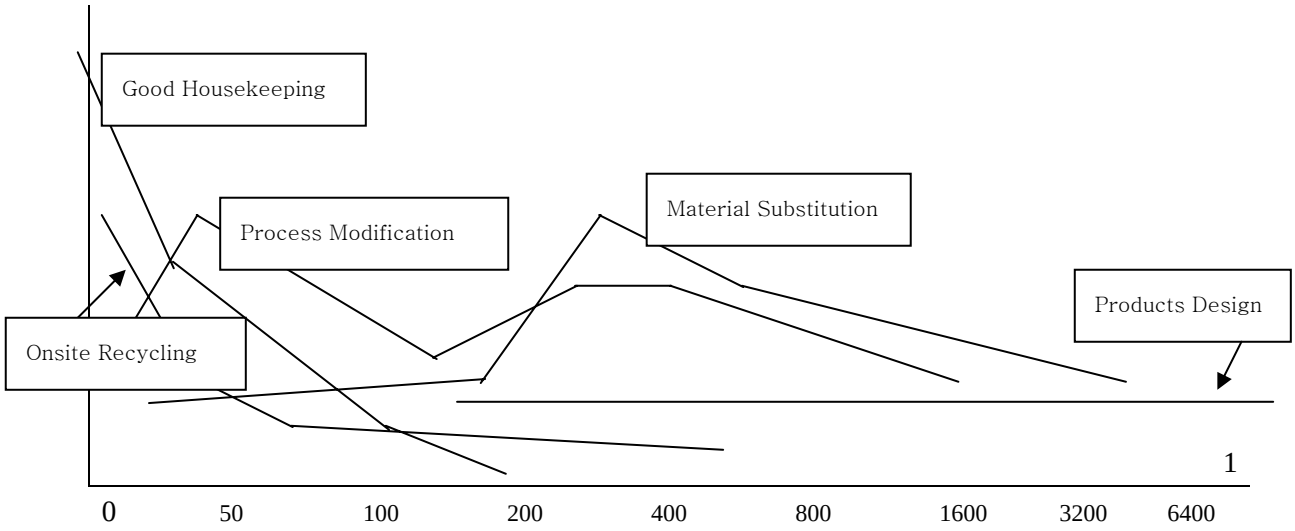
recycling, each needs considerable capital investment in addition to standard maintenance costs. To illustrate this point, one case cited a Dutch semiconductor company that invested USD 450, 000 in adopting good housekeeping practices; while another French aluminium foil company invested USD 640,000 to install its onsite recycling system. This implies that firms go through the internal process of deciding to adopt a CP approach, while facing financial risks when implementing the selected technological approach. In order to minimize the financial risks, this process requires comprehensive and reliable knowledge (Hammitt, 1997). [8]

(iii) Each technological type has a wide range of capital requirement. In this study's data sample, this ranged between USD 2,000 to USD 6,000,000. It can be inferred from these data that within this array of CP options, the company's choice and level of implementation is commensurate with its willingness, financial resources and external motivators.

Figure 6-2 shows the variety of capital requirements according to the five technological types. Based on Figure 6-2, two important observations can be made. First, the degree of willingness and technological knowledge may be of paramount importance in implementing CP given the array of choices. Secondly, these data suggest that there may be a wide range of CP options, which can be implemented according to different developmental stages to the CP implementation. (See Hypothesis 1)

Figure 6-2: Range of Capital investment vs. CP Technological types*

(No. of cases: from 0 to 10)



2. Payback period

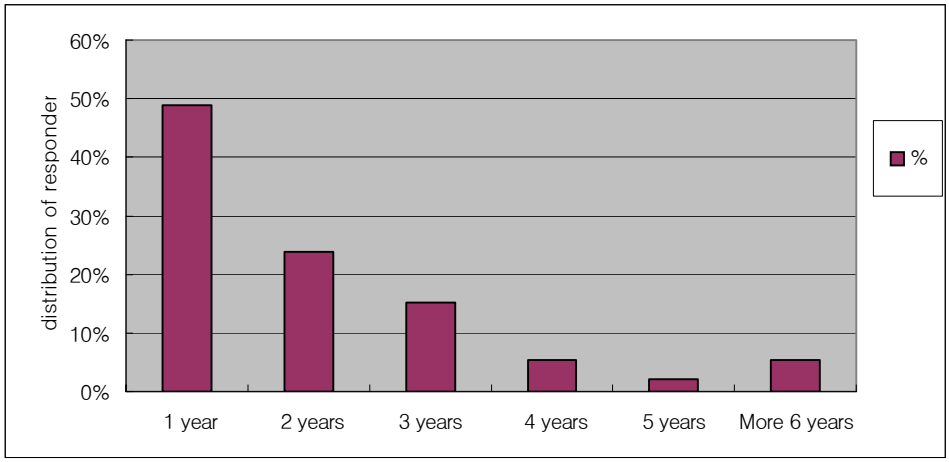
By definition, the payback period of CP options implemented, refers to the time period, usually the number of years, over which the cost of the CP investment is –'paid back' (John Arnold & Stuart Turney, 1996, Accounting for management decision, 3rd edition, Prentice Hall, London). As shown below, the payback period is a formula used to evaluate the profitability of an investment:

P (Payback period) = I (Investment) /R (average annual returns on investment)

Although this method has drawbacks in that it does not account for time value, total return, etc., it can provide a simple picture of whether the investment is worthwhile. Specifically, an environmental investment is more easily justified when it has a relatively short payback period

Of the 100 CP cases, 92 provided data on the payback periods in number of years, which are, presented in Figure 6-3.

Figure 6-3: Payback Periods for the Adoption of CP Practices



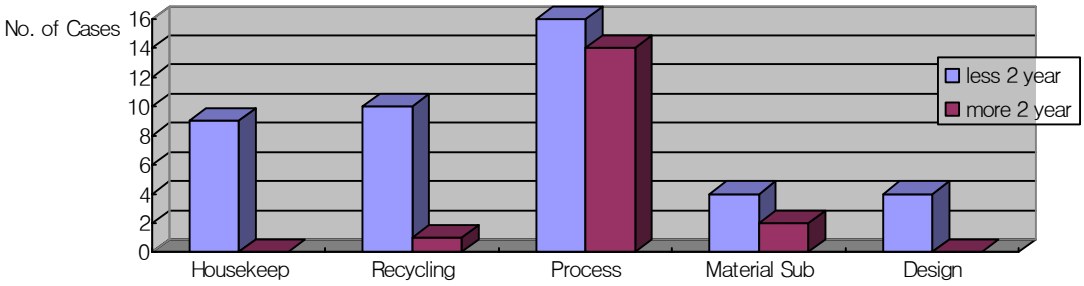
The sample cases results reveal that 63% of CP cases had a pay back on their investments of two years or less. In only a very small percentage of CP cases (5%) did the payback period exceed six years. One company indicated 'long time', which was assumed to suggest beyond six years. These data lead to two different assumptions about CP. First, with 95% of the CP cases recovering their initial investments within five years; most of the CP cases were both environmentally sound and economically beneficial. This scenario is consistent with the 'win-win' strategy of CP advocates'. Second, this five-year payback among 95% of the CP cases indicates that most private firms would not invest in CP if their investments were not returned within five years.

While the data do not prove one assumption over the other, because of governmental policy design for CP, different policy options can be implemented according to the specific situation. For example, assuming most CP practices are environmentally sound and economically beneficial and capital investments are returned within at least five years, government policy should be oriented towards one of dissemination of information about such successes and about how such applications can be made in all companies in all industrial sectors. Conversely, if most firms prefer adopting CP practices which have relatively less financial and environmental risk, governmental policy should be diversified from a simple dissemination policy to one of promoting and developing knowledge, technology and more positive motivational approaches so it is appealing to larger percentage of firm's leadership.

In order to further identify the motivational behaviour of firms in implementing CP options, this thesis author used, reorganized the data as presented in Figure 6-4.

Figure 6-4 indicates that there is a significant difference in payback period between CP technological types. For example, the average payback period for process modification is seven times longer than for good housekeeping changes. Another characteristic of the data is that 82 % of the payback periods that took 'more than three years' occurred within the 'process modification approaches'.

Figure 6-4: Payback Periods by CP Technological Type (among 100 Cases)



As stated in Chapter 3 Section 2 (Economic analysis of CP), longer payback periods and higher capital costs could be the main factors that increase the marginal cost of CP. Therefore, assuming that such CP cases are riskier that those with shorter payback periods and less capital investment, the data from the 100 CP firms shows that 28% have a 'longer payback period' (more than three years), while 72 % have a 'shorter payback period' (less than two years).

Two implications can be inferred from these data. First, while opting for CP options has a financial risk, referring to the longer payback period and higher capital investment, in taking this decision the company is capable of avoiding financial risk associated with the investment. This is evident that among the 28% of companies that faced relatively long-term payback periods, nearly all had chosen to adopt 'process modifications' (14 companies among 17 companies, 83%), or material substitution (2 companies among 17 companies, 12%) in implementing CP. This indicate that by choosing good housekeeping, on-site recycling, or product re-design, a company can lessen or avoid the financial risks associated with an investment in CP.

Second, the data do not support Hypothesis 4 which stated that 'in implementing CP practices that are characteristic of a mixed good, the supplier of CP could follow the four developmental stages of the CP motive: the compulsory motive, the pecuniary motive, the communal motive, and finally the pioneering motive. In other words, although these evolutionary stages of CP motives could be envisaged theoretically; in practice, the private sector's implementation of CP seemed to have been undertaken due to mixed motivations and collaboration with other social actors such as governments. Therefore, the intensity of the motivations and their interrelationships in achieving CP activities could be different according to the context of the situation, which was already identified in Chapter 5 Section 2.

Table 6-5: Simplified Payback-period &Investment of CP-types

Payback period Capital	Shorter	Intermediate	Longer
Less investment	Good Housekeeping		
Medium investment		On-site Recycling	
Higher investment		Material Substitution, Design for the Environment	Process Modification

Here, in order to summarize the policy implications from the data presented on the capital investment (Table 6-5) and payback periods (Figure 6-3), the data have been simplified

according to the six technological types of CP (Table 6-5). The data in this table indicates that in general 'process modification' is riskier financially than 'good housekeeping' or 'on-site recycling', assuming that risk is defined by the length of the payback period and degree of capital investment.

In this context, the following policy implications could be generally inferred from the data for designing an effective policy to encourage continual CP:

(i) In the case of the good housekeeping and onsite recycling, which have a lower risk, government policy should be utilized to disseminate information on the importance and financial value associated with these CP options;

(ii) In the case of 'process modifications' which are relatively more risky due to their higher capital investments and longer payback periods, government needs to develop the policy tools to lessen the risks of adopting such CP options;

(iii) In case of the options such as 'material substitution' and 'Design for the Environment' which require relatively higher capital investments, but which themselves consist of an essential part of the final product, which may be used to make the payback period, shorter, government needs to adjust its policy tools according to the specific company's specific contexts.

3. 'Eco-efficiency'

While capital investments and payback periods are data that indicate economic costs and benefits of CP, the term 'eco-efficiency' indicates the environmental efficiency of a CP practice. It is defined as the ratio of reduced pollutants per environmental target. Among the 100 CP cases, 75 included an eco-efficiency rate. Table 6-6 shows the data.

Table 6-6: Eco-efficiency of CP Practices

(Parenthesis: Number of cases)

Tech-type Percentile (%)	Good Housekeeping	On-site Recycling	Process Modification	Material Substitution	Design for the Environment	Total
90- 100	-	60%	29%	62%	25%	37%
80 – 89	-	20%	11%	-	-	9%
70 - 79	-	13%	6%	-	-	5%
60 - 69	-	-	3%	-	25%	3%
50 - 59	25%	7%	26%	15%	50%	21%
40 - 49	25%	-	14%	8%	-	11%
30 - 39	38%	-	-	15%	-	7%
20 - 29	13%	-	6%	-	-	4%
Less 20	-	-	6%	-	-	3%

Overall, 76% of the CP cases were implemented at an eco-efficiency rate of more 50%. These data show that CP practices generally have a good eco-efficiency rate. The data also shows that eco-efficiency differs according to the technological type of CP that is implemented. For example, the most environmentally efficient type is on-site recycling where 80% those cases had an eco-efficiency rate of more than 80%. The second strongest performing group was the 'material substitution approach' where 62% of those cases registered had a 90% eco-efficiency rate. Both on-site recycling and material substitution approaches are typical CP types that reduce pollutants directly at their source. The process modification approach had an eco-efficiency rate ranging from 9% to 100%, while the 'good housekeeping approaches' had the lowest eco-efficiency rate among the five methods.

4. Summary of three indicators
Thus, based on the UNEP data of Cleaner Production cases, three indicators of CP (capital investments, payback periods, and eco-efficiency) were analysed from the supply side perspective of CP. Each of the five CP methods has its own capital investment, payback period, and eco-efficiency, ranges. From the data, it was clean that each technological type of CP has slightly different patterns of the three CP indicators.

It can be argued that with a lower capital investment, shorter payback period and higher eco-efficiency rates, a firm will face fewer risks in implementing CP. In this context, considering the combined affects of these three indicators, general characteristics associated with each CP technological type can be made about the behaviour of the implementing firm. Table 6-7 presents a simplified comparison among three indicators.

Table 6-7: Supply-side Indicators of CP by Technological CP-types

	Capital Investment	Payback Period	Eco-efficiency
Good Housekeeping (GH)	Lowest	Shortest	Lowest
Onsite Recycling (RE)	Intermediate	Relatively shorter	Highest
Process Modification (PM)	Wide range	Longest	Wide range
Material Substitution (MS)	Higher	Intermediate	Higher
Design for the Environment (PD)	Higher	Intermediate	Intermediate

6.4 Four CP supply systems

As stated in Chapter 1, the final CP supplier/user must be a firm. However, there have been various kinds of internal or external CP supply systems which facilitate or encourage firms to implement CP practices. The UNEP Cleaner Production data base contains information related to the background of each CP case. These background data recorded not only which organizations had initiated CP practices, but also what motive had prompted them to do so. Although the data of the UNEP documents were compiled based on each company's voluntary report, they do provide meaningful information on the categories of firms within the CP supply system (subsequently referred to as 'CP supplier').

This thesis author organized these into four categories or types, which include '*internal compliance CP-supplier'*, '*internal non-compliance CP-supplier'*, '*governmental CP-supplier'*, and '*international CP-supplier'*.

1. Four types of CP supply system (CP-supplier or CP-program)
First, the 'internal compliance CP-supplier' category refers to a firm's internal CP program which it has designed to fulfil environmental regulations by implementing CP. In order to comply with governmental regulations, the firm choose to adopt CP, because the approach is more efficient in the given context than pollution control. An example of this is that of a metal company that changed its raw materials from cadmium to aluminium in order to avoid violating stringent cadmium regulations. Such a supply system focus on reducing a regulatory pollutant at the source was designed to comply with the regulations, but may not lead the company to continue on the CP journey. From the perspective of the intrinsic motive suggested in Chapter 5 this is considered to be a company responding to the compulsory motive.

The second category, 'internal non-compliance CP-supplier' refers to a firm's internal CP production program which is designed to implement CP based on a non-compliance motive. As

stated in Chapter 2 Section 2, this motive may be related to monetary profit (financial motive), improvement of the community environment (communal motive) or upgrading the company's sustainability (pioneering motive).

An example in the sample cases is the auto manufacturer, which initiated a recycling program for its shredder waste in order to reduce the amount of shredder waste and thereby to lower its disposal costs. In general, this type of CP supply system might be the most desirable type, because the private sector voluntarily develops CP technologies and products.

The third category, 'governmental CP-supplier' refers to a government- or public organization-driven CP supply system. Such a system would encourage the private sector to either adopt CP or promote a voluntary environmental program within the private sector. In many such cases, a company does not benefit financially from implementing CP practices. Furthermore, most companies are unwilling to initiate CP activities which may be environmentally friendly, but are financially risky in the criteria of business management. Therefore, governments or public organizations of many countries are providing diverse programs to encourage CP.

In light of the 'mixed good' nature associated with implementation of some CP practices along with the wide variety of environmental situations that firms face, government-driven programs focusing on CP are required not only to fill the sustainability gap that the private sector cannot address, but also to develop methodologies for CP to be implemented more efficiently. One of the essential research goals of this thesis is to review ongoing governmental CP supply programs and to suggest a more effective CP supply system.

The fourth category, 'international CP-supplier' refers to the role of international organizations in either leading or being involved with the CP supply system. This category aims to encourage the private sector to adopt CP and work towards sustainable development at the global level. In practice, many CP activities have been initiated by international organization or with their cooperation such as UNEP, the World Bank. Considering the pivotal importance of the global ecosystem and international agreements such as Agenda 21, that are designed to protect it, the role of international organizations should be expanded. Furthermore, the environmentally friendly management of the production sector on the global scale must be one of the key determinants of sustainable development.

The existence of these four categories of CP-suppliers can be considered to be one of the most important facets for promoting of widespread CP implementation. Such CP-suppliers serve not only to implement CP, but also to 'incubate' various '*embryonic CP options*' to evolve into new CP practices. Without such CP-suppliers, CP would not be developed in a more practical manner and to a higher-stage, as if without oil refinery companies, a community could not actually obtain its needed petroleum supplies even if it has a huge oil reserve**.**

2. Empirical data on the four CP-suppliers

CP requires not only considerable capital investment, but also technological engineering and related environmental knowledge. The decision to implement CP can present significant environmental and economic risks.

Therefore, it can be assumed that the continual maintenance and development of these four types of CP-suppliers could be a necessary condition for continuous development of CP in sustainable societies. This interdependence suggests that if all four CP-suppliers function well in a given society, CP will also develop well. By the same argument, CP cannot develop well when all four CP-suppliers are not working together.

In this context, the UNEP data on these four CP-suppliers and the company cases provide valuable information to help recognize the practical state of CP supply. These data furthermore give strong indications as to the appropriate governmental policy for the continuous development of CP.

Table 6-8 shows the four categories of CP-suppliers along with data as they relate to companies' capital investment, payback period, and eco-efficiency regarding their respective CP approach. In this grouping, internal compliance CP-supplier and internal non-compliance CP-supplier refers to the supply of CP that is private sector-driven, while governmental CP-supplier and international CP-supplier refer to the supply of CP that is public sector-driven.

3. Interpretation of the empirical data on the four CP-suppliers

Different from the previous section's analysis on the motivational structure of CP, these UNEP data presented in Table 6-8 shows the degree to which the four CP-suppliers actually *initiated* a company's CP practices. It furthermore, illustrates what differences exist between private CP-suppliers and the public CP-suppliers. Though far from conclusive, the data are suggestive of the behavioural patterns of the four CP suppliers. In Section 3.2, the framework of the proposed *triangular knowledge links* to CP, suggested that the motivational factors for CP within a community form the basis of the contextual knowledge on CP. Additionally, the behavioural patterns of CP suppliers also provided technological knowledge to CP.

(i) P*rivate CP-suppliers supply CP practices more than the public CP-suppliers*: The data show that CP practices were initiated and supplied both by the private sector and the public sectors. According to Table 6-8 63% of these sample cases were initiated and supplied by the private CP-suppliers, while 38% of the sample cases were initiated by the public CP-suppliers such as governmental programs or international partnership programs. Indirectly, this fact supports an assumption that CP activity is not a pure economic activity, but rather a dualistic activity, which is a mixture of economic activity and ecological activity.

(ii) *The most general technological prototype of CP is the 'process modification approach'*: Table 6-10 shows that the practical and operational compositions of 'CP practices which each CP-supplier provides are highly similar. In other words, each CP-supplier preferred to provide 'process modifications', which represented 60%, 53%, 52%, and 60% respectively. The CP choices of the 'material substitution' and 'on-site recycling' represented (approximately 15%), while the 'good housekeeping approach' and 'design for the environment approach' represented the least. However, 'good housekeeping' practices' were relatively more prevalent among internal non-compliance CP-suppliers (13%), as was 'the design-for-the-environment approach' among governmental CP-suppliers (17%).

(iii) *The supply of 'Internal Compliance CP-practices' decreased over time*. This observation is, based upon the: decrease of the CP supplier's inputs from the 1980s through the 1990s which revealed that the percentage of 'internal compliance CP-supplier' decreased from 46% (before 1989) to 28% ('94 – '97) and then to 10% ('94 – '97).

Conversely, the percentages of the other three 'CP-suppliers' gradually increased: 'Internal non-compliance CP-supplier' increased from 32% (before 1989) to 33% ('90 – '93) to 40% ('94 – '97), 'Governmental CP-supplier' increased from 14% (before 89) to 28% ('90 –'93), and 22% ('94 – '97), and 'International CP-suppliers' increased from 9% (before 89) to 11% ('90 – '93) and 30% ('94 –'97).

Table 6-8: Four CP-suppliers reorganized from UNEP CP data

(%, Number in Parenthesis: CP Cases)

	Private Sector		Public Sector		
	Internal Compliance CP-supplier	Internal Non-compliance CP-supplier	Governmental CP-supplier	International CP-supplier	Total
<Chronology>					
Before 1989	46	32	14	9	100%
'90 – '93	28	33	28	11	100%
'94 – '97	10	40	20	30	100%
Sub-total(N)	28 (25)	34 (30)	23 (20)	15 (13)	100%(88)
<Technology>					
GH	4	12	4	0	6
RE	17	12	13	27	16
PM	63	52	52	60	56
MS	20	19	13	13	17
DE	0	3	17	0	5
Sub-total (N)	100% (25)	100% (32)	100% (23)	100% (15)	100%(95)
<Capital-investment>					
Less 500 T. USD	77	97	85	82	87
More 501 T. USD	23	3	15	18	13
Sub-total	100% (17)	100% (34)	100% (20)	100% (17)	100%(88)
<Payback period>					
Less 2 years (24 M)	23	83	80	73	69
More 2 years (25M)	77	17	20	27	31
Sub-total	100% (17)	100% (35)	100% (20)	100% (15)	100%(87)
<Eco-efficiency>					
Less 50%	42	33	50	50	42
More 51%	58	67	50	50	58
Sub-total	100% (19)	100% (30)	100% (16)	100% (14)	100%(79)

(iv) *CP implementation may pass through four developmental stages within companies: the compulsory motive, the pecuniary and communal motive, and the pioneering motive* [see Hypothesis 1]: In terms of capital investment and payback period, the data show significant differences between the 'internal compliance CP-supplier' and 'internal non-compliance CP-supplier' in terms of capital investment and pay-back period. Only 3% of 'internal non-compliance CP cases' (1 among 34 cases) invested more than 500,000 USD in capital investment for CP. Comparatively, 23% of 'internal compliance CP cases' (4 among 17cases) invested more than 500,000 USD in capital investment for CP. The number is bigger than that of governmental CP-cases or international CP cases. Instead, in case of payback period, 83% of 'internal non-compliance CP cases' (29 among 35cases) had a payback period less than 2 years. Comparatively, 23% of 'the internal compliance CP cases' (4 among 17cases) had payback periods **within 2 years**.

These results indicate that the majority of companies which implemented CP with a long-term

plan and considerable investment without external support were focusing upon compliance with governmental regulations, by using preventive CP approaches. Consequently, it can be inferred from these results that if a company reaches a sufficiently stable level of regulatory compliance, the company may be unwilling to implement additional CP approaches by themselves. In this sense, the non-existence of appropriate regulatory pressures on firms may be one of practical barriers against further development of CP in the supply side.

[Empirical data to support Hypothesis 2]
These data show clear differences between 'CP cases for compliance' and 'CP cases for non-compliance' in all three indicators (capital investment, payback period, and eco-efficiency). In case of the mean capital investment, the Compliance CP-cases invested capital an average of 526% more than was invested in the Non-compliance CP-cases.

The mean payback period of the Compliance CP-cases (35 months) is much longer than that of the Non-compliance CP-cases (16 months). The mean eco-efficiency of the Compliance CP-cases (63%) is slightly less than that of the Non-compliance CP-cases (70%). It could be inferred from these three indicators that the CP firms on average are generally spending their money and time on 'CP cases for regulatory compliance' to a significantly greater degree than 'CP cases for non-regulatory compliance'.

Therefore, *in relation to Hypothesis 2*, it can be reasoned that 'CP cases for compliance' (compulsory motive) have a smaller '*sustainability gap'* than 'CP cases for non-compliance' (non-compulsory motive) have. In other words, 'the willingness to pay' for CP of the latter was smaller than that of the former, even though the two had the same social demand for CP.

[Suggested revised Hypothesis 1]
It would be more practical to slightly change the third hypothesis on the developmental stages of CP implementation, because few data presented in Table 6-8 support the hypothesis that the compulsory motive may be an important independent factor in implementing CP practices, especially in the initial stage, while the 'financial motive' is not the most influential factor in many CP cases. This was also indicated in Chapter 5 (the top-manager's CP decision). However, from the motivation data of Chapter 5, it can be deduced that the profit factor in CP might be embedded in every evolutionary stage of CP. The profit factor therefore, plays a ubiquitous catalytic role in upgrading the existing level of CP; this is complimentary, to the role the financial motive plays in triggering the initial CP implementation process within the company.

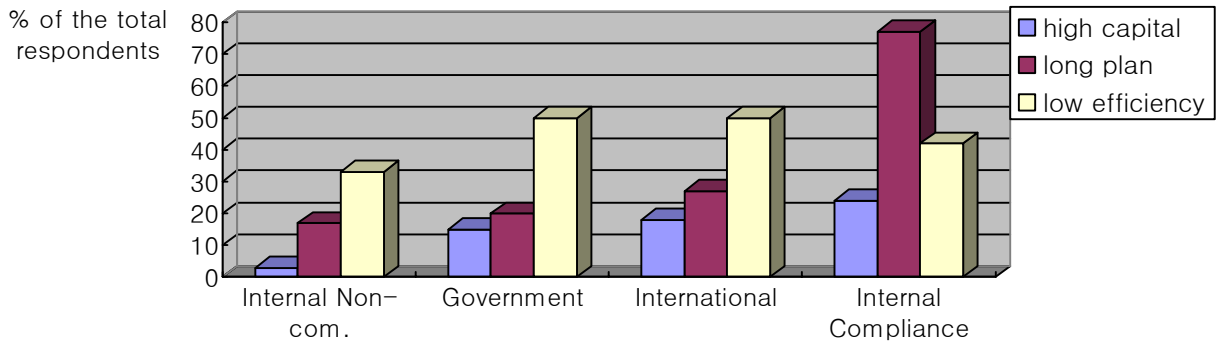
In implementing a CP practice, the company's attitudes may pass through three developmental stages: (1) *the compulsory motive and/or the financial motive* (2) *the communal motive*, and finally (3) *the pioneering motive*. [See Hypothesis 1]

(v) *The firm's close association with external organizations such as governments in initiating CP, may lead the firms to be more positively to risk-taking in implementing it*: The next concern is to recognize the differences between 'Internal (Private) Non-compliance CP-suppliers' and 'governmental (public) CP-suppliers' especially in undertaking more risky CP options.

Figure 6-5 indicates four CP-suppliers' data on these three kinds of simplified risk indicators (Data: Selected from Table 6-8).

First of all, it should be noted that 'Non-compliance CP-suppliers' are characterized by the highest degree of voluntarism among the four CP-suppliers, while the other three CP-suppliers are closely associated with the external public sectors.

Figure 6-5: Comparison between Four CP-suppliers in Environmental Risk-taking (%)



Endogenous Initiative	External Motivation for Cleaner Production

In light of the general assertion that CP implementation within the private sector originated from overcoming the environmental inefficiency of 'end-of-pipe' approaches mainly developed to meet governmental regulations, this 'Internal Non-compliance CP-supplier' is likely to be the most central part of CP. One of the research questions of this thesis is to identify whether or not it is possible that those voluntary CP practices would develop without external pressure or incentive. [9]

The data presented in Table 6-8 and Figure 6-5 support those presuppositions on the complicated dualism of CP as illustrated in the following:

(a) Although the internal CP-suppliers (Compliance + Non-compliance CP-supplier) supplied 60% of the total CP examples, the percentile of CP cases closely associated with external motivators (Compliance + Government + International Organization) is also 60%. It can therefore, be inferred that CP cases would be significantly reduced if there is no external regulatory pressure or incentive for encouraging CP.

(b) Although the internal CP-suppliers represented 40% of the total CP samples, only 3% among them invested 'more than 500,000 USD' in capital investment, and 17% among them had more than a two year-payback period; while 33% of them had less than a 50% efficiency rate. 'Internal Non-compliance CP-suppliers' are the lowest in all three indicators. This means that the 'Internal Non-compliance CP-suppliers' are the lowest environmental risk-takers among the four types of CP-suppliers.

(c) Even if there are differences among them, the rankings of the four CP-suppliers according to three risk-taking indicators are consistently the same. Consequently, it can be inferred from these data that 'internal non-compliance CP-supplier' which can be considered the most desirable CP type mainly due to its voluntary nature, do have serious limitations in supplying more risky CP practices.

(d) As a corollary, it can be envisaged that if CP is developed continuously, it would be necessary to enhance continually the capacity building of internal CP-suppliers, or to develop external pressures or related incentives, continually. This means that even if there are various kinds of good 'embryonic CP options', which are environmentally

friendly and economically beneficial for transitioning to a sustainable society but require long-term implementation plans and expensive capital investments; a company will not voluntarily implement such a risky CP option. Consequently, this thesis author believes that additional motivations need to be provided by the public sector to upgrade the level of CP implementation within the private sector.

NOTES

1. While this analysis provides meaningful suggestions on firms' behaviour with respect to CP, conclusive knowledge is slightly weakened due to the limited sample-size. Table 6-1 shows the composition of the 100 sample companies' by country and industrial sector. See www.UNEP.fr for more detailed information.

Table 6-1: Composition of the 100 Company Samples, Examples Country and Industrial Sector.

<Country> (Number: Frequency of company)

USA	China	Austria	UK	Netherlands	Sweden	Canada	France	New Zealand	Poland
16	10	8	7	6	6	5	4	4	4
Italy	Germany	Indonesia	Mexico	Philippine	Australia	India	Tanzania	Tunisia	Chile
3	2	2	2	2	2	2	2	2	2
Singapore	Greece	Thailand	Denmark	Malaysia	Hungary	Zimbabwe	Portugal	Egypt	*Total*
1	1	1	1	1	1	1	1	1	*100*

<Industry> (Number: Frequency of company)

Metal	Chemistry	Service	Electronics	Textile	Food	Automobile	Steel
15	15	12	11	11	11	5	5
Furniture	Paper	Leather	Non-metal	Sement1	Rubber	Agriculture	*Total*
4	4	2	2	1	1	1	*100*

2. 'Technological knowledge' includes both engineering knowledge and economic knowledge for providing practical CP from a supply side perspective. This technological knowledge contrasts with 'contextual knowledge' for demanding CP from a community perspective. Chapter 5 mainly addressed contextual knowledge for CP, while Chapter 6 mainly addressed technological knowledge for CP. Further, Chapter 7 addresses 'reconciliatory knowledge for CP from a governmental perspective.

3. Data for 1998 were not taken from the UNEP document, but rather from a previous survey of 59 companies, worldwide.
4. Again data for 1998 were taken from the previous survey.
5. In the previous section 5.2. (patterns of CP motivation), it was established that CP activities were driven by multi-faceted motivational inter-linkage between internal factors and external factors that are government and community supported.

6. These data are based on each company's voluntary report.
7. These data on capital investments from UNEP were focused on the costs.
8. It must be properly evaluated with regard to the financial, human health and safety, environmental and other benefits. Further, the costs and benefits of CP options must be compared with the costs of not doing anything as well as the costs and benefits of 'end-of-pipe,'

approaches. Otherwise the costs of CP options are not evaluated fairly in comparison with other options.

9. In Chapter 1, the CP was defined as a dualistic activity mixed economic activity with ecological activity. It was because not only that a CP activity has the characteristics of a public good which is not generally traded in the market (non-marketability), but also that the CP is intrinsically associated with industrial production activity which is traded in the market (marketability). Therefore, these dualistic characteristics of non-marketability and marketability which CP has presuppose theoretically that CP could develop well under the certain context, and that CP could not be developed continuously without being provided with continuous external stimuli.

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Chapter 7 Development of an Evolutionary Sustainability Policy Model for CP

Chapter 7 contains an outline of an evolutionary sustainability policy model for fostering continuous implementation of CP. The model was developed by integrating the motivation survey results and the behavioral patterns of firms (Chapter 5 & 6) into the theoretical framework of this thesis.

Meanwhile, based upon the major findings from the two empirical studies, this researcher suggests five guiding principles for a sustainable society to enable the continuous implementation of CP. The five guiding principles are integrated into the evolutionary sustainability policy model for CP.

7.1 Major findings of the two empirical studies

1. Multiple motivators and their linkages in implementing CP practices
The results of the survey of 250 environmentally sound companies worldwide (response rate: 24%), where 15 motivation-items and one open-item were given to the respondents, produced three meaningful findings as follows [1]:

(I) There are at least four leading motivators with more than 10% practical influence on CP practitioners' activities, and seven supplementary motivators with more than 3% practical influence on the practitioners' activities.
Those are:

i) The four leading motivators: (1) top-manager's environmental leadership, (2) profit incentives, (3) governmental regulations, and (4) good public image;
ii) The seven supplementary motivators: (5) internationally standardized guidelines, (6) corporate in-house engineer's creative input, (6) government's economic incentive (7) CP cases from other companies (8) scientific reports on certain pollutants discharged (9) international environmental conventions (10) compliance with international trade orders.

As shown by these survey results, there is no one or two dominant factors that influence the demand for CP.

(II) The second significant finding is that the majority of CP practitioners have their own specific motivational structure which consists of several motivational items. For example, A company's CP implementation was largely motivated by Motivator (1^{st}) + Motivator (6^{th}) + Motivator (7^{th}), while B company's CP implementation was largely motivated by Motivator (3^{rd}) + Motivator (5^{th}) + Motivator (10^{th}). The motivational structure of B company was completely different from A's.

This diversity of motivational structure for fostering CP implementation suggests that a governmental policy for encouraging CP would be more effective if it reflects the diversity of motivational structures of the firms. For example, as illustrated by Company A, its most important motivator was their top-manager's change of mind; in this type of situation, CP educational programs for top-managers would be most effective. In contrast, in the case of Company B, where the most important motivator for their CP was to avoid violation of the governmental regulations, CP programs associated with regulatory compliance would be more effective. In other words, in encouraging CP which is based on the firms' voluntary participation, governmental policies must be different according to the firms' motivational structure, which means the policies should be adaptive rather than rigidly compulsory towards the firms.

(III) Another finding is that most of the motivational structure is a mix of company-related motivation items, government-related items, and community-related items. When asked of the three most important motivations for CP implementation, the percentage of the respondents which had all three company-related motivation items was only 9%. Sixty-five per cent of the respondents answered that government-related factors influenced their CP implementation as one of the three most important motivators; 37% of the respondents answered that governmental factors were their highest priority motivator. Therefore, it is evident that the responsibility for continual implementation of CP is not only within industry but also in government and the community.

2. Empirical identification of technological patterns of implementation of CP

The identification of the technological aspects related to the 100 CP cases' produced the following findings:

(I) Change of technological patterns of CP: The most frequently utilized technological change for CP was the 'process modification approach' (38%), the next was 'on-site recycling approach' (24%). The 'Design for the Environment' approach was the least, but its frequency was increasing. Another interesting finding was that the number of 'CP options per company' slightly increased over time.

(II) Each technological type of CP such as 'process modification approach' or 'new material substitution approach' has its own characteristics different from other technological type. For example, in general, the 'good housekeeping approaches' require relatively low capital investment, but the eco-efficiency rate is low, while the 'new material substitution approach' requires relatively large capital investments, but its eco-efficiency rate is relatively high.

A '*sustainability gap'*, may be present on the demander side, when a new, environmentally sound product does not achieve an appropriate market share or does not cover the additional cost in the market. In other words, it is clear that 'environmentally sound products' are not always the same as 'functionally and economically sound products'. In this case, governmental policies for promoting CP should be associated with other related environmental policies in order to enhance their effectiveness. [See Hypothesis 2]

3. Four types of CP-suppliers

Analysis of UNEP's CP cases revealed that there are four types of CP suppliers or supply systems: internal compliance CP-suppliers, internal non-compliance CP-suppliers, governmental CP-suppliers, and international CP-suppliers. The differences among these CP-suppliers in terms of 'Capital Investment', 'Payback period', and 'Eco-efficiency' provided knowledge on the practical CP-supply patterns were clarified in the study.

Among 94 sample CP cases, 39% of them were driven by 'Internal non-compliance suppliers', 21% by 'Governmental suppliers', 21% by 'Internal compliance suppliers', and 18% by 'International suppliers' respectively. From the perspective of voluntarism which is an essential factor in the continual implementation of CP, 'Internal non-compliance CP-suppliers' should be promoted first of all.

The data from 100 CP cases, however, showed clear differences between 'CP cases for compliance' and 'CP cases for non-compliance' in all three indicators (capital investment, payback period, and eco-efficiency). Especially, in case of the mean capital investment, the Compliance CP-cases invested as average of 526% more than the Non-compliance CP-cases.

'CP cases for compliance' (compulsory motive) have a smaller '*sustainability gap'* than 'CP cases for non-compliance' (non-compulsory motive) have.
This result suggests that governmental policies are required to reduce the sustainability gap which the non-compliance CP-supplier has, if *the sustainability gap* poses a serious barrier to achieving sustainable society. [See Hypothesis 2]

7. 2 Suggestions of five guiding principles for the CP policy in a sustainable society and the proposal of an appropriate evolutionary CP policy model

In Chapter 5, a theoretical basis was proposed for helping to ensure continual implementation of CP based upon working with the 'triangular knowledge links' to CP, which exist among demanders, suppliers, and governments. From these empirical data on CP motivators and suppliers (Chapters 5 & 6), five guiding principles for a sustainable CP policy were developed for fostering continual CP improvement within a sustainable society. These guiding principles can help governments to generate appropriate reconciliatory knowledge (that is, CP policies) for the continuous implementation of CP in a sustainable society. These guiding principles were tested in the Korean CP program and are presented in Part IV.

1. The Aspiration Principle: Maintaining a balanced motivational structure for CP between social actors

The first finding from the previous chapters was that a balanced motivational structure for CP could be considered more developed than an unbalanced motivational structure. Suppose that there are four psycho-social motivational types for CP, the financial, compulsory, communal, and pioneering motive. According to the motivation survey (see Chapter 5), the motivational structure of CP cases in developed countries has a balanced motivational structure (financial: 27%, compulsory: 24%, communal: 27%, pioneering: 22%). While the CP cases in developing and transitional countries have an unbalanced motivational structure, focusing more on the financial motives and compulsory motives (financial: 32%, compulsory: 43%, communal: 16%, pioneering: 8%).

These survey results indicated that a larger number of CP cases in the developing and transitional countries were implemented to meet regulatory requirements or to gain profits. These were usually achieved in the initial phases of implementation of CP. In comparison to CP cases of the developed countries, the data shows that more than half of the CP-companies in the developing and transitional countries developed CP practices associated with communal and pioneering motives.

A balanced or pioneering motivation structure is highly complementary to the evolutionary process of CP implementation. A sustainable society that is moving towards advanced CP requires not only continual internal efforts but also social aspirations for upgrading the existing structure to a more advanced one. It should be noted that almost half of sample CP cases in the developed countries were decisively influenced by the communal or pioneering motives. Therefore, it may be concluded that unless external motivations are continually and persuasively provided to the private sector, continual improvement of CP will be significantly restricted.

In this context, it is essential that governments or other actors develop and provide 'the contextual knowledge for supplying CP needs'. For example, if both the manufacture and the consumer are provided with sufficient information on the cause and environmental impacts of global warming or uncontrolled combustion of hazardous wastes, such contextual knowledge can increase the social benefit of reducing carbon dioxide and hazardous chemicals by leading

to increasing social demands for CP in the areas of energy conservation and waste minimization.

2. The Adaptation Principle: Adjusting governmental policy to the different evolutionary stages of companies in their journey of implementation of CP

Empirical data from successful CP cases showed that the general behavioral pattern of CP practices, in the private sector, develop in an evolutionary manner beginning with the compulsory motive stage or the financial motive stage, followed by the communal motive stage, and last by the pioneering motive stage. While many theorists have suggested similar developmental steps in environmental management (Raju 1992, Bill 1996, Billatos 1996, Philip 1996, Park 1998, Jennifer 2002), the data presented in Chapters 5 & 6 further showed that:

• The motivation for 50% of the CP cases in developing countries was in order to meet environmental regulations, while in developed countries this was approximately 25%;

• The UNEP CP cases show that the percentage of 'CP cases for compliance' decreased over time (46% to 10%), while the percentage of 'CP cases for non-compliance' increased over time (55% to 90%);

• The majority of the CP cases for non-compliance purposes prefer less risky options, which include lower capital investments, shorter payback periods, and higher efficiency rates. For example, 97% of the 'CP cases for non-compliance purposes' invested less than $500,000 in capital investment for CP, while 77% of 'CP cases for compliance purpose' invested less than $500,000 in capital investment;

• The pioneering CP options, are different from the compulsory or profit motive, because they generally have a lower threshold for 'CP implementation' (which could be defined as an acceptable level of CP options in a firm's management setting.). This suggests that a firm with the pioneering motive is more willing to adopt CP although it entails a longer implementation time and higher levels of capital investment. The results of fifty-nine companies' CP Motivation Survey showed that 13% of the respondents started their CP options with the pioneering motives;

• It can be inferred that the pioneering motive is the final and ideal stage for continual CP implementation. This is an improvement beyond the financial, compulsory and communal motives. It should be noted, however, that this does not imply that, in practice, all companies will pass through these four stages step by step, but rather it is the ideal situation for the development of CP.

If CP develops in such an evolutionary way, governmental policies that are designed to encourage CP should specifically target these developmental stages. In other words, a CP policy must be tuned, adjusted and tailored to the appropriate stage of CP implementation. As a corollary, if government pursues the continual improvement of CP in the private sector, the government must design and implement an upgraded policy that is adaptive to the next stage of CP motivation. It is important to note here that the upgraded stage does not exclude emphasis upon the preceding one, as explained in Chapter 5 (Figure 5-4).

3. The Knowledge Principle: Invigorating CP markets based upon the 'Triangular Knowledge Cycle' for continuous implementation of CP

This thesis researcher has argued that CP activities occur within the framework of the market of

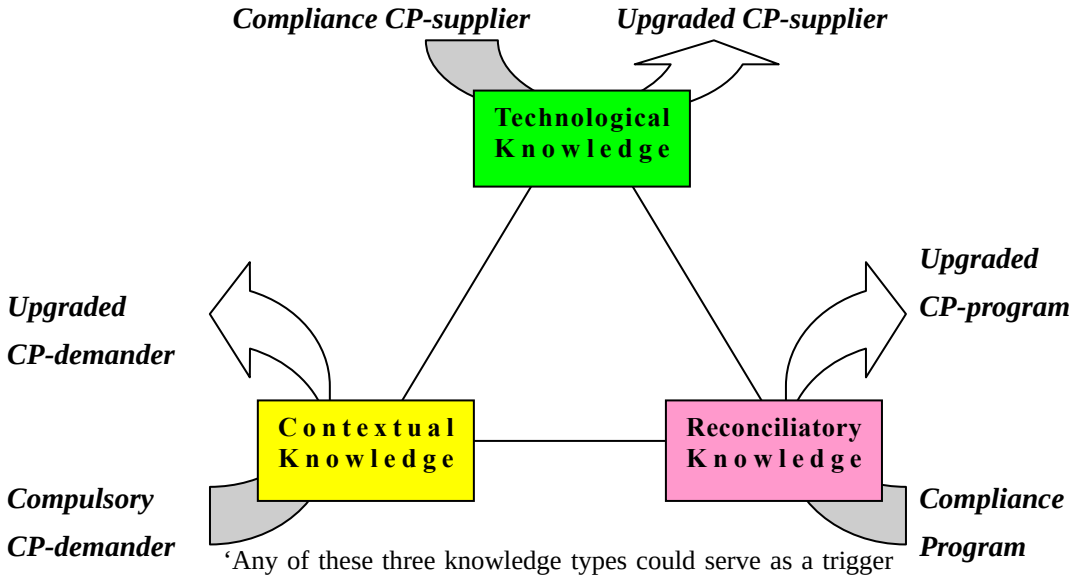
the mixed goods, where the quantities of public goods are determined at the intersection of the social demand and the social supply (See Chapter 3). [2] Given that neither the marginal social costs nor the marginal social benefits of a CP option can be statistically easily identified in the real world, this thesis researcher suggested in (Chapter 4, Figure 4-3) that contextual knowledge should be the indicator to recognize the demand side for CP, and technological knowledge can reflect the position of the supply side, while reconciliatory knowledge plays the role of '*practical negotiator'* between the contextual demand and the technical supply of CP.

The first condition required for the 'triangular knowledge links' to work is that each societal actor makes an effort to generate its respective knowledge type. For example, a scientific report in the global community that the sea level of North Atlantic Ocean has become higher due to the increased carbon dioxide in the air serves as an external motivator for corporate leaders of power plants to adopt CP options for energy conservation.

It should be noted that the environmental impact of an economic activity can usually be identified by social actors such as scientists or public researchers, other than the producers themselves. The economic activity is usually traded simultaneously between the buyer and seller in the market, while the life cycle of an environmental activity – from the emission of a pollutant to its protection – is usually carried out by many actors over a long period.

The suggested model of a triangular knowledge link for CP was designed to represent the simplified social system for CP, where different kinds of knowledge systems (e.g. contextual, technological, and reconciliatory knowledge) which are produced by each social actor, are the means of communication among actors for improving the system of sustainable production. In order to function in an environmentally friendly manner, a sustainable society must have and use a shared knowledge system. Figure 7-1 illustrates the relationship among the three types of knowledge for developing CP.

Figure 7-1: Process of CP Evolution by Triangular Knowledge Cycle



'Any of these three knowledge types could serve as a trigger to adopt and implement CP. The other two knowledge types provide additional momentum for continual implementation of CP.'

As stated in Chapter 2, the contextual knowledge enables social actors to recognize why they have to undertake new environmental actions. The technological knowledge may guide them on how to proceed. The reconciliatory knowledge suggests the ways or advantages of cooperation between demand and supply in improving environmental sustainability of the society.

Therefore, it can be inferred that the second condition for the 'triangular knowledge cycle' to work is that the three knowledge types must be inter-linked to ensure mutual communication and working together to foster or upgrade the existing level of CP implementation to higher level of CP implementation. Each social sub-system must have a willingness to renovate or to integrate its conventional functions in an environmentally friendly way, to enable them to communicate and negotiate among other social subsystems to create a sustainable CP environment.

In this context, the three types of knowledge have no difference in triggering CP, and each could provide impetus for adopting CP. Any of these three knowledge types could serve as a trigger for implementing or upgrading CP. Then, the other two knowledge types could provide additional impetus or practical resources for completing implementation of CP. This must be a core driving-force for an evolutionary CP implementation. This interactive mechanism will differ among communities. In general, the adoption of CP in developing countries is triggered by the intervention of governments, while in developed countries a company's entrepreneurship plays a more significant role. In some countries, civic groups may provide the main impetus for initiating CP improvement.

The results of the motivation survey of 59 environmentally friendly companies (Chapter 5) indicated that in 49% of them, CP adoption was triggered by company-related factors such as profit. In 34% of them, CP adoption was triggered by government-related factors such as compliance with regulations. Finally, in 17% of them, CP adoption was triggered by community-related factors such as improving their social image. A highly significant finding was that 92% of the respondents had a mixed motivation structure which consisted of internal motivators (company-related factors) and external motivators (government- or community-related factors).

4. The Program Principle: Diversifying CP suppliers/programs

While CP activities are physically implemented inside the workplaces of firms, the suppliers of CP are not limited to the industrial sector. In the previous chapter, four types of CP suppliers were identified based on the analysis of 100 UNEP CP cases; they were defined as '*CP program providers or CP suppliers'*. They include the internal compliance suppliers, the internal non-compliance suppliers, the governmental suppliers, and the international suppliers.

The empirical data presented in Chapter 6 also revealed that the majority of industries that implemented non-compliance CP programs had their own '*maximum action threshold* for CP implementation' as measured by capital investment, payback period, and eco-efficiency. In this situation, in order to implement the continuous improvement of CP it is necessary for government or external CP providers to take an action for overcoming such '*maximum action threshold* for CP implementation.' This may be an actual existence of the sustainability gap which normal firms intrinsically face. These can be the practical objectives of governmental policy for continuing CP.

In order to close or reduce those sustainability gaps, governments have to take additional or newly adaptive actions from the perspective of the proposed evolutionary CP policy model. However, each sustainability gap has its own context and goal. It can be associated with the four

different types of CP motive of firms. It can be also associated with different industrial sectors and different communities. Therefore, the CP suppliers (or CP program providers) need to be diversified in order to meet such diverse sustainability gaps which might be generated differently according to their different financial, technological, political, and ecological context.

The empirical analysis of CP cases showed that each CP supplier has its own purpose and instruments. For example, the compliance supplier aims to help the company in complying with governmental regulations by implementing CP practices. The empirical data showed that due to their close association with regulatory policies, the internal compliance providers made the most determined efforts among the four providers for supporting the initial stages of implementation of CP. However, this CP-supplier can generate different type of the sustainability gap, because such compliance supplier cannot meet sufficiently the higher demand of a sustainable society for continuous implementation of CP. In Chapter 5 these behavioral patterns were identified in terms of capital investment, payback period, and eco-efficiency. New types of CP programs need to be provided as new sustainability gaps for CP are generated. Therefore, not only internal CP programs-providers need to be developed, but also external CP program-providers such as governmental and international initiatives have to play a central role in upgrading the level of CP implementation by overcoming the current action threshold of CP implementation. Therefore, on a macro perspective, CP programs should be provided in a diverse manner in order to bridge various profiles of the sustainability gaps.

5. The Sustainability Principle: Establishing 'CP Sustainability Programs' designed to continue to support efforts to upgrade the level of CP implementation

The fifth guiding principle for governments to promote on-going implementation of CP is for them to be essential partners in the social system, by catalyzing CP in conjunction with the fourth condition. The latter suggests that just as the psychosocial motive for CP develops in an evolutionary manner, the government's activities within the '*triangular knowledge links*' framework must evolve, in parallel, with private production developments.

It is assumed that the evolutionary processes of the psychosocial motive of CP within a firm start from *the compulsory motive or the financial motive*, evolves through *the communal motive*, and finally culminates with *the pioneering motive.* Under this scenario, the governmental action in selecting and designing policy instruments for CP must also take an adaptive approach to each developmental phase of CP demand. (See Guiding Principle 2) In parallel with the stages of development, these governmental actions could be called a 'soft compliance program', a 'voluntary program,' and finally an 'innovative sustainability program.'

In Chapter 6, the analysis of the UNEP' CP cases indicated that at the initial stage (before 1989) of CP implementation, more than half of the companies, 15 among 25 companies, undertook implementation in accordance with direct or indirect government regulations. However, the UNEP' CP cases between 1990 and 1994 showed a different trend in that more than half of the companies in the developed countries, 19 among 29 companies, developed their own non-compliance CP programs. These data support the hypothesis of this thesis that the psychosocial motive of corporations' CP implementation develops in an evolutionary manner moving from the compulsory motive to the non-compulsory motive.

The results also indicated that non-compliance CP in the private sector had its 'tolerance limits,' in terms of its capital investments, payback periods, and eco-efficiency rates. Chapter 6 Section 4 (Table 6-10) indicated that in spite of the increasing demand for 'voluntary CP', 97% of the sample firms which were implementing non-compliance CP practices invested 'less than

$500,000' in CP capital, and 83% of them expected a payback period of 'less than 2 years.' [3]

Even though in a given community the private sector would have a demand for CP beyond their limiting factors, they were unable or unwilling to adopt such risky CP options. The analysis of 'risky CP cases' revealed that 'non-compliance CP-suppliers' prefer significantly 'less risky CP options' than 'governmental CP-suppliers' or 'compliance CP-suppliers.' This author clustered 100 CP-cases into two groups: the 'more risky group' and the 'less risky group'. The 'risky group' refers to the CP-cases with higher capital investment than $ 50, 000, longer payback period than 25 months, a lower eco-efficiency rate than 50 %. The data of 100 CP cases showed that 'the compliance CP-suppliers' adopted a more risky approach to CP implementation than 'the non-compliance CP-suppliers' in terms of 'larger capital investments,' 'longer pay-back periods' and 'lower eco-efficiencies.'

The following inferences can be drawn from these data:
Despite the increasing social demand for 'voluntary' implementation of CP, the data indicate that the major supply of CP in the private sector is still confined to a 'certain threshold level' of CP implementation. This appears to be due to a 'sustainability gap' from the supplier side.

Therefore, supposing that the 'internal non-compliance CP supplier' will play a leading role in continuous implementation of CP, three alternatives can be envisioned for a society to improve its level of CP implementation beyond present levels by means such as:

(i) Private firms must take the pioneering approach to CP;
(ii) Public organizations, including governments, international organizations and NGO's should provide direct and continuous external motivation to encourage implementation of CP;
(iii) Both the private sector and public sector must work together for the private sector to develop the pioneering approach to favor implementation of advanced CP approaches.

Within this context, it was concluded that government is required to play an active role in promoting implementation of CP practices beyond the conventional action threshold for CP within the private sector. In this upgraded level of CP practice defined as the 'pioneering stage,' firms generally need support from external organizations - especially governmental- to attain this level. As a manager of the ecosystem, government needs to strive for establishing a 'CP Sustainability Program' to facilitate meeting the environmentally friendly needs of the private sector, which is required for the continuation of CP and the achievement of sustainable society .

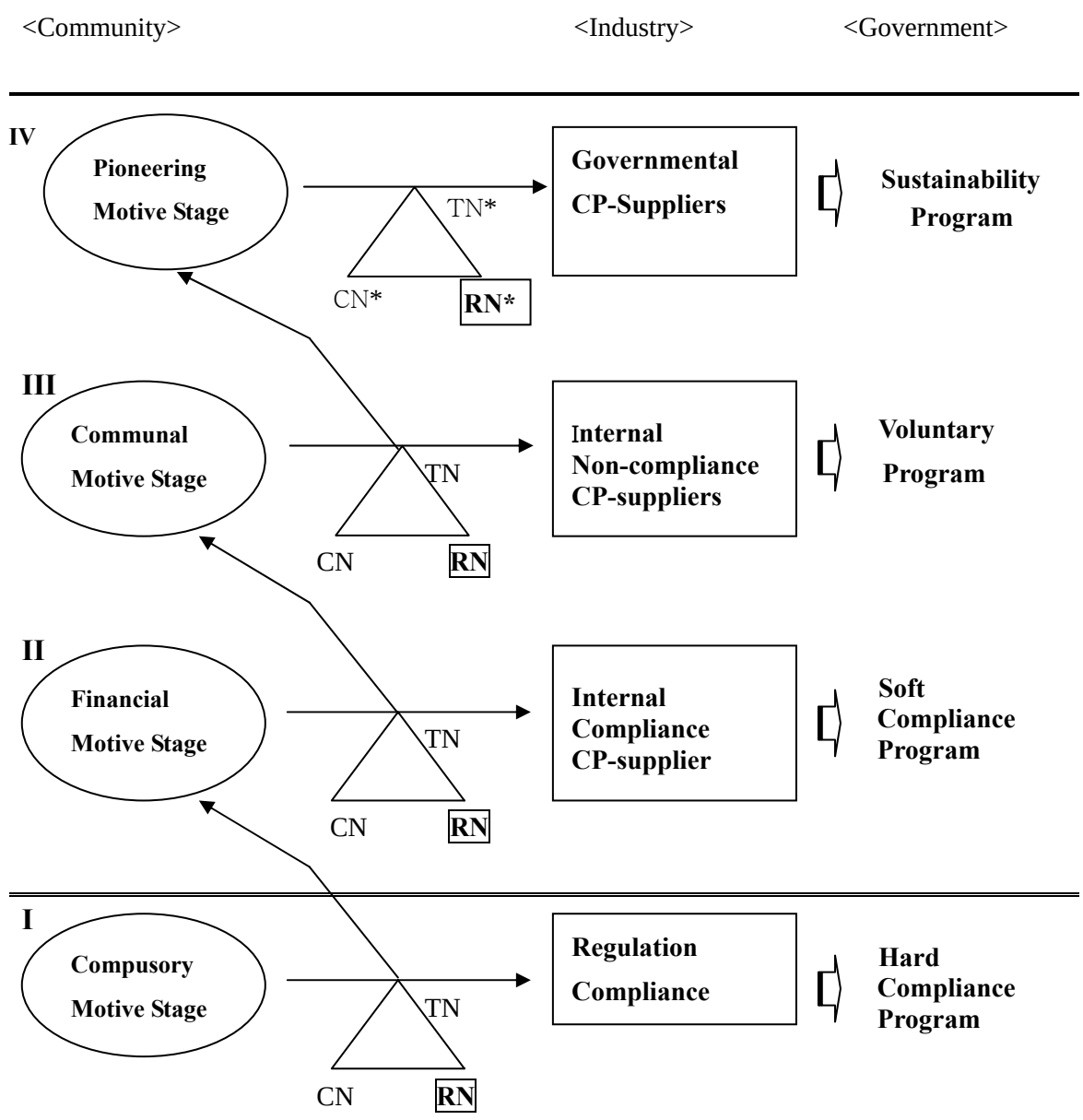
6. Summary: Integrating the five guiding principles into an associated policy model for CP

Figure 7-2 diagrammatically illustrates the integration of these empirical findings and the resultant guiding principles for a sustainable CP policy based upon the four behavioral motives of firms and the contextual connectedness between social sub-systems for CP. It graphically illustrates how CP could develop dialectically in line with motivational factors and suppliers. This illustration reflects what was discussed thus far, including the functional role of the '*triangular knowledge links to CP'* in this framework, and the four types of governmental policy models for CP, which were drawn from the analytical results of the two empirical studies. (See Figure 7-1)

The proposed developmental steps presented in Figure 7-2 share the general perspective that CP strategies develops in an evolutionary manner, over time. However, the perspective in this thesis has different features that are different from others. They are:

i) The proposed model is based on the firms' psychosocial behavioral motives for environmental protection that include: compulsory, financial, communal, and pioneering motives. While classical economics is based upon the premise that firms aim at maximizing their profits, this evolutionary model is based upon the premise that firms have dualistic values on CP, which develops dialectically.

Figure 7-2: An Evolutionary Sustainability Policy Model for Continuous CP



***TN: Technological Knowledge, CN: Contextual Knowledge, RN: Reconciliatory Knowledge**

ii) It could be reasoned that in the evolutionary process, each developmental step could have or could experience its own *sustainability gaps* between the demand for CP (or what needs to be done) and the practical supply of CP (or what has been done). The two empirical studies identified that except for a very small portion of private companies, the majority of the private sector companies have their own 'threshold levels of CP implementation,' which usually do not satisfy the CP demands of the community. When the private sector has to pass through this evolutionary stage of CP, they will face various kinds of sustainability gaps.
iii) Considering such sustainability gaps are largely generated through the mutual interaction between industry and its surrounding environment rather than upon their intrinsic needs, continual development of CP in society might presuppose the functional cooperation among different social subsystems which include, the community as the demander for CP, the private sector as the supplier of CP, and the government as the promoter of CP.

iv) Thus, the central driver of implementation of CP would not be one independent social sub-system such as industry or government, but would be based upon an environmentally-oriented social system which is underpinned by the *triangular knowledge cycle.* Therefore, when the three sectors of society are systematically related to each other, each part of the social system works well, and once a certain level of sustainability has been achieved by their policy, they need to set the target for the higher levels of sustainability.

v) This thesis author now explores the desirable roles for governments in promoting CP supported by the proposed five guiding principles, which help generate appropriate *reconciliatory knowledge for CP*. This model suggests the four CP policies which are adapted to each developmental stage of CP implementation: the compliance program, the soft (flexible) compliance program, the voluntary program, and the sustainability program. These four types of governmental policies for CP, which were drawn from the normative presupposition, were also supported by empirical data and analyses. (See Chapter 5 & 6) It is important that government, as one of necessary subsystems of sustainable society, develop appropriate policies that are adapted to the evolutionary stage of the nation or the community in question, because closing the *sustainability gaps generated in the developmental process* could/should be the main objective of the governmental CP policy.

Therefore, under this proposed evolutionary framework of CP, one of the essential research questions is how do governments become effectively involved in upgrading the level of CP in a given society. To this end, Part IV tests this proposed model and the five guiding principles for a sustainable CP environment in a Korean CP policy known as the 'Environmentally Friendly Enterprise Certification Program' (hereafter EFEC Program), which has been in the process of implementation in South Korea by the Korean Ministry of Environment (KMOE) since 1995.

NOTES
1. The CP is not a pure economic activity which is traded exclusively in the market, but a dualistic activity which contains two entities: economic activity and ecological activity. Therefore, while the market economy theory simplifies that only the most important factors that determine the demand of a private product is the price of the product, the factor to influence the demand for the CP activity could not be reduced to one or two dominating ones.
2. The CP is in fact a mixed good, though the character of the cleaner production as a private good is beyond the objective of this research. Rather, the focus in this study is the public-ness or the ecological characteristics of cleaner production.
3. By the same criteria it could be envisioned that the percentage of firms with a willingness to invest more than $ 500,000 in changes that have greater than a two year' payback period, would

be far less than 1%, even among environmentally friendly companies (EFCs). The percentage of EFCs would also be less than 1 % among general private firms in most countries under the assumption that the Number of 14000 registered companies is a criterion for the EFCs. As a corollary, it can be envisioned that if there were no additional external encouragements for CP implementation, the number of companies that will implement the final and ideal level of CP might be less than 100 firms in Korea.

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PART IV TESTING THE SUSTAINABILITY MODEL IN KOREA

An overview of this research, thus far, may be summarized as follows:

- Developing the integrated theoretical framework for CP (Part II);
- Analysing the motivators and suppliers of CP implementation based upon two empirical studies on CP cases worldwide (Part III Chapter 5, Chapter 6);
- Suggesting five guiding principles for a sustainable CP policy based upon the empirical findings and developing an evolutionary sustainability policy model for fostering continuing implementation of CP (Part III Chapter 7).

Chapter 8 provides a brief review of the history of Korean industrial environmental policy prior to testing the proposed guiding principles and the model. This chapter is designed to generate the contextual and technological knowledge sets in the Korean CP policy in terms of the triangular knowledge links model.

Chapter 9 tests the five guiding principles for a sustainable CP policy in Korean EFEC Program by examining the survey results of the EFEC companies, and based upon data and information extracted from historical documents and official statistics. The survey questionnaire was designed to evaluate the effectiveness of the EFEC Program by querying their views and opinions regarding the EFEC Program and to obtain information about their preferences for governmental policy instruments to encourage firms' CP implementation.

Further, this researcher develops and recommends a new CP policy options for Korea based upon the five guiding principles and the survey results of EFEC companies. [1]

Chapter 8 Review of the Korean EFEC Program

8.1 Brief history of industrial environmental policies in Korea

1. Ecological and economical context

While the Republic of Korea (hereafter Korea) has been well recognized over the last three decades as a country with a rapid economic growth rate and an extremely high population density, the state of its environment is not well known to the people of the world.

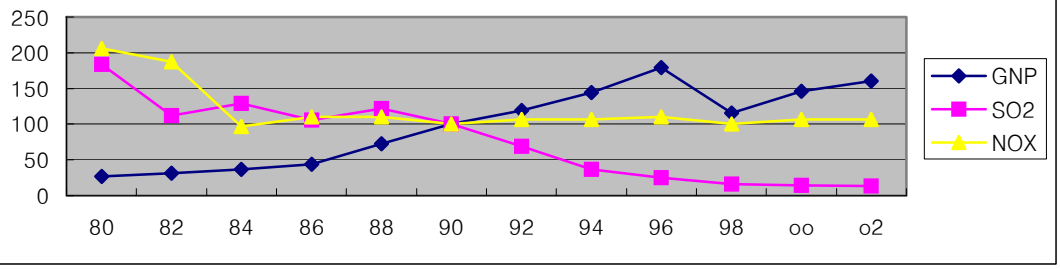
Korea occupies an area of 99,392 km2 in the southern part of the Korean Peninsula. About two-thirds of the land is forested, and 70% is mountainous. The Tebek mountain range reaches a height of 1,708 meters and runs the full length of the east coast, on the range's western and southern sides, descending gently towards the coast (OECD, 1997). Originating from the Tebek mountain range, Korea's four main river basins contain a large number of rivers and streams: the Geum, Youngsan, Nakdong and Han River are the main water sources for industry, agriculture and community life. The Han, Youngsan, and Geum rivers flow into the Yellow Sea, lying between the Korean Peninsula and China, and the Nakdong River flows into the South Sea. Annual rainfall averages 1,276 mm, but varies greatly from year to year and from location to location; the heaviest rainfall generally occurs during June, July and August. In early spring, gusty winds bring in yellow dust from northern China. (OECD, 1997)

Known as the 'economic miracle on the Han River,' Korea has managed to transition from a rural, underdeveloped society to a modern economy in one generation; therefore, it is, known as the 'economic miracle on the Han River.' Over the past three decades, Korea has achieved an annual average economic growth rate of 8.6 percent, mainly thanks to an export-oriented

strategy and repeated 'five-year economic development plans', which were started in the early 1960s. As a result, from 1962 to 2002, Korea's Gross National Income (GNI) increased from US$ 2.3 billion to US$ 477 billion, with its per capita GNI soaring from US$87 to about US$ 10, 013. Korea has become the world's 12th largest economy and joined the OECD at the end of 1996.

Although GNI and per capita GNI drastically dropped to US$ 312 billion and US$ 6,744 in 1998 due to the financial crisis across the Asian countries in late 1997, these figures returned to the pre-economic crisis level in 2002. (The Bank of Korea, 2003)

Figure 8-1: Trends of GNP and Air Pollutants in Korea
(The Basic year: 100, No. of Figure are percentiles based on 1990)



The share of primary industries in the overall industrial structure decreased steadily from 31.5 % in 1970, to 15.7% in 1980, and further to 5% in 2002. At the same time, the share of manufacturing industries increased from 14.7% in 1970, to 36.0 % in 2002. The share of the service industries stood at 47.5% in 2002.

Korea's economic growth was initially led by labor-intensive light industries, notably textiles. Though from the mid-1970s, it turned to the promotion of heavy and chemical industries that have come to account for over half of the nation's total manufacturing output. Korea produces a wide range of industrial machinery and equipment. Steel, shipbuilding, automobile, and electronics industries are the leading growth sectors in the country. Korea is ranked as one of the six-largest auto, electronics, and steel manufactures in the world. Other principle industrial products include cement, processed foods, petrochemical products, chemical fertilizers, clothing, ceramics, glass, nonferrous metals, and farm implements. In line with the advancement of the nation's industrial structure over recent years, Korea has been making substantial investments in the information and communication industries such as computers, and telecommunication equipments.

On the other hand, Korea is very dependent on the import of natural resources. More than 96% of the primary energy supply is imported. As one of the largest import markets in the world, major import items includes industrial raw materials such as crude oil, liquefied natural gas and natural minerals, general consumer products, foodstuffs and goods such as machinery, electronic equipment and transportation equipment.

Korea will continue in its pursuit of continuous growth and development, (MOE, 1992, National report of the republic of Korea to UNCED, p.65) however, it needs to address the socially unwanted externalities and ecological disorders behind its remarkable economic growth. Korean society has already started to find ways to reconcile their economic needs and aspirations with the ecological importance of the Korean peninsula and the needs of the future generations.

2. The Evolution of the industrial environmental policy in Korea

This section describes the evolution of Korea's industrial environmental policy. The selected time frame begins with the year when substantial revisions and changes related to environmental laws and regulations occurred with respect to the private sector. It therefore covers from '1962' to 2003, spanning the first national Pollution Protection Act to the convening of the Johannesburg World Environment Summit, which was held thirty years after the first international Conference on the Human Environment, held in Stockholm in 1972.

In this brief historical description of the Korea's industrial environmental policy on industry, two questions should be considered. First, what were the industry's responsibilities with respect to the environment during the each stage of environmental policy in Korea? And second, what were the essential governmental instruments used to achieve the intended environmental goals. For analytical purposes, the past four decades have been divided into three different phases: the environmentally complacent period (1962 – 1979), the pollution control period (1980 – 1992), the transitional period towards sustainability (1993 – 2002).

The Environmentally complacent period (1962 – 1977)

Korea's first environmental law was the Pollution Protection Act enacted in 1963. The Act was not designed to implement practical environmental regulations upon industrial polluters because there were, at that time, no serious industrially-related environmental problems. The law was therefore, largely ineffective until the early 1970s when the 1972 Stockholm Conference on the Human Environment influenced most countries to develop governmental regulatory organizations and regulatory measures. Additionally, due to the fact that in the mid-1970s, industrial pollutants began contaminating the rivers and the air, public concern increased about the pollution of the main rivers, such as the Han-Gang ('Gang' means 'river' in Korean.) and Nakdong-Gang, coastal seas, and the air pollution in the major cities, such as the metropolitan regions of Seoul and the industrial city of Ulsan.

The 'Command-and-Control' period (1978 – 1991)

As environmental pollution became more serious with rapid economic growth, the Korean government enacted a new, comprehensive environmental policy named 'the Environmental Preservation Act' (1977). The first enforceable environmental act was passed by Parliament in December 1977, signed by President Park Jung Hee, and went into effect on July 1 1978. The Marine Pollution Act was also enacted at the same time. In January 1980, the Environmental Agency was launched as an independent governmental organization.

The 1977 Act adopted many requirements for environmental regulation such as environmental ambient standards, environmental monitoring system, emission standards for private and public, - the so-called 'command-and-control' approach - and various administrative sanctions against illegal polluters. The establishment of a new environmental agency was an important factor for the development of environmental policy. The Environmental Preservation Act has been amended several times. The amendment in 1981 introduced an emission charge system to strengthen the enforceability of emission standards. The amendment in 1986 enabled six regional offices of the Environment Agency to be launched across the country, thus establishing a local organizational structure for implementing centralized environmental regulation.

From the mid-1980s, the people of Korea enjoyed greater economic prosperity and broader political freedoms than ever before. The resulting democratic reform from the constitutional change and subsequent presidential election in 1987 allowed environmental civic groups to more openly express opinions (MOE, 1992). To meet the rising expectations of the public for better environmental quality, President Roh Tae Woo upgraded the status of the central

environmental organization from the Environment Administration to the Ministry of Environment, a member of the Cabinet chaired by the President.

In July 1990, the Parliament passed new environmental bills requested by the Minister of Environment, which changed the comprehensive 'Environment Preservation Act' into one basic environmental law with six media-specific (air, water, ecosystem, noise, waste, hazardous chemicals) laws, with additionally one procedural law on environmental dispute settlement. As a result, the Korean government established a satisfactory environmental legal structure. However, in spite of the establishment of a sufficient legal structure, there remained two fundamental questions about Korea's environmental policies. The first was how to effectively implement laws in accordance with changing social and economic circumstances. The second was how to overcome the 'command-and-control' approaches, which had been an underlying principle in all of Korea's regulatory laws.

The Transitional period towards sustainability policy (1992 – 2002)

The 1992 Rio Declaration signed by 179 heads of government, including Korea, called on governments to adopt national strategies for sustainable development. Agenda 21 influenced the Korean government to incorporate a number of its guiding principles in domestic, environmental policies. In the introduction to the National Action Plan for Agenda 21, Lee Soo Sung, Prime Minister of Korea, highlighted the following:

"The government of the Republic of Korea has reviewed all domestic policies that have been formulated and implemented for sustainable development and is now embarking on a plan called the, '*National Action Plan*,' to be in line with Agenda 21. This implementation is only the beginning of a new effort to realize sustainable development in the 21st century." (KMOE, 1996, National Action Plan for Agenda 21)

Since the Rio Declaration, the Korean government recognized that the main principles of Agenda 21 such as integrated approach (Principle 4), community involvement (Principle 10), precautionary approach (Principle 15), equity within and between generations (Principle 3), and ecological integrity (Principle 1, biological diversity convention) would not be easily applicable within the existing policies and procedures. The government therefore, started to take new initiatives and to develop new laws which are consistent with those principles.

In 1992, Korean government launched an eco-labelling program to bring consumer's attention to environmentally friendly products, which were produced in less-polluting or more energy-efficient ways. In 1994, the Environmental Technology Development Support Act was adopted to introduce preventive measures in the private sector by promoting and supporting environmental industry. On May 1994, the government adopted the 'multi-ministerial guidelines on water quality control', which were designed to produce appropriate measures through an integrated mechanism between different ministries responsible for protecting water quality in major river basin. In 1995, the '*Environmentally Friendly Enterprise Certification Program*' (EFEC), which is the objective of this thesis, was introduced to promote environmentally friendly management. These initiatives did not use compulsory instruments, but rather, were based upon participatory, indirect, and voluntary approaches to changing the environmental behaviour of firms.

3. Reviewing the industry-environment policies of Korea in the evolutionary policy model

The previous section summarized the development of environmental policies in Korea according to the governmental approaches to reducing industrial pollutants. However, the adoption of new laws or policies usually does not exclude the application of old laws and policies. For example, even if the eco-labelling program was implemented for manufacturers,

the companies, which produce eco-labelled products, also have to comply with typical coercive regulations such as the Air Pollution Control Act or the Water Conservation Act.

It is useful to classify all environmental laws governing industrial pollutants according to the four types of government policy. (See Figure 7-2, Chapter 7.) These are 'Hard compliance programs', 'Soft compliance programs', 'Voluntary programs', and 'Sustainability programs'. Table 8-1 shows the industry/environment-related laws of Korea in terms of the evolutionary policy model.

Table 8-1: Korea's Environmental laws/guidelines on Industry (2002)

Hard Compliance program	**Soft Compliance program**	**Voluntary Program**	**Sustainability program**
<*Guiding principle*> Binding standard Inspection & Sanction Meeting the standard	Binding standard Incentives & Guidance Meeting the standard	Non-binding target Voluntary participation Social image & Benefit	Ecological integrity Promoting sustainability Environmental innovation
1. Air Quality Preservation Act ('90) 2. Water Quality Preservation Act ('90) 3. Noise & Vibration Act ('90) 4. Natural Environment Preservation Act ('91) 5. Environmental Crime and Punishment Act ('91) 6. Toxic Chemicals Control Act ('91) 7. Act relating to the Treatment of Sewage, Night Soil and Livestock ('91) 8. Transboundary Hazardous Waste Disposal Control Act ('92) 9. Soil Preservation Act ('95) 10. Underground Space Air Quality Act ('96) 11. Act relating to the Han River Watershed Management and Support for Local Community ('99): Total maximum load project 12. The Nakdong River Watershed Management Act ('02): Total maximum load project (continued) 13. The Geum River Watershed Management Act ('02): Total maximum load project 14. The Yeongsan River Watershed Management Act ('02): Total maximum load project	1. Environmental Improvement Charge Act ('91. 12) 2. Resource Conservation and Reuse Act ('92) 3.Act relating to the Special Accounting for Environmental Improvement ('94) 4. Technical support: Act relating to Environmental Technology Development & Support ('94) **5. Directive for the Environmentally-Friendly Enterprise Certification Program ('95)**	1. Eco-Mark: Act relating to Environmental Technology Development & Support ('94) **2. Directive for the Environmentally-Friendly Enterprise Certification Program ('95)**	[*1. Special Act on the Ecosystem Preservation of Islands such as Dokdo islands ('97)**] * This law is not directly related to industrial issue.

Table 8-1 illustrates the structure of Korea's environmental laws/guidelines classified according to the suggested evolutionary policy model. It is clear from Table 8-1 that 'command-and-control' approaches still shape and dominate the central framework of the industrial environmental policy in Korea. Nevertheless, it is clear that since 1992, voluntary compliance

and non-compliance programs have been gradually developed on diverse topics. Furthermore, the EFECP started in 1995, was one of the two CP policies initiated amid overwhelming command-and-control policies. Considering that the Eco-mark program has actually been managed by the non-governmental organization named, 'the Korea Eco-Mark Association', the EFEC is a unique CP program in Korean environmental policy.

In developing a more effective CP policy, it is crucial to analyse the achievements the EFECP has made as well as the challenges it has faced or must face in the future. To obtain background information, this researcher utilized surveys of EFEF Program companies and related documentary data in the context of the evolutionary environmental policy model developed in the previous chapter.

8.2 The Structure of the Environmentally Friendly Enterprise Certification Program (EFEC Program) and the experiences gained through implementing it.

1. Background

The EFEC Program is a voluntary approach instrument designed to facilitate the establishment of environmental improvement plans through contractual agreements between firms and the Ministry of Environment (MOE). The EFEC is based on the principle of environmental management in industry and business. (KMOE, 1997) The firms need to be encouraged to assess the environmental impacts of the entire production process and to make continual efforts to improve the quality of their surrounding environment. The EFEC was designed to encourage firms to adopt voluntary CP options that go beyond government regulations.

The introduction of the EFEC in Korea was designed to meet the widespread concern that the conventional pollution control approaches based on 'emission standards and inspections' are not enough to achieve a satisfactory sustainability level within firms' environmental management. Taking into account the important role of the private sector in realizing a sustainable society, the government of Korea needed to initiate a voluntary, non-compliance program to stimulate firms to continuously improve their environmental management beyond the coercive regulation.

2. Process and incentives of EFEC Program

The Ministry of Environment certifies a firm as an '*Environmentally Friendly Enterprise*' if the environmental improvement plan submitted by an applicant company satisfies the required qualifications. The program requires the applicant company to conduct an environmental impact assessment (EIA) for all of their production processes. Based on the firms' internal environmental impact assessments, they must prepare detailed environmental improvement plans which include, among others, target pollutants, CP options, and a time schedule for implementation of the changes.

Process for EFE Certification

In general, the application goes through the following three steps:

- 1st step: An applicant company submits the required application papers to a regional environmental office. The regional office reviews the papers, collects past inspection records, and after having monitored the current state of the applicant's environmental management on wastewater and hazardous chemicals, air pollutants, etc., determines the level of the applicant company's existing environmental management.

- 2nd step: An ad hoc committee which is composed of 5 –10 local civic experts is formed to examine the applicant's environmental performance and reviews the applicant's three year

environmental improvement plan according to the guidelines.

- 3rd step: After receiving the ad hoc committee's report on the applicant's environmental performance, the Ministry of Environment make the final decision on whether to certify the applicant company through the internal EFEC Committee.

To ensure transparency of the entire process, the EFEC coordinators utilize the following evaluation criteria:
- In the initial step that occurs at the regional environmental office, a company is only recommended to the local expert EFEC Review Committee for an environmental performance review when an applicant gets more than 80 points of a maximum 100.
- Then, the local expert EFEC Committee examines the validity and feasibility of the applicant company's application papers. The Committee's evaluation sheet is composed of three main elements: the status of general environmental management including CP policy (7 items, weighing points: 70/400), achievement of pollution control by media such as wastewater, air pollution, and waste (5 items that contain 130 out of 140 points), feasibility of the environmental improvement plan such as implementation of CP approaches, environmental investment plan, wastewater treatment plan, air pollution control plan, etc (8 items that contain 200 out of 400 points) When an applicant earns more than 320 points (80% of a Maximum of 400 points), they are eligible to become an EFEC firm. Then, their application and their evaluation papers are delivered to the MOE EFEC Committee for the final certification decision.

Incentives/disincentives for the EFEC Companies
The certificates are effective for three years from the date of issue. During this period, the EFEC companies must send annual achievement reports to the Head of the Regional Office, of the MOE. This is to include performance reports of the previous year and an improvement plan for the next year. If the Head of the Regional Environmental Agency makes no additional requests after reviewing the submitted report, the certification is automatically extended for another year.

During the certified periods, the following incentives are offered:
- Exemption from obtaining a permit when planning a new workplace, or extending or modifying an existing workplace. Instead, a simple announcement to authorities is enough;
- Exemption from regular environmental inspections by local environmental authorities;
- Provision of low-interest loans for SMEs from a special environmental fund;
- MOE's public notification of being an EFEC 'green company'.

However, the EFEC can be cancelled if:
- The submitted papers, such as the environmental improvement plan, contain substantially incorrect data;
- A serious environmental accident or public complaint occurs during the certified period;
- The certified company does not submit their annual reports.

3. Accomplishments of EFEC Program from 1995 to 2002

Number of EFE Certified companies
Table 8-2 shows the trends of EFEC companies from 1995 to 1992. The data reveal that with since the first three EFEC companies – Samsung Electronics, Doosan Crown, Samsung Chemicals (18 Aug.1995) – the number of EFE certifications increased rapidly until 1997, but decreased after the Asian financial crisis (1997 - 1998). Since then, the number of EFE certified companies has fluctuated around 110 companies.

Table 8-2: Fluctuations in the Number of EFEC companies from 1995 to 2002

	'95	'96	'97	'98	'99	'00	'01	'02
Total Number	28	105	122	102	112	99	108	110
Net Change	28	77	17	- 20	10	-13	9	2
Large Company*	28	74	117	97	106	93	101	2
SMEs	2	3	4	5	6	6	7	0
Increasing/decreasing Rate/year	-	275%	16%	- 16%	10%	- 12%	9%	2%

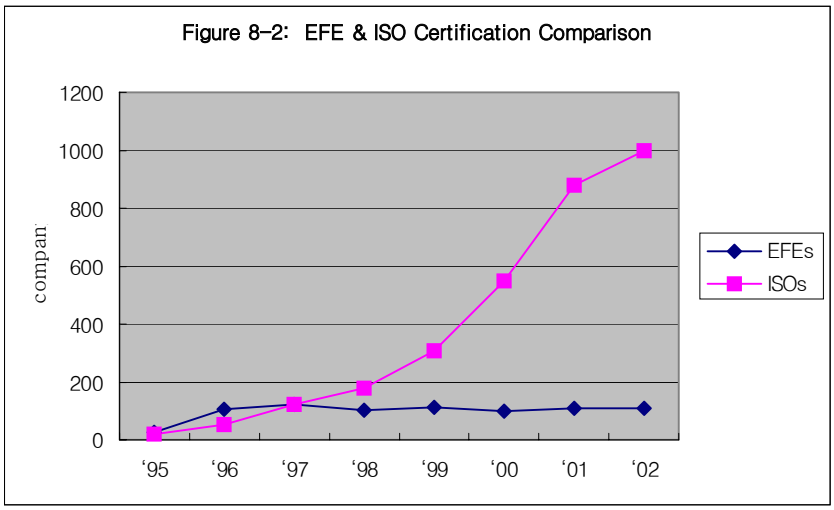
* A subsidiary company of Big Business Groups is considered as a large company.

A noteworthy characteristic of the EFEC Program is that Korean big business groups dominate the program. Approximately 80% of the EFEC companies belong to the big business Groups. In line with this characteristic, the portion of small & medium-sized enterprises (SMEs) with the EFEC has been extremely low at less than 5%. Some of the SMEs are not of pure Korean ownership but are usually part of a multi-national company. In other words, the number of new SMEs in the EFEC Program has been near zero during the last 8 years. These figures of the EFEC Program are in stark contrast to the ISO 14001 Certified companies in Korea. Table 8-3 shows the number of Korean ISO 14001 certified companies.

Table 8-3 Trends of ISO 14000 Certified-companies in Korea from 1995 to 2002

	'95	'96	'97	'98	'99	'00	'01	'02
Total Number	19	54	121	180	309	548	880	1002
Net increase	19	35	67	59	129	239	332	122
Large Company	-	33	34	18	25	25	(27)*	-
SMEs.	-	21	33	41	104	214	(222)	-
Increasing/decreasing Rate/year	-	184%	124%	49%	72%	77%	61%	11%

* The figure is of 30. Oct. 2001.



Comparing the data of the two tables, while the number of ISO 14001 certified companies has increased rapidly, the number of EFE certified companies has fluctuated around 110 companies except during the first two years of the program. It should be noted that the majority of EFEC companies are large enterprises centering around the *Korea Chaebol Groups*, while many of the

ISO certified companies are small & medium-sized companies (SMEs). In 2001, more than 90% of EFEC companies were large, while approximately 90% of the new ISO 14001 certified companies were SMEs.

Technological achievements of the EFEC participant companies

In 1998, KMOE published a report on the successful technological cases of EFEC participant-companies. From this report, it is clear what kinds of technological improvements for CP have been made since the adoption of the EFEC Program. Table 8-4 shows the technological achievements of EFEC companies by CP typology.

Table 8-4: Technological Performances of EFE Certified Companies (MOE, 1998)

(Unit: No. of company)

	Water quality	Air quality	Waste minimization	Energy/resource conservation	Hazardous chemicals	Noise & odour	others	total
Process modification	10	9	7	8	2	-	1* *landscape	37 *34%*
Good Housekeeping	9	2	3	7	-	-	1* *safety	22 *20%*
On-site Reuse	7	1	5	1	2	-	-	16 *15%*
Design for environment	2	1	4	3	-	1	-	11 *10%*
Material substitution	2	1	1	1	3	-	-	8 *7%*
Sub-total	30	14	20	20	7	1	2	84 *77%*
End-of-pipe Technology	15	5	1	-	1	3	-	25 *23%*
Total	45 *41%*	19 *17%*	21 *19%*	20 *18%*	8 *7%*	4 *3%*	2 *2%*	109 *100%*

In light of this technological performance, the EFEC program has provided important momentum for the private sector to adopt CP practices and to improve pollution control technologies in diverse environmental areas in Korea. As shown in Table 8-4, the EFEC program includes both CP options and pollution control technologies. Although 22.9% of EFEC companies listed in Table 8-4 have improved 'end-of-pipe' technologies, it is very interesting and encouraging that more than 70% of the EFEC companies have implemented CP technologies of diverse types, including process modifications, and Design-for-the Environment, changes.

Therefore, it is noteworthy that the EFEC Program initiated by government to promote more comprehensive CP approaches, was based upon the assumption that, in general, private companies consider endogenous environmental issues to be external diseconomies; therefore, without such a governmental CP program, they would only focus on complying with government regulations focusing on adequate management of end-of-pipe facilities – e.g. wastewater treatment systems, back-filters, incinerators, etc.

Closing remarks

As stated in the previous section, the introduction of the EFEC Program and the Eco-mark Program in 1995 were the beginning of a new dimension in the Korean environmental policy whereby, it moved towards sustainable development policy and beyond the sole focus upon the

conventional ‘command-and-control approach’ (Ko Jae-Young, 1996).

In order to consolidate the adoption of the EFEC Program, the Minister of Environment made a decision concerning ‘the guideline for the EFEC program’ in April 1995. The consequent amendment of related articles of the Air Quality Conservation Act and the Water Quality Conservation Act were made for the smooth implementation of the guideline on December 1995. Since the start of the EFEC Program in 1995, the Korean Ministry of Environment has designed and implemented diverse types of flexible, non-compulsory and industry-supporting environmental policies. These include, the ‘Environmental Consulting (Home Doctors) Program’ implemented in 1998 [2], the ‘local voluntary agreement program for environmental management’ in 2000, [3] the ‘Green Building Certification Program’ [4] and the financing program in 1994 for development and implementation of environmentally sound technologies (KMOE, 2001).

However, it was also identified by official statistics and records that there are significant challenges which must be overcome for the continuous implementation of CP in Korea. One of the most serious challenges is that the number of EFEC companies has not increased in the last eight years. Many data indicate that the EFEC program does not work successfully to contribute to continuous implementation of CP in Korea. Therefore, it is necessary to develop a new CP Program for Korea to test the proposed five guiding principles for a sustainable policy and the proposed sustainability model in the context of the EFEC Program.

NOTES

1. This overall framework of policy evaluation is consistent with ‘Brunswikian Lens Model’ for human epistemological synthesis (Brunswik, 1950). In a sense, this evaluation framework is similar to an application of ‘Brunswikian Lens Model’ for the knowledge integration to the area of sustainable policy evaluation (Scholz & Olaf Tietje, 2002), although this thesis did not attempt to apply his psychological model to a CP policy case.
2. This program is a government supported environmental technology-consulting program designed to encourage interested firms to implement preventative environmental management with the assistance of environmental experts and consultants selected by the KMOE.
3. This program was designed to encourage voluntary agreements between local governments or Regional MOE offices and private companies within the local or regional jurisdiction. The environmental agency supplies and uses comprehensive manual for the voluntary agreements, and according to the manual the participant company has to submit its environmental management improvement plan for a certain period of time to the local environmental agencies.
4. This program was designed to encourage construction of environmentally friendly buildings with special foci upon energy efficiency, resource conservation, pollutant reduction, and enhancement of amenity value, etc.

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Chapter 9 Testing the Proposed Guiding Principles in the Korean EFEC Program

The nature of the testing

As Chapter 8 described, in spite of some successful achievements the EFEC Program has made, it was clear that by official statistics and records there are significant practical problems, which need to be overcome for ensuring continuous implementation of CP throughout all of Korea.

Given that the important problems of the EFEC Program were identified by historical records in Chapter 8, it may be useful to test the five proposed guiding principles in the Korean policy context. In testing them in Korean situation, the thesis author raised the following three questions:

- Has the EFEC Program satisfied the five guiding principles properly? If they are satisfying them, are modifications needed in the proposed guiding principles because currently the EFEC Program is not functioning optimally?
- Do the views and opinions of the EFEC Program participants support the guiding principles or not? If their views are largely consistent with the guiding principles, the guiding principles can be tested as useful tools.
- Do the five guiding principles, separately and together, help to generate useful and innovative insights into designing a new sustainable CP policy for Korea?

In order to answer these questions, the triangulation method was used. Three types of data from different sources were collected: (i) from historical records and documents on the case CP program (Chapter 8); (ii) The survey results of 1998/2002 EFEC Program participants; (iii) The survey results of 2002 ISO companies in Korea as a comparison group.

This test had two purposes. The first was to evaluate the usefulness of the proposed guiding principles by applying them to the Korean CP policy. This was done to provide insights about which elements of the EFEC Program have led to problems and achievements in terms of the five proposed guiding principles. The second was that if the triangulations of results from three different approaches were consistent, the proposed guiding principles and the associated policy model could contribute to designing and implementing a sustainable CP policy not only for Korea but also for other countries. [1]

9.1 The Aspiration Principle: Maintaining a *balanced motivational structure* for CP among the three main social sub-systems

Introduction

First of all, this thesis author assumes that CP activities have a characteristic of being a mixed good or service. Such an assumption is supported by the results of the motivation survey done as part of the research for this thesis. According to the results (Table 5-20 in Chapter 5), 39% of the respondents answered that they initiated CP activities because they were decisively influenced by the ‘compulsory motive’, while 25%, 23%, and 13% were decisively influenced respectively by the ‘profit motive’, the ‘communal motive’ and the ‘pioneering motive’. These results are quite different from the profit maximization assumption of firms’ behavior that is typical of classical economics.

Specifically, the motivational structure within companies of developed countries showed a balanced composition between the four motives – the financial motive representing 27%, the compulsory motive representing 24%, the communal motive representing 27%, and the pioneering motive representing 22%. These data showed that the CP practitioners of the developed countries were keeping balance between the internal motivation for CP

implementation (49%) and the external motivation for CP implementation (51%), suppose that the financial motive (27%) and the pioneering motive (22%) are considered the internal motivation of firms for CP implementation and the compulsory motive (27%) and the communal motive (24%) are considered to be the external motives.

This author suggested in Chapter 5 that these balanced motives for CP is potentially one of the best conditions for the continuous improvement of CP implementation, because this balanced motivational structure can be foundation for CP implementation, which facilitates and encourages the relevant social actors to design and implement more CP options and practices. Normatively, such a balanced motivational structure could be shaped in the community where *aspirations for* an environmentally sustainable society are strong.

The survey results of 1998/2002 EFEC Program Companies and the Aspiration Principle
Questions 1 & 2 obtained EFEC Program participants' views on 'practical motivators for implementing their CP plans' (Question 1) and 'social actors' responsibility for environmental protection' (Question 2).

Figure 9-1: Social Actor's Environmental Responsibility (%)

Q 1. Which social actor do you think *is* most responsible for protecting the environment? Choose *the top actor* among the given list.

(Legend: '1998 EFEs' refers to 'EFEC companies', 2002 ISOs: 2002 ISO 14001 certified companies in Korea)

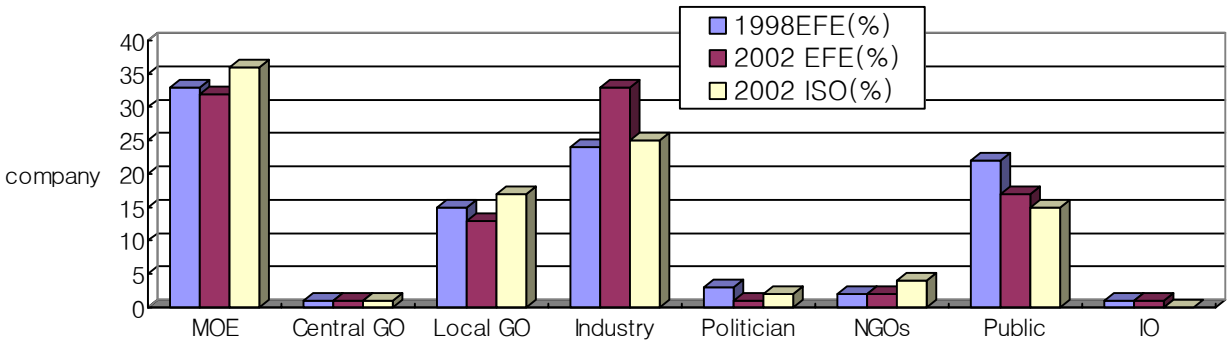


Table 9-1: Practical Motivators in Implementing CP plan

Q 2: Which motivators or stimuli *were* most influential in catalyzing implementation of CP practices in your company's workplace? Choose the top among given items according to your experience.

Ranking	1998 EFEs (%, N=78)	2002 EFEs (%, N=80)	2002 ISOs (%, N=83)
1.Top manager's environmental behavior	20	19	21
2.Providing more governmental incentives	16	⬆ 19	19
3.Developed environmental technology	18	18	14
4.Good coordination between functions inside	17	⬇ 12	14
5.Strengthening governmental regulation	10	⬆ 12	9
6.International efforts for EMS such as ISO	8	8	10
7.Environmental requirements in trade	3	6	3
8.Rival companies' environmental action plan	4	5	2

9.Growing pressure from civic groups	3	1	5
10.Labour union's concern	1	0	1
Total	100%	100%	100%

Figure 9-1 shows the respondents' view on the relative environmental responsibility of the main social actors. Overall, this figure reveals that there is a balanced responsibility for the protection of the environment among social actors, especially among central government (33% in 2002), the industry (33% in 2002), and the public (18% in 2002). Comparing the 2002 EFEC companies (or 'EFEs') to the 1998 EFEs, the percentage for 'industry and business' is considerably increased (from 24% to 33%), while the percentage for 'the public' decreased (from 22% to 18%) and the percentage for 'the government' is unchanged (1998 EFEs: 49%, 2002 EFEs: 47%, 2002 ISOs: 54%, when the percentages of local government are included). The survey results suggest that Korean EFEC companies still expects that government should play the most important role in ensuring the environmental protection. They also expressed that the responsibilities of industry and business was increasing, over time. Such an increased aspiration for better environment within firms must be one of the most important preconditions for a sustainable society. [2] [3]

Question 2 asked for the actual motivators that influences their CP implementation. Table 9-1 presents information about the actual influences of the social motivation items for CP in the 1998 and the 2002 survey. Overall, the rankings of the items of the 2002 EFEs are almost the same as those of the 2002 ISO-certified companies (ISOs). [4] The most influential motivator for implementing CP in all three surveys was the 'Top-manager's Environmental Behavior.' This result is the same as the motivation survey worldwide discussed in Chapter 5. The ratings of governmental functions, such as incentives and regulations in the 2002 survey are higher than those in the 1998 survey.

However, the results of the 1998/2002 EFEC survey on the CP motivators indicate that the influence of the internal motivator decreased and the influence of the external motivators increased. For example, the percentage of 'Governmental Incentive' increased from 16% in 1998 to 19% in 2002 and the percentage of 'Governmental Regulations' increased from 10% in 1998 to 12% in 2002, while the percentage of 'Top Corporate Manager's Environmental Behavior' and 'Good Coordination between Functions Inside' decreased from 20% in 1998 to 19% in 2002 and from 19% in 1998 to 12% in 2002, respectively. These tendencies of 'actual' motivators for CP (e.g. the results of Question 2) were slightly different from those tendencies of 'expected' responsibility for the environment (e.g. the results of Question 1). These data themselves do not provide insight into why these inconsistencies occurred. Considering that the surveys were administered to private companies, however, it can be explained by the perception of the 'sustainability gaps' between the socially sustainable ecological levels and the practically acceptable ecological levels. (See Section 3.3) In this situation, therefore, the increased rate of governmental influence on CP implementation indicates that the higher the responsibility of firms for CP is, the more important the involvement of government in encouraging CP is, because CP activities basically require 'motivational interactions among social actors.' (See Section 5.2) Therefore, the survey results of the 1998/2002 survey on social motivators for CP support Guiding Principle 1 that a balanced motivation structure among social actors should be maintained in order to foster continuous implementation of CP.

Policy implications for the sustainable CP in Korea from testing the Aspiration Principle

In the case of the EFEC companies in Korea, it is clear that most of them started CP practices to meet governmental regulations and to avoid inspections from environmental agencies. This behavioral pattern of firms is not enough to reach a sustainable society. A Korean report about

the results of the program suggests that the continual development of CP could be more adequately encouraged under a social culture which catalyzes the private sector to implement CP practices. (KMOE, 1997) Among the EFEC companies, it was observed from the official documents on the EFEC case studies that some companies started their CP practices not in order to comply with governmental regulations, but in order to enhance their social image or the environmental quality of the community. Companies that belong to this category are those that strive for 'zero pollutant discharge' or which developed new CP technologies for their own use.

However, as identified either in the official documents or in the survey results, it is premature to conclude that Korean society has a balanced motivation structure for continuing CP. Rather, the compulsory motive and the financial motive for CP implementation are still the dominant social motivations for implementing CP, while the communal motive and the pioneering motive are still in an initial or experimental level. (See Figure 5-5, Chapter 5, Table 9-1 Chapter 9) These results strongly suggest that the Korean government should have a balanced motivation structure for CP implementation. This can be accomplished by developing and implementing a set of policy programs that stimulate the communal motive or the pioneering motive for CP implementation.

9.2 The Adaptation Principle: Adjusting governmental policy to the *different 'evolutionary stage of companies* in their journey of implementation of CP'

Introduction

The second guiding principle is whether the new CP policy is appropriately adjusted to the evolutionary stage of sustainable CP in the firm or the region? According to the proposed model CP policy, the Korean government has been trying to overcome the problem of the, '*command-and-control'* approach. The EFEC Program was initiated based on the compulsory motive, which was hypothesized as the first stage for the private sector to implement CP. In this regard, the EFEC Program is moving in the right direction. Most CP cases of certified companies were designed to help meet regulatory requirements via implementing CP practices. The most important incentive, which Government provided for the certified companies, was to allow them to be free, for three years, from regular environmental inspections and consequent legal sanctions by the local environmental agency.

It is not the ultimate policy goal of the EFEC Program to make industrial polluters avoid governmental regulations. That is an instrument for reducing environmental pollutants. The evolutionary policy model indicates that firms have three types of intrinsic motives for implementing CP, apart from the basic financial motive. Therefore, with appropriate time, the CP policy should evolve in a dialectical and more environmentally sustainable way, by adapting to the community's new demands for sustainable society. Accordingly, a government should adjust its CP policies so that they more adequately satisfy the changing demands.

In order to develop adequate and timely policy-goals, the existing policy must be adapted according to the developmental pattern of CP in that region or firm. For example, the 'non-inspection' incentive might be useless for a company which works toward a 'zero pollutant target'. Although, it is not known how long the lifespan of the current EFEC Program will be, the Program needs to be updated in order to adapt to new social demands and new technologies.

The survey results of 1998/2002 EFEC Program Companies and the Adaptation Principle

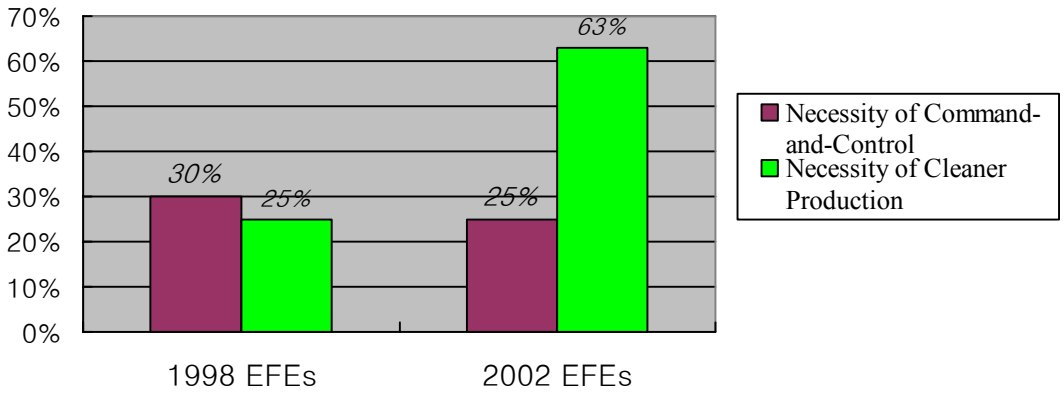
In relation to this precondition, this researcher introduced the 1998/2002 survey results of question 3, 4 & 5 of the questionnaire which asked respondents for their views on the

necessities of the 'command-and-control' policy (Question 3) and industrial CP adoption (Question 4), and governmental involvement in various CP options (Question 5).

Figure 9-2 presents data of how the EFEC companies' views the necessities of the 'command-and-control' policy (Question 3) and the adoption of CP (Question 4) changed between 1998 and 2002. The percentage of support for the 'necessity of the command-and-control' decreased from 30% in 1998 to 25% in 2002 and the percentage of support for the adoption of CP increased by from 25% in 1998 to 63% in 2002. It is evident from these data that the CP environment in Korea has changed significantly. The survey results for Question 3 are consistent with those of Question 4 in that the data of both showed increased demands for more CP implementation and decreased support for the 'command-and-control' policy in the private sector.

Figure 9-2: EFEC Companies' Changes of Views on Necessities* of the Command-and-Control Policy (Question 3) and Industrial Cleaner Production (Question 4)

Q 3. Do you think it is necessary for government to take strong pollution control measures based on emission standards?
Q 4. Do you think it is necessary for industry and business to adopt environmental management systems such as 'cleaner production'?



**The percentages in Figure 9-2 refer to respondents that selected "Definitely Necessary" among the four progressive options.*

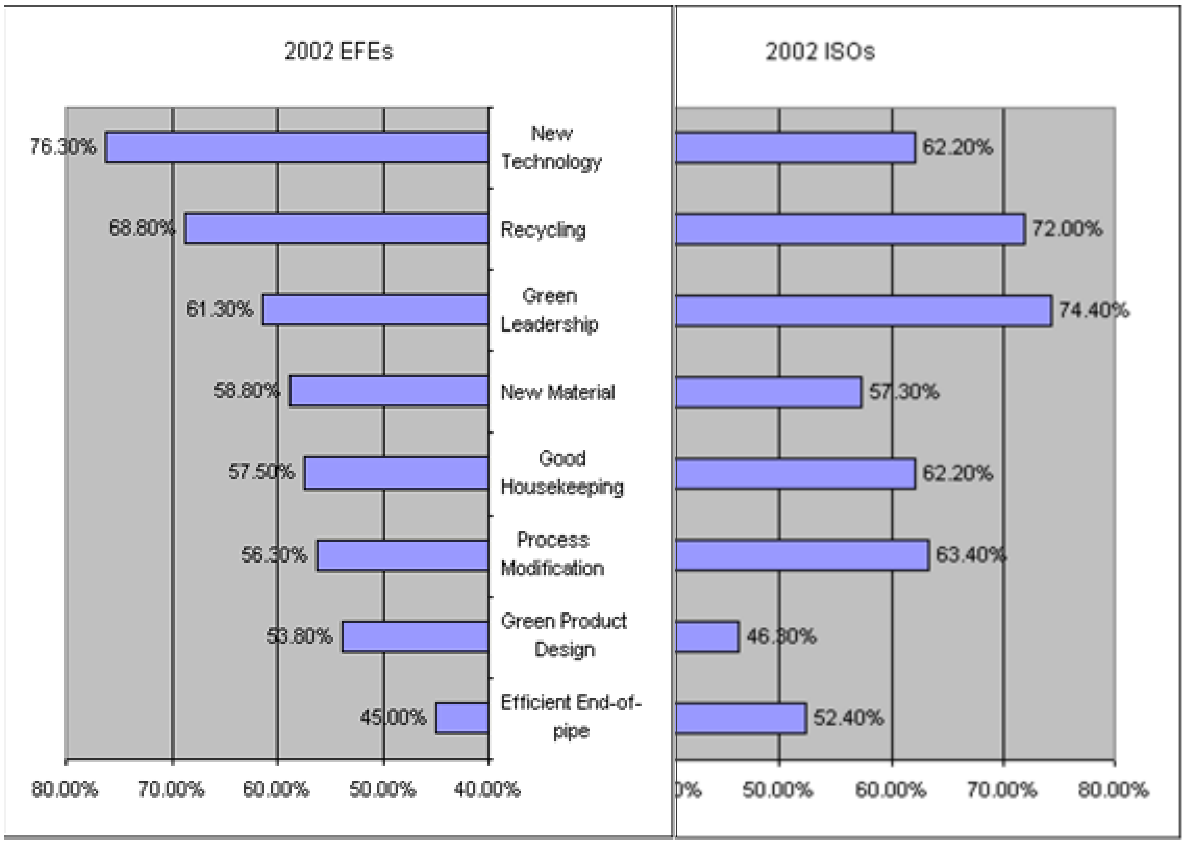
Figure 9-3 presents the 2002 EFEC companies' views of the necessity of governmental intervention in the eight technological CP categories. The leading CP area which requires most governmental involvement is 'Development of new environmentally friendly, technologies' (76%, almost 8 in 10 respondent companies), followed by the item, 'Recycling of wastewater, energy, and material' (69%) and 'CP education for managers and administrators' (61%). Apart from these three top areas, 'Material substitution' (59%), 'Good house keeping' (58%), Process modification (56%), Product design (54%) follow them, and 'End-of-pipe technology' (45%) ranked the last among eight categories. More than 50% of the respondent companies answered that they need governmental involvement or support in most of the CP areas except 'End-of-pipe technology'.

The survey results of Question 5 indicated what kinds of CP policy reform were required from a CP technological perspective. Based upon the proposed sustainability policy model, those 2002 EFEC companies require more upgraded governmental CP programs, which would be different

programs from those required by the 1998 EFEC companies. This statement is consistent with the Adaptation Principle, which says that governmental CP policy should appropriately adjust to an evolutionary stage of CP implementation in order to more adequately foster continuous improvement of CP.

Q 5: *How much do you think governmental support is required, when implementing the suggested cleaner production plans? Please indicate the* ***degree of necessity*** *for each item by circling a number below.*

Figure 9-3: Degrees of Necessity of Governmental Involvement in Eight Types of CP plans



The question is how much has the current ECEC Program in Korea been satisfying these requirements? Unfortunately, as identified in Chapter 8, the current EFEC Program is based upon the command-and-control paradigm such as 'exemption from regular environmental inspections by local environmental authorities'. (See Chapter 8 Section 2) The Program does not provide any updated programs to satisfy these requirements of EFEC companies or for potential program participants.

These results of the triangulation of the three different approaches (the Adaptation Principle, historical data of the EFECP, and the survey results of Question 3, 4 &5) enabled this thesis author to document that these three statements provide similar insights under the different situations. The current Korean EFEC Program does not sufficiently meet the Adaptation Principle.

Policy implications for sustainable CP in Korea tested against the Adaptation Principle

According to the survey results, the current EFEC Program needs to overcome the current logic of the regulatory regime. If the strongest motivation for implementing the current EFEC Program is the exemption from regulatory inspections by environment agencies, the EFEC Program may be considered to be a tool for the 'command-and-control' policy. The Korean Government must adapt the program to the new demands of the program participants as presented in Figure 9-2 and 9-3. In this regards, the new CP program in Korea must be upgraded from being a soft regulation program to a voluntary program and on to a sustainability program in order to meet the communal motive and the pioneering motive of firms, as suggested in Chapter 7. [5]

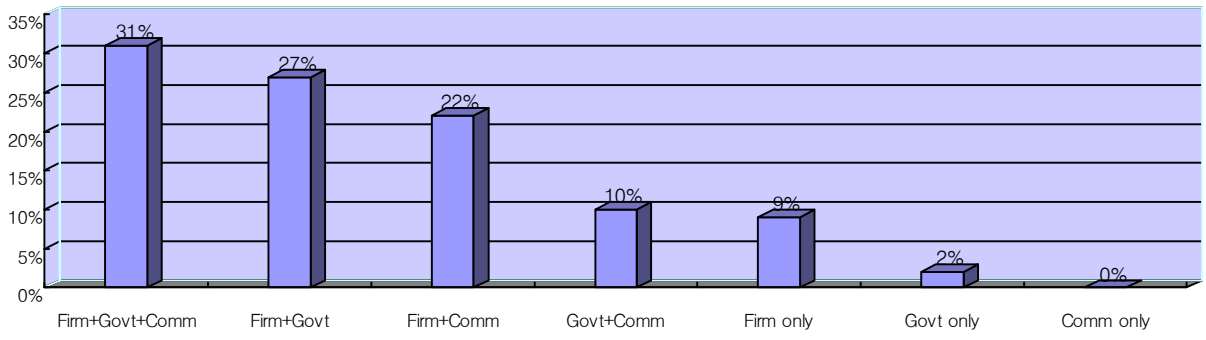
From these findings, it is reasoned, based on the evolutionary sustainability model for CP, that when the Korean Government started the EFEC Program, it was well-adapted because the program was designed to encourage firms to adopt CP approaches beyond the existing regulatory program. Therefore, during the first two years' the numbers of participant-companies increased more than 50%. The start of the program was successful, at least in terms of program-participants. However, the Korean government did not develop and implement upgraded and adaptive CP programs which moved along the trajectory of the evolutionary sustainability model for CP.

9.3 The Knowledge Principle: invigorating CP markets based upon the Triangular Knowledge Cycle for continuous implementation of CP

Introduction

Knowledge is an actor's information for what is still going on and what is to be done (John Dewey, 1916). As discussed in Chapter 4 (Figure 4-3), each social subsystem requires related knowledge for environmental action. Based on the Parsonian typology for a functional society, the thesis author assumes several points related to the roles of sustainable society's subsystems. In this sense, the community requires 'contextual knowledge for its action', industry and business requires 'technological knowledge', and government requires 'reconciliatory knowledge'. Each social subsystem can be helped by the other social subsystem in *producing* knowledge; however, the individual social actor needs to play a central role in *managing* the knowledge.

Figure 9-4: Motivational Collaboration Type among Social Subsystems for CP (%)



Then, the *triangular knowledge links* should mutually cooperate based on each actor's specific

function and knowledge. The results of the empirical study presented in Chapter 5 indicated that 92% of the respondent companies implemented CP under the influence of extrinsic motivation or through mutual interaction with other social subsystems. For example, a chemical company started CP implementation to enhance its social image as a green company, which was motivated by a government CP program. Chapter 5 empirically demonstrated seven types of motivational interactions among the social subsystems of CP. This is shown in Figure 9-4, which is adapted from Table 5-6 in Chapter 5.

While any of the social subsystems, government, community, or industry could theoretically be the initial driver for generating three types of knowledge for CP, this thesis was designed to focus on the desirable strategy of government among the main social subsystems. In testing Guiding Principle 2, it was identified that the CP environment of Korea has changed positively and significantly between 1998 and 2002. Under the changed CP environment, which CP policies are most effective in fostering continuous implementation of CP in the private sector? This thesis author tested the Knowledge Principle in Korean context mainly by analyzing the 1998/2002 survey results of Question 6 and partially by collecting information from official records.

The survey results of 1998/2002 EFEC Program Companies and the Knowledge Principle

(i) Question 6 was designed to query the EFEC companies to select the first and the second-most important policy instruments among the given items for six CP areas. The survey was administered once in 1998 and once 2002. The method of testing Guiding Principle 3 was a methodological triangulation on desirable CP policy for different types of CP options. They were: (i) the policy instruments which the current EFEC Program is using (see Chapter 8); (ii) the requirements which Guiding Principle 3 suggested for the purpose of the continuous improvement of CP implementation (see Chapter 7); (iii) the survey results of the EFEC program participants on desirable policy instruments for six CP areas.

Q6: *What do you think are the most important governmental policy steps for helping your company to implement its 'environmental improvement plan'? Please indicate the most important and the second-most important policy-instruments among the given items for each suggested improvement plan.*

In order to obtaining useful data for testing the Knowledge Principle, the following two assumptions were made. Firstly, the six CP areas were clustered into two groups with three CP-options by the degree of risk (see Chapter 6):

- More Risky CP Options: Development of new environmentally friendly technology, Process modification for better environment, Material substitution for better environment
- Less Risky CP Options: Good Housekeeping such as water & energy conservation, recycling of wastewater, energy, and material, CP education for managers and administrators.

Secondly, six generic environmental policies – which are used as six questionnaire items of Question 6, must be redefined from the proposed *triangular knowledge* perspective as follows:

- The *technology co-development policy* can be considered the governmental program to generate more specific technological knowledge with the private sector;
- The *technical knowledge provision policy* refers to the governmental program to provide less specific technical knowledge which is applicable to the broad industrial areas;
- The *public awareness & education policy* means governmental policy to educate the

public through the contextual knowledge or more general environmental knowledge;
- The *reconciliatory knowledge* does not mean a specific knowledge, but refers to a required set of policy instruments which can close or bridge the sustainability gaps.

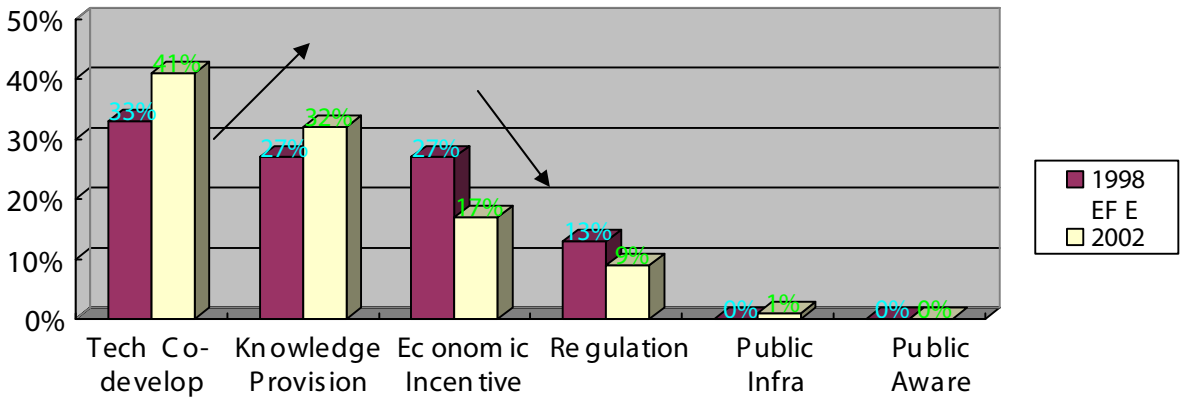
(ii) Interpretation of the survey results on More Risky options: In Chapter 6, the analysis of 100 CP cases was designed to gain insights into the behavioral patterns of firms in implementing CP. The essential findings were:

- Although the internal non-compliance CP-programs (or providers) represented 40% of the total CP companies, only 3% among them invested 'more than USD 500, 000' in capital investment; the other 97% of them invested 'less than USD 500,000 in capital investment and 17% among them had 'more than a two year' payback period. This means that 'Internal non-compliance CP-program' is the lowest environmental risk-taker among four types of CP-programs (providers).
- The Internal non-compliance CP-programs have bigger '*sustainability gaps'* than the internal compliance CP-programs. These results suggest that the internal non-compliance CP-programs require adequate governmental or external incentive policies more than the internal compliance CP-programs, if *the sustainability gaps* pose a serious barrier to continuing implementation of CP (see Chapter 6 Section 4).

It is evident, based upon these data, that the non-compliance CP-programs require adequate governmental encouragement policies in order to facilitate implementation of the 'More Risky CP options'. These results of the policy preference survey for implementing 'More Risky CP options' are consistent with the conclusion from Chapter 6.

Figure 9-5 presents the relative preference of respondents for governmental instrument on implementing 'More Risky CP options.'

Figure 9-5: The Percentages and the Changes in Preference for Policy Instruments with regard to the 'More Risky CP' options



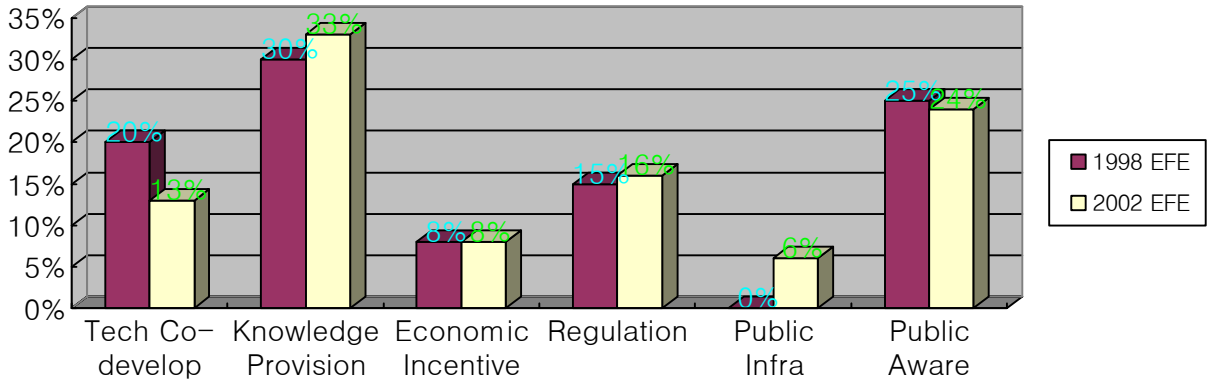
These 1998/2002 survey results of CP policy preference revealed that there was a meaningful shift in the patterns of CP policy preference between 1998 and 2002 at least in the area of 'More Risky CP.' As presented in Figure 9-5, the percentage of the respondents who supported 'Development and Support of Technology Co-development policy' and 'Technical Knowledge Provision policy' increased by approximately 20% between 1998 and 2002. In contrast, the

percentage of the respondents who support the 'Economic Incentive policy' and 'Regulation policy' decreased by more than 30% between 1998 and 2002.

Assuming that implementation of 'More Risky CP options' is essential for continuing CP, it is evident from these survey results of the EFEC companies that a paradigm shift should be made in the area of CP policy. According to these survey results, both policies on 'Development and Support of Technology Co-development' and 'Provision of Technical Knowledge', which seek to develop/generate technology and knowledge concerned with CP based upon cooperation between government and industry, should be the primary components of CP policies at least in the field of the 'More Risky CP options.' These results definitely support the 'Knowledge Principle' of the sustainability policy model, which states "Government has to invigorate CP by exploring 'triangular knowledge links' for CP between industry, community, and government."

(iii) Interpretation of the survey results on Less Risky options: There is a meaningful contrast between Figure 9-5 policy preference for implementing 'More Risky CP options' and Figure 9-6 policy preferences for implementing 'Less Risky CP options.' Firstly, there was little change in the patterns of CP policy preference between 1998 and 2002 in the area of 'Less Risky CP.' As presented in Figure 9-6, the percentage of the respondents who supported 'Technical Knowledge Provision policy', the 'Public Awareness and Education policy', the 'Economic Incentive policy' and even the 'Regulation policy' were essentially constant between 1998 and 2002. Secondly, the percentage of the respondents who supported 'Public Awareness and Education policy' (24% in 2002) was much higher than that for the 'More Risky CP' (0% in 2002). Thirdly, the percentage of those who supported the 'Regulation policy' increased slightly, while the percentage of 'Development and Support of Technology Co-development policy' decreased.

Figure 9-6: Changes of Preferences for Policy Instruments in the 'Less Risky CP options' (%)



It can be inferred from these data that 'Less Risky CP-options' require government to take different policies from the policies for 'More Risky CP-options.' Considering that 'Less Risky CP-options' used to be called the 'low-hanging fruits,' policies to help firms implement 'Less Risky CP-options' should include: high quality general CP information, a broad economic incentive package, and other contextual knowledge for CP, which could be provided by governments, while firms to implement 'More Risky CP-options' require government to provide more technological and specified knowledge or to cooperate in developing technological knowledge.

Policy implications for sustainable CP in Korea based upon testing the Knowledge Principle

The main components of the current EFEC Program of Korea, however, do not include the development and support to generate the triangular technological knowledge for CP. It is not easy to identify how much effort Korean society has made to invigorate the 'CP market or programs' by providing the three types of knowledge for continuous implementation of CP. However, the following secondary clues were found that provide insight into this issue:

- MOE's budget for 'encouraging the EFEC Program' has not been increased since 1995.
- The Korean Environmental Institute's research activities on CP have not been funded since 1998.
- There was no increase in the number of significant articles on CP in the major Korean media between 1998 and 2002.
- No civic group's activities to promote the firms' CP activities were found since 1995.
- A few environmental reports from Korean companies were found, but there were no Sustainability Reports from Korean companies since 1995.

This author's conclusions from the 1998/2002 survey results and these secondary data are that the EFEC companies support the need of the Knowledge Principle for continuing CP in Korea and the EFEC program does not include the technology & knowledge development program based upon cooperation among government, industry, and the community, which is called '*triangular knowledge links for CP*' in this thesis. Figure 9-5 graphically illustrated the necessity of paradigm shift in the patterns of CP policy from 'Regulation and Economic Incentive' to 'Technological Knowledge and Cooperation' at least in the field of 'More Risky CP implementation.'

9.4 The Program Principle: Diversifying CP suppliers (e.g. program-providers)

Introduction

The analysis of suppliers of CP practices in Chapter 6 revealed that there are four types of CP program providers: the private firm' compliance CP program, the private firm' non-compliance CP program, the government CP program, and the international organization' CP program in terms of the program provider. The results of the analysis of 100 UNEP CP cases (Chapter 6) indicated that each provider had its own strengths and weaknesses and that continuous improvement of CP could not be achieved only with the private sector' non-compliance or compliance program, but that government CP programs, including the public sector's CP program, are required, especially for encouraging CP practices with the *communal* or *pioneering motives*. While CP activities combined with the *communal or pioneering motives* should be developed and encouraged for the purpose of realizing a sustainable society, such cases are rarely undertaken, in practice. Therefore, diversifying the CP suppliers or CP program providers must be, at least, a sufficient condition for the continuous improvement of CP.

According to Table 8-1 (Korea's environmental laws/guidelines on industry), the Korean government does not operate diverse CP programs. Apart from the current EFEC program, the Korean government manages the 'Eco-Mark' program and the 'Comprehensive R & D Fund for Environmental Technology'. (KMOE, 2002) Further, the 'Eco-Mark' program is considered an indirect CP program and the R&D fund still focuses on encouraging the end-of-pipe technology. Therefore, the EFEC Program was the unique CP encouragement program operated by the Korean government, at this time. Nevertheless, as shown in Figure 8-2, the number of participating companies of the EFEC Program has remained essentially the same during the last

eight years. Except during the one or two years initial stage, private companies are not being encouraged well by the EFEC program management. Why has the Program not been interesting to potential company participants? Why is the Korean CP program not as active as it was at its initial stage?

According to the guidelines of the Korea EFEC Program (KMOE, 1997), it was designed to promote CP basically being combined with the firms' compulsory motive for CP. In this case, CP practitioners are likely to consider CP implementation to be a tool for meeting regulatory programs. However, environmental impacts of products and production process are very wide spatially, complex chemically, and complicated economically. Regulatory programs cannot control overall ecological impacts of production systems in an environmentally sound and economically effective manner.

Therefore, if CP approaches are preventive, holistic, and legally non-binding environmental activities, governmental CP policies need to be diversified so as to encourage other potential CP activities, which are associated with other three motives for CP implementation. In Chapter 8 it was confirmed that the Korean CP program has not developed innovative or encouraging action programs to meet the financial, communal, and pioneering motives.
In the 1998/2002 survey of the EFEC Program companies, Questions 7 and 8 were designed to evaluate the current EFEC Program itself by querying: i) their views on the needs of various governmental CP encouragement programs (Question 7), ii) the weakness of the EFEC Program (Question 8). The results of two questions provide useful data to test the Program Principle.

The survey results of 1998/2002 EFEC companies and the Program Principle

Question 7 asked respondents to indicate the top three governmental instruments which are most required for implementing CP in their workplaces. The 2002 EFEC Program survey results compared to 1998 EFEC Program survey results.

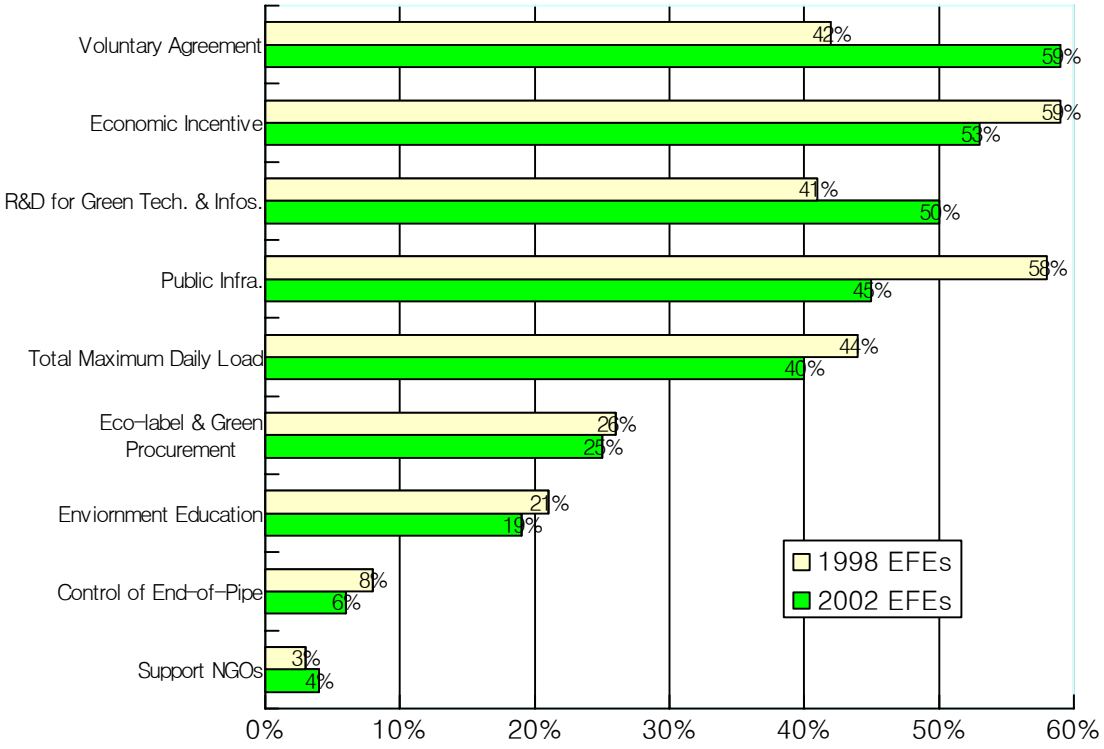
The 'Voluntary agreements through negotiation' was ranked the highest in the 2002 EFEC Program Survey (59%), while it was in 4th position in the for 1998 survey (42%). The 'R&D Program for green technology and knowledge' increased to 3rd position (50%), while it was ranked as 5th in 1998. In contrast, there was a decline from 59% in 1998 to 53% in 2002 on the percentage of 'Economic incentive program' and from 58% in 1998 to 45% in 2002 for the 'Environmental public infrastructure like wastewater treatment plants.'

Such shifts in attitude about several policy instruments are consistent with the assumptions of the evolutionary CP policy model. As a paradigm of environmental policy evolves and is changed according to the demand of society, the relative importance of policy instruments must be changed in an adaptive manner to support the transition to sustainable society.

According to the proposed evolutionary policy model, the EFEC Program is the second stage of the CP policy model, which is called a 'Soft Compliance Program'. At this stage, governmental policy makers assume that CP implementation within the private sector is mainly motivated by the compulsory motive and the financial motive. Therefore, the auxiliary or incentive policies to supplement the main policy should be focused upon reducing the regulatory and financial burdens of the participating firms. This thesis author attempted to associate the four types of CP motives with developmental types of CP activities. Likewise, each of the governmental instruments for fostering CP implementation need to be adapted to new CP environment and need to be diversified to meet diverse CP motives which firms have. (See Chapter 2, Chapter 6)

Q 7. Which governmental instruments do you think are most useful for fostering implementation of CP in your company's workplace? Choose *the top three policies* among the given list, and if there are any additional options, write it or them in the blank.

Figure 9-7: Needs of Diverse Governmental Instruments for Fostering CP Implementation

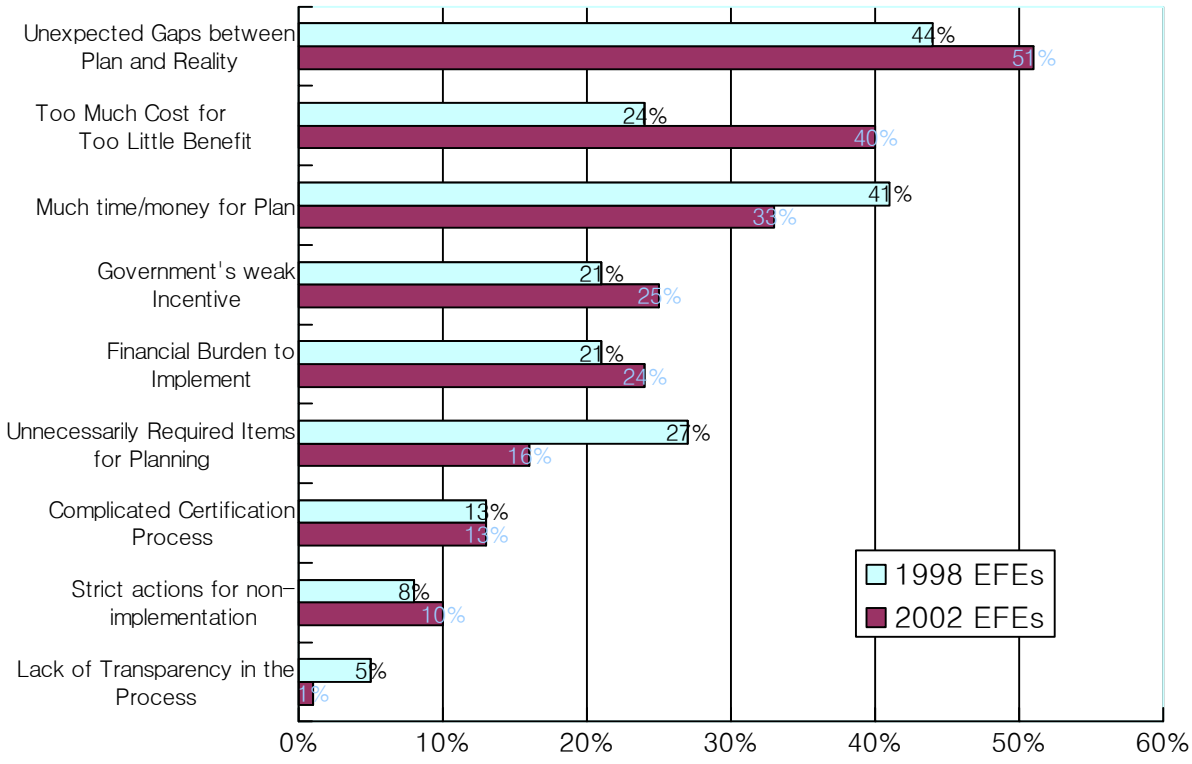


For example, as stated in previous chapters, the communal motive and the pioneering motive of the private sector needs to be connected to new governmental CP programs, because the programs for enhancing ecological sustainability in a certain community is usually beyond the legal regulation or benefit-maximization principle. Therefore, the 'Voluntary agreement program' and the 'R&D program for green technology and knowledge' were ranked the first and the third as well as were increased most rapidly. These encouragement programs may be more appropriate tools for satisfying the communal motive or the pioneering motive for CP implementation than the 'Direct control program' or the 'Public infrastructure program' does. Therefore, diversification of CP programs does not mean the intentional increase of CP program, but it may be an evolutionary process of CP policy to meet increasing and diverse demands for CP implementation in the production sector. The survey results to Question 7 (Figure 9-7) support the need of diversified instruments for fostering continuous CP implementation, which is the Program Principle.

On the other hand, Question 8 pertains to respondents' evaluation of the EFEC Program as a governmental CP policy. Considering that more than 8 years have passed since the start of the EFEC Program, it is useful to reflect on the evaluation of policy participants in designing a new CP policy. Question 8 asked the EFEC companies what were the weaknesses of the EFEC Program in 1998 and again in 2002. Rather than the strengths of the program, the weaknesses of the current policy may be more indicative of the kinds of problems the EFEC Program is now facing. Figure 9-8 presents the percentages of weaknesses of the EFECP by different survey respondents.

Q 8. What do you think are the weaknesses of the EFEC Program? Choose the top two items from the list.

Figure 9-8: Weaknesses of the EFEC Program



The survey data suggested the following three weaknesses: Firstly, 1998 EFEC companies responded that the top weakness of the EFEC Program is 'Unexpected gaps between the three year environmental action plans and the current reality' (44%), which was also ranked top in 2002 by a much higher percentage (51%). This must be a practical example of *a sustainability gap* in the supply side (see Chapter 6) which was generated during the CP implementation

process. This result also indicates that the current governmental program does not have a flexible mechanism to sufficiently reduce the uncertainties or risks which the 'environmental improvement plans' (e.g. CP options) of a program participant company may need. The EFEC Program guideline (KMOE, 1997) includes several articles on this issue as follows:

- EFE-certified companies have to faithfully perform 'the three-year environmental improvement plan' which was submitted by an applicant and reviewed by 'Evaluation Group for EFE Certification', which consist of local experts and local environmental agency officials. (Article 10)
- EFE-certified companies have to summit an annual achievement report to the Regional Office of MOE by the end of the month when certification was initially finished. (Article 12, i)
- The Director -General of the Regional Environment Office reviews the achievement report of the EFEC company through the sample survey and its evaluation report was sent to the Environment Minister. (Article 12, ii)
- Then, the Environmental Minister can cancel the certification of a company which does not have an evaluation score of more than 80/100 from the Regional Office of MOE. (Article 14)

As stated in the EFEC Program guidelines, the Program uses a scoring system by Regional Environment Agency for evaluating the performance of the EFEC companies. According to these companies more than half expressed concern about the possibility that they cannot perform, sufficiently well, the three-year environmental improvement plan, which is a voluntary agreement between a company and government. In relation to Hypothesis 2 (the existence of a sustainability gap), it is clear from these results that there are practical gaps between EFEC companies' 'willingness to pay for CP options' and their actual investments and implementation.

Secondly, the second-ranked item, 'Too much cost for too little benefit' showed the largest percentage increase among the nine items from 24% in 1998 to 40% in 2002. These data indicate that forty percent of the program-participants considered that their company was worse off than before their participation in the program. These results pose a significant problem for the manager of the EFEC Program, that is, Korean government. Another important problem is that the rate of responses to this item is increasing sharply over time. The percentage of, 'Government's weak incentives,' the fourth-ranked item, also increased from 21% in 1998 to 25% in 2002.

Thirdly, in contrast, participants' negative views on administrative procedures were much improved. The percentages of 'Many unnecessary items for preparing the implementation plan', the sixth-ranked item, and 'Too much time/money for preparing the action plans', the third-ranked item, decreased by more than 20%.

It may be evident from the 1998/2002 survey results on the weaknesses of the 2002 EFEC program that the EFEC program does not sufficiently motivate the current participants nor does it challenge potential program participants to join the program willingly. As discussed theoretically in Chapter 2 and empirically supported in Chapter 5, firms may have four intrinsic motives for implementing CP: the regulatory motive, the financial motive, the communal motive, and the pioneering motive. Therefore, it can be reasoned from these motivation hypotheses that the 2002 EFEC Program did not provide a satisfactory level of financial motivation for CP implementation, nor a satisfactory level of communal or social motivation, or provide a satisfactory level of motivation for technological innovation.

The lack of diverse motivation programs which may encourage industry and business to initiate their CP programs, might lead to the unsatisfactory situation that the number of participant companies has remained approximately constant around 110 companies for the last 8 years, with most of SME's not interested in the EFEC Program. The survey results of Question 7 are

consistent with those of Question 8, both of which support the Program Principle.

Policy implications for the sustainable CP in Korea from testing the Program Principle

In order to gain more useful data on designing governmental encouragement policies for CP, this thesis researcher attempted to make a list of prioritized CP encouragement programs based upon the 1998/2002 survey results on **'**Degrees of necessity of government involvement in various CP plans' (Question 5, see Figure 9-3) and 'Policy preference of program participants for CP implementation' (Question 6, see Figure 9-5) as follows. If those two sets of data are combined by the following formula, a prioritized list of 'governmental policies for CP' from the program participants' (or demanders') perspective can be developed by more specified type.

Governmental policy priorities for CP = [Degree of Necessity of Governmental Involvement by CP Area] x [Degree of Participants' Preference for Policy Instruments by CP Area]

Assuming that CP implementation is basically motivated by program participants' voluntarism and that more demander-oriented policies are more effective in implementing such voluntary programs, a prioritized list of governmental policies based upon the voting of program-participants demonstrates how many potential programs are required for encouraging CP by the private sector and what kinds of programs, from that list had been adopted by the EFEC Program adopted.

As presented in Table 9-2, the program participants suggested a wide range of CP governmental programs and their priorities for their implementation. The diversity of suggested policy options and their clear differences in priorities are consistent with the Guiding Principle 4, which requires the diversification of CP policy programs in order to implement the continuous improvement of CP.

Table 9-2: Prioritized List of 48 Potential CP Policy-options for the better EFEC Program

(●: in operation, Δ: no action for the EFEC Program)

Rank	Cleaner Production Policy Options*	Current Choice in Korea
1	Public-private partnership program for 'new cleaner technology'	Δ
2	Provision of 'new cleaner technology' information	Δ
3	Public-private partnership for process modification	Δ
4	Technical '*green*' training for managerial group	Δ
5	Public-private partnership program for material substitution	Δ
6	Technical knowledge provision on 'design for the environment'	Δ
7	Public-private partnership program for 'design for the environment'	Δ
8	Provision of technical knowledge on 'on-site recycling'	Δ
9	Provision of technical knowledge on 'end-of-pipe' management	Δ
10	Provision of technical knowledge on 'good housekeeping	Δ
11	Public awareness & education for managerial group	Δ
12	Public-private partnership for 'end-of-pipe' management	●
13	Provision of technical knowledge on 'material substitution'	Δ
14	Provision of technical knowledge on 'process modification'	Δ
15	Public awareness & education for 'good housekeeping'	Δ
16	Regulatory/deregulatory program on 'on-site recycling'	●
17	Public awareness & education for 'on-site recycling'	Δ
18	Public-private partnership for 'on-site recycling'	Δ
19	Economic instruments (tax, subsidy, etc.) for 'material substitution'	Δ
20	Regulatory program for environmental leadership of managerial group	Δ
21	Economic instruments for new cleaner technology	Δ ●

22	Public-private partnership for 'good housekeeping'	Δ
23	Economic instruments for 'process modification'	Δ
24	Regulatory/deregulatory program on 'material substitution'	●
25	Public awareness & education for 'design for the environment'	●
26	Economic instruments for 'good housekeeping'	Δ
27	Regulatory/deregulatory program on new cleaner technology	●
28	Building public infrastructure for 'recycling'	Δ
29	Economic instruments for 'on-site recycling'	Δ
30	Regulatory/deregulatory program on 'end-of-pipe' management	●
31	Regulatory/deregulatory program on 'good housekeeping'	●
32	Economic instruments for 'design for the environment'	Δ
33	Regulation/deregulation program on 'design for the environment'	●
34	Economic instruments for 'end-of-pipe' management	Δ
35	Building public infrastructure for 'good housekeeping'	Δ
36	Regulatory/deregulatory program on 'process modification'	●
37	Public-private demonstration project for environmental leadership	Δ
38	Economic instruments for environmental leadership of managerial group	Δ
39	Building public infrastructure for environmental leadership	Δ
40	Building public infrastructure for new technology development	Δ
41	Building public infrastructure for 'material substitution'	Δ
42	Public awareness & education for 'material substitution'	Δ
43	Building public infrastructure for 'process modification'	Δ
44	Building public infrastructure for 'design for the environment'	Δ
45	Building public infrastructure for 'end-of-pipe' management'	Δ
46	Public awareness & education for 'process modification'	Δ
47	Public awareness & education for 'end-of-pipe' management	●
48	Public awareness & education for 'new cleaner technology'	Δ

However, it was supported by this list of CP policy tools that the 2002 EFEC Program has not adopted diverse policy-options. Among 48 suggested CP policy options, eight options which are all related to regulatory/deregulatory tools. According to the survey results of the program participants the eight options the EFEC Program has used have very low priorities with regard to CP policies. They have not used the more demand-oriented policy options and they have not adopted more diverse policy options.

As presented in Figure 9-7, the Korean government is not on the side of the sustainability demander, but on the side of sustainability co-supplier with industry and the community. This could be called a paradigm shift. In implementing sustainable CP policy like the EFEC Program, the Korean government should change its philosophical approach of its environmental policy from the 'polluter pays principle' to the 'sustainability shares principle' in that social sub-systems have to share the cost of enhancing their sustainability. Without an external motivation system of diversified CP programs, as both the 1998 EFEC Program survey results and the 2002 EFEC Program survey results indicated, the inclination of private firms to implement CP will diminish.

Consequently, government must proactively provide diverse and adaptive instruments for facilitating and encouraging implementation of CP practices in the private sector. This is the fourth guiding principle for the continuous implementation of CP.

9.5 The Sustainability Principle: establishing 'CP Sustainability Program' designed to continue to support efforts to upgrade the level of CP implementation to help societies make progress toward their goal of a sustainable society

Introduction

This thesis author assumes that CP implementation will eventually lead to the conservation or enhancement of the quality of the ecological system surrounding a given community. The utility or amenity that CP produces is not paid for by the consumer in the market, while many unknown people consume or enjoy the utility or the amenity. As indicated in Chapter 3 (Figure 3-11), the total social benefit from an improved environment is, in many cases, far more that the sum of the individual costs for the improved environment.

Normatively speaking, a sustainability gap occurs when any member of a community does not have the willingness to pay for the consumption of environmental services or sustainability (an environmental good). The proposed 'Sustainability Principle' of the evolutionary sustainability policy model for CP proposes that in order to ensure continuous development of CP, government should proactively establish and implement a 'Sustainability Program for CP,' which can reduce or eliminate such sustainability gaps and thereby help Korea make more rapid progress toward becoming a sustainable society.

To test the proposed 'Sustainability Principle' the thesis researcher employed the triangulation method in the following ways:

(i) The Sustainability Principle of the evolutionary sustainability model was drawn from empirical analysis of 100 UNEP CP database (see Chapter 7). The Sustainability Model suggested four developmental stages of the governmental program, which include 'Compliance Program', 'Soft Compliance Program', 'Voluntary Program', and 'Sustainability Program' (Figure 7-2, Chapter 7).

(ii) The internal barriers to implementing CP were identified (Figure 9-9) that usually cause the 'sustainability gaps.' The continuous reduction of such sustainability gaps through proper implementation of CP is the main elements of the 'Sustainability Program.'

(iii) This thesis author suggests in Table 9-3, 'Fifteen Prioritized Policy-options for CP' based upon the 1998/2002 EFEC Program Survey. This table presents which policy options for promoting CP are required in the 'Sustainability Program,' which is theoretically the final stage of the evolutionary sustainability policy model for CP.

By comparing these three types of data, the author attempted to justify the Sustainability Principle. In doing this testing, the assumption was that governmental actions for continuing implementation of CP should reconcile 'the needs of public sustainability' with 'corporate responsibility for sustainable development,' thereby, overcoming the sustainability gaps between community and industry.

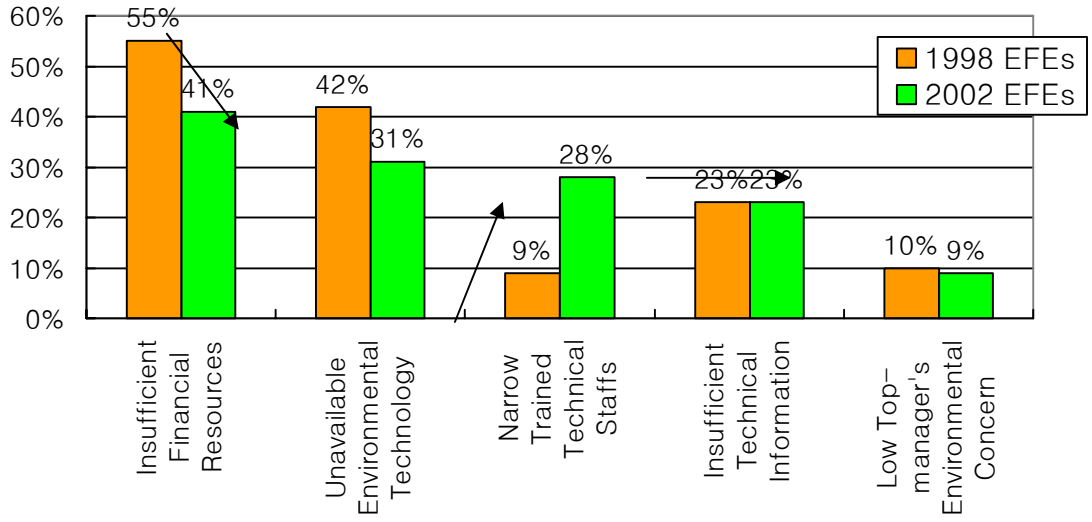
The survey results of 1998/2002 EFEC Companies and the Sustainability Principle

Finally, Question 9 queried the EFEC Program participants' views on technical barriers to implementing the certified CP plan. In fact, many types of constraints or barriers faced in the process of implementing CP may be the main components of practical sustainability gaps from a firm's point of view. If such practical barriers to implementing 'the company's CP plans' are identified, diverse government encouragement programs (see Figure 9-7) should help firms to eliminate and reduce such sustainability gaps.

Figure 9-9 illustrates which types of sustainability gaps the firms are facing in the process of attempting to implement CP options. [See Hypothesis 2]

Q 9: What have been the main barriers to implementing your 'three- year cleaner production plan'?
** Percentage refers to the rating of the respondents to answer, 'Serious' and 'Very Serious.'*

Figure 9-9: Major Internal Barriers to Implementing Corporate CP Plans



Several policy implications can be reasoned from the data of Figure 9-9. First, both the 1998 EFEC companies and the 2002 EFEC companies expressed the same view that the top barrier to implementing CP was the 'Insufficient financial resources.' It is evident from these data that the primary factor to generate a sustainability gap may be 'Insufficient Financial Resources for CP implementation' among the five main barriers: financial factors, technological factors, human resource factors, information factors, and leadership factors. However, it is interesting that the percentage of the 'financial factor' decreased from 55 % in 1998 to 41% in 2002.

Further, the number of 2002 EFEC companies that answered 'very serious' about the financial factor was reduced by 50% compared to that of 1998 EFEC companies (from 14 companies to 7). These data do not provide and explanation about the cause of this shift. However, considering that more than 80% of the survey respondent-companies in the 1998 Survey were the same as those of the 2002 Survey, it can be reasoned that the financial factor for implementing CP decreased over time, because the initial capital investment costs might have already been invested. This phenomenon is in line with typical economic theory that average fixed costs (AFC) decreased over time.

A question could be raised on this issue: 'Should all the costs for implementing CP practices be paid by the EFEC companies? This question is relevant because CP has the characteristic of a mixed good. From an economic perspective, the benefit of the CP does not exclusively belong to the company implementing it. Although the degree of its publicity varies by individual context, the public enjoys a part of the environmental amenities from the CP activity without paying for them. (See Sub-section 2.2.3 and 3.3.1) Further, from the perspective of the proposed evolutionary sustainability model, it was hypothesized and also identified in Chapter 6 that at least from the level of the Sustainability Program, government should share the costs of the Sustainability Program in order to continue to foster implementation the CP. [7] In this context, it is suggested that if government should share some part of CP implementation costs with the

private sector, it would be more effective to partially support the costs at the initial stage and to more actively share the cost of the Sustainability Program with 'More Risky CP options.'

What is also clear from these data is that the percentage of the item, 'Narrowly trained technical staff for implementation of CP,' increased very sharply from 9% in 1998 to 28% in 2002. This is more than a 200% increase! These data indicate that there is a shift, from the need for more financial resources to a need for more technical assistance in implementing the CP plans. These results suggest that as CP evolves, it requires more knowledge-oriented capacity. These increasing tendencies of policy needs for 'Technical Assistance' or 'Technology & Knowledge' were consistent with the survey results of Question 6 &7 (Figure 9-5, 9-6 & 9-7), where the respondents requested more 'R&D for Green Technology and Knowledge.'

Another meaningful finding is that there may be two clusters of barriers: 'Practical Barriers' and 'Background Barriers.' Among the suggested items, 'Insufficient Financial Resources,' 'Unavailable environmental technology,' and 'Narrowly trained technical staffs' belong to the former group, and 'Top-manager' environmental concern,' and 'Insufficient technical information' belong to the latter group. Figure 9-9 shows that the needs for overcoming the 'Practical Barriers' are changing, while the needs to overcome 'Background Barriers' are relatively constant.

Assuming that both groups generate critical sustainability gaps around CP implementation, maintenance of environmentally sustainable industrial production may depend on how effectively government identifies and bridges these sustainability gaps. In this context, the data highlight the urgency for governments to design and implement the 'Sustainability Program,' in such a manner that it reduces or eliminates the gaps by working more closely with industry and the community in adaptive and creative ways. which should reconcile the increasing demand of the community for CP with the conservative CP implementation of the industrial sector by eliminating and reducing certain sustainability gaps adaptively and effectively.

Policy implications for sustainable CP in Korea derived from testing the Sustainability Principle

Based upon the 2002 survey results of the EFEC Program participants, the previously proposed forty-eight prioritized CP policy-options (Table 9-2), and the framework of the evolutionary sustainability policy model, this thesis researcher suggests 'Fifteen Prioritized CP Programs' for the future CP program of Korea.

Although, the final policy will be decided upon through the political process, it is important to recognize the prioritized direction of the CP program and the mechanism to bridge the sustainability gaps by designing and implementing appropriate programs. The overall data strongly suggest that the Korean Government's environmental policy for industry should be changed to promote an adaptive and flexible 'Sustainability Program' for CP, which was strongly supported by the EFEC companies.

According to Table 9-3, the most required governmental program for CP is 'Sustainability Program' represented by a 'Public-private Partnership Program for New Cleaner Technology and Process Modification' (ranked 1st and 3rd). Then, 'Voluntary Program' represented by 'Provision of Technical Knowledge on On-site Recycling' (ranked 8th) and 'Soft Compliance Program' represented by 'Regulation/deregulation Program on On-site Recycling' (ranked 12th). These survey results also support the Sustainability Principle, which reinforces the necessity of a 'Sustainability Program' initiated by the government.

Table 9-3: Fifteen Prioritized 'CP Encouragement Programs' based upon the 2002 Survey Results

Revised Rank by EFE Survey*	CP Program Options	Program Level by the Evolutionary Model	Rank by ISO Survey*
1	Public-private Partnership Program for Development of and Implementation of 'New Cleaner Technologies'	**Sustainability** Program	3
2	Provision of 'New Cleaner Technology Information'	**Sustainability**/ Voluntary Program	18
3	Public-private Partnership for making better 'Process Modifications'	**Sustainability** Program	7
4	Technical '*Green*' Training for the Corporate 'Managerial Group'	**Sustainability/** Voluntary Program	2
5	Public-private Partnership Program for making better 'Material Substitutions'	**Sustainability** Program	4
6	Provision of Technical Knowledge on 'Design for the Environment'	Sustainability/ **Voluntary** Program	17
7	Public-private Partnership Program for improved 'Design for the Environment'	Sustainability Program	10
8	Provision of Technical Knowledge on 'On-site Recycling'	**Voluntary** Program	16
9	Public Awareness & Education for the 'Managerial Group'	**Voluntary** Program	1
11**	Provision of Technical Knowledge on 'Material Substitutions'	Sustainability/ **Voluntary** Program	12
*10***	*Public-private partnership for 'End-of-pipe' Management*	***Soft Compliance*** *Program*	*5*
12	Provision of Technical Knowledge on 'Process Modification'	Voluntary Program	15
13	*Regulation/deregulation Program on 'On-site Recycling'***	***Soft Compliance*** *Program*	*11*
14	*Economic Instruments (taxes, subsidies, etc,) for implementing New Cleaner Technology*	*Voluntary/* ***Soft Compliance***	*8*
15	Economic Instruments (taxes, subsidies, etc.) for implementing 'Process Modifications'	Voluntary/ **Soft Compliance**	6

* The order of the priority is made basically by combining the survey results of the EFEs, and partially reflected the survey results of the ISO-certified firms in case the ISO-certified firms evaluated some items high (within top 10 rankings) or low (below the top 20 rankings).

** The order of these two items is reversed so that the 15 suggested items may be clustered into similar policy groups.

The list of priorities for CP policy identified that the 2002 EFEC Program, the CP Program of Korean government, did neither implement 'Sustainability Program' nor 'Voluntary Program' for the continuous development of CP in Korean society. This indicates that the program elements of the 2002 EFEC Program pose a significant problem in terms of the continuous development of CP

in Korean society. Table 9-3 indicates that, overall, the progressive rise of ranking in policy priorities for CP is in parallel with the developmental stage of the evolutionary sustainability policy model for CP. This suggests that the role of government will progressively increase as the level of CP in a society evolves.

9.6 The conclusions from the tests

- Government should reconcile industry and business with the ecosystem by helping to identify and bridge the Sustainability Gaps in CP implementation. -

Government, as one of the three main suppliers of sustainable CP, needs to design and implement its 'CP program' effectively and in an adaptive and evolutionary manner, which is the aim of this evolutionary sustainability policy model for CP. According to the 'Fifteen prioritized CP policy options' (Table 9-3), it can be easily identified that there are many and varied gaps between the expected policy programs which the policy-participants require government to provide and the current policy program which the government has designed and implemented. These sustainability gaps must be overcome in order to achieve a sustainable society.

In Chapter 9, this author tested the five guiding principles by employing the triangulation method. He identified that there is a logical consistency among the five guiding principles and the achievements and problems of the 2002 EFEC program and the survey results of the 1998/2002 EFEC Program participants. It was found from the historical data and the survey results that the 2002 Korean EFEC Program did not satisfy five guiding principles. Therefore, it was concluded that the five guiding principles can be used to generate useful and innovative insights into designing the new CP policy of *the sustainable Korea*. In other words, the five guiding principles form the fundamental characteristics of the reconciliatory knowledge for CP, which enables the government to reconcile industry and business with the ecosystem.

Although Table 9-3 represents policy categories or policy objectives rather than specific policies themselves, they not only reflect the views of the program-participants group for the required governmental policy but also suggest the reconciliatory knowledge the Korean government should provide to ensure the continuous development of CP from the perspective of the evolutionary sustainability policy model.

Under the profit maximization assumption of private firms and the public good assumption of the environment, it might be natural for a given society to face various kinds of sustainability gaps. For the last three decades, it has been recognized that such environmental sustainability gaps cannot be sufficiently reduced by government regulations alone, which are generally based upon the 'polluter pays principle'. CP practices are not based on the polluter-pays-principle, or upon market price principles. Although the two principles could partially help CP practitioners to adopt CP, they are not adequate to explain why CP is necessary for a sustainable society.

In this situation where environmental benefits and economic successes seem to be mutually exclusive and therefore, neither regulations nor the market seem to work constructively for reducing the sustainability gaps; this thesis author introduces two insightful quotes on the role of government *for greater society* from two different eras:

'The last duty of the state is that of erecting and maintaining those public institutions and *those public works, which, though they may be in the highest degree advantageous to a great society*, are, however, of such a nature that the profit could never repay the expense to any individual or

small number of individuals, which therefore, it cannot be expected that any individual or small number of individuals should erect or maintain. …*Those public works are necessary for facilitating the commerce of the society*…' (Adam Smith, 1776, The Wealth of Nations)

'To be a sustainable society in a very competitive world, *Corporate Social Responsibility* needs to have a genuine economic foundation. The Government has two roles to play in this. First, it can ensure that regulatory and fiscal frameworks encourage CSR and do not stifle it. Secondly, *Government can work in partnership with business and community organizations to catalyze the conversion of CSR theory into real social and environmental investment*. …. Like regulation, these fiscal interventions are not a magic wand. Yet, in some circumstances a financial stimulus is appropriate and *the Government has to take a lead in providing some key inducements to make CSR more widespread*.' (Douglas Alexander, 2002, Business and society, corporate social responsibility report 2002, DTI)

Both Adam Smith (1776) and Douglas Alexander (2002) argue that government needs to play a facilitating or catalytic role in achieving a greater society (or a sustainable society) by providing appropriate *public works* or *stimuli*. While this may be in the highest degree advantageous for a better society, they are such that no individual or small number of individuals is able to afford them. The 'sustainability gaps' addressed in this thesis are in line with this idea. In other words, if there is a gap between what should be done for a satisfactory level of sustainability in a certain context and what has been done by conventional mechanisms, this gap must be reduced or eliminated through government's direct involvement to create a renewed social mechanism. [8]

Therefore, government must identify where socially unacceptable sustainability gaps exist and what government can do to close those gaps in CP implementation so society can evolve in an environmentally sustainable manner. There could be two steps for government to take to help reduce or eliminate such sustainability gaps. The first is to identify where the sustainability gaps exist. The second is to develop the reconciliatory knowledge for CP based upon the five guiding principles, in order to reduce or eliminate them. As the responsible manager of the ecological system, the government has or at least should have a workable vision for a sustainable society, whereby it can identify sustainability gaps, and provide effective stimuli to reconcile the demand of the current economically oriented society with the aspirations for an environmentally sustainable society.

NOTES

1. As the program is a very technical policy, the public or other governmental officials in general could not provide reasonable and valid information. Instead, the policy practitioners could be considered trained and reliable experts for on the EFEC program. Ninety-four percent of respondents of the questionnaire were environmental managers or technicians working for the company. Therefore, some survey results can be reviewed in light of the five guiding principles for continuous CP and some survey results could be useful input knowledge for formulating new CP policy options.
2. The survey results of 2002 EFEC companies show that the percentage of the responsibility of 'industry and business' for the protection of the environment' (remained at 33% in both the 1998 Survey and the 2002 Survey); while the responsibility of 'Ministry of Environment' (MOE) for the protection of the environment increased from 24% in the 1998 Survey to 33% in the 2002 Survey.
3. Under the framework of the sustainability policy model, where the compliance rate of industry is over 99% in most countries, the legal conception of the pollutants and polluters

needs to be constructed in a socially negotiable and environmentally friendly way.
4. As discussed in detail in Chapter 5, motivators for CP are the other side of the barriers to CP. Question 2 asked Korean respondents to answer the three top practical motivators in implementing their CP practices. Although, a similar question was asked for 60 CP companies worldwide, it was slightly different from this Korean case. The question in the survey worldwide was focused on identifying the motivational structure of CP activity (that is, who '*made'* your company start the CP?), while the question for the Korean EFE-certified companies was focused on finding the influential factors in implementing their 'environmental improvement plans' at their workplace; that is, what '*would be'* actually helpful in implementing CP at your workplace?. The latter question was asked to obtaining useful information for designing more effective governmental actions for CP.
5. These survey results support the assumption that the development of CP does not need to exclude the 'command-and-control' policy and that the environmental policy maker needs to establish the complementary framework between the conventional 'command-and-control' policies and the flexible CP policies at the level of country or community.

6. This shows that the survey results are statistically valid and reliable even if the number of samples is approximately 80 companies.
7. It may be a political issue to decide how much government has to share the cost of implementing the highly upgraded level of CP within the private sector. However, when a government aims to provide a CP program effectively and successfully, it has to sufficiently share the financial burden in order to bridge the 'socially shared sustainability gaps.' Therefore, it must be a categorical role of government to measure the status of the 'socially shared sustainability gaps and to devise ways to help close the gaps.'
8. The conception of 'government' here does not refer to just certain central government but covers the much broader area to include general public organizations' roles, which expand upon the functions of government, in the narrow sense.

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Part V CONCLUSIONS

Chapter 10 Conclusions and Recommendations

10.1. Five theoretical hypotheses and the findings from empirical studies

This thesis author started this thesis with an assumption that many public sector issues including environmentally sustainable development areas are likely to face public-private dualistic valuation discrepancies and that CP has dualistic characteristics due to being simultaneously a public good and a private good (Musgrave & Musgrave, 1976, Samuelson & Nordhaus, 1985, Taylor 1998). [1] Under such a dualistic valuation system, most communities will face a 'sustainability gap' where, on the one hand, a member of a community does not have the willingness to pay for producing certain kinds/amounts of environmental sustainability, and on the other hand, the people of a community or the public aspire to be provided with certain kinds/amounts of environmental amenities.

This thesis is designed to answer the research question, 'Which CP policies will enable a given society to promote continuous implementation of CP?' This question is focused on how can social actors, including government, reduce or eliminate the 'sustainability gaps' between the CP demand of a community and the practical supply of corporate utilization of CP.

As a tool to overcome these 'sustainability gaps' from the perspective of government [2], the thesis researcher developed an '*Evolutionary Sustainability Policy Model for CP,*' which is based on the evolutionary stages of firms' psychosocial motives for implementing CP practices: the compulsory motive, the financial motive, the communal motive, and the pioneering motive. It was hypothesized that the driving-force of the evolutionary sustainability policy would be the workable knowledge and technology rather than the conventional command-and-control regulations and standards. This is presented as the '*Triangular Knowledge Cycle for Continuous Implementation of CP*.' In order to build the theoretical framework of CP policy, this author proposed five hypotheses (see Table 10-1) that were tested, mainly by data derived from two empirical studies based upon reports from companies, worldwide, that have implemented CP and from one policy case study of CP implementation in Korea. More specifically, the studies were:

A. The motivation survey of 59 successful CP companies worldwide (see Chapter 5).
B. The analysis of UNEP's 100 successful CP cases (see Chapter 6).
C. The 1998/2002 surveys of the EFEC Program companies in Korea (see Chapter 9).

Table 10-1 presents the summarized results of the empirical findings.

Table 10-1: Summary of Main Empirical Findings in This Thesis

Theoretical Hypotheses	Main Findings
H1. The CP supplier's (e.g. firm) motivational pattern of CP implementation evolves with four developmental stages: the compulsory motive, the financial motive, the communal motive, and the pioneering motive.	<Empirical identification of four motives for CP implementation> • The results of the motivation survey of 59 CP-companies revealed that their CP activities were driven by compulsory motive (39%), financial motive (25%), communal motive (23%), and pioneering motive (13%). (Section 5.4) • Developing countries' respondents have a larger percentage of the 'compulsory motive'(32%), while developed countries' companies have a larger percentage of the 'pioneering motive' (22%) and the 'communal motive' (27%) (Section 5.4). <CP-suppliers at early stage of CP implementation> • 46% of CP-practices before 1989 were undertaken to meet

	governmental regulation and the ratio is decreasing over time (Section 6.4). <Private firms have a certain threshold level for CP implementation> • 'Non-compliance CP-suppliers' (non-compulsory) prefer significantly 'less risky CP-options' than 'Governmental CP-suppliers' and 'Compliance CP-suppliers' (compulsory). Firms are reluctant to be upgraded in the level 'communal' or 'pioneering' status (Section 6.4).
H2. In implementing a CP practice, there is a psycho-social gap on the desirable level of sustainability between the demander's (community) aspirations to ensure that these options are implemented and the supplier's (a firm) willingness to supply and implement them. This researcher calls this the '*sustainability gap*' in CP.	< Difference of actual investment between voluntary CP-supplier and compulsory CP-supplier> • Three percent of the non-compliance CP cases (1 in 33 companies) invested more than 500,000 USD in implementing CP, while twenty-four percent of the compliance CP cases invested it (Section 6.4). • There was a gap between the mean of the capital investment of compliance CP cases (compulsory base – 621,000USD) and non-compliance CP cases (non-compulsory base -118,000 USD) (Section 6.4) < Implementation gaps between 'suggested plan' and 'implemented plan' > • Fifty-one percent of EFEC Program participants revealed that there were gaps between 'suggested CP plan' and CP implementation. (Section 9.4)
H3. Not only company-related factors but also community-related factors and government-related factors work together as joint determinants for CP implementation. In evolutionary stages of CP implementation, *the harmonized triangular knowledge links for CP* based upon those collaborations among different social subsystems play a role as the central driving force in changing the current level of CP implementation into more upgraded level of CP implementation.	<The motivational inter-connectedness for CP implementation among social sub-systems> • Ninety-two percent of the respondents implemented CP through mutual interactions with other social subsystems. These data revealed that CP activities are not pure economic activities but a collective good which requires collaboration of related social subsystems such as government and community. (Section 5.2) • Eighty-six percent of the respondents had its unique CP motivation styles. The results of the survey revealed that private firms have great diversity of CP motivation styles. (Section 5.2) <Cooperation between government and industry> • Thirty-eight percent of sample CP cases were initiated by the public sectors (Section 6.4). • Forty-one percent of Korean EFEC companies supported partnership program with government for implementation of 'More Risky CP options.(Section 9.3)
H4. In order to promote continuous implementation of CP, governments are required to play a reconciliatory role between the societal aspiration for CP and the practical will of firms for CP implementation, having the vision for a sustainable society.	<The role of government in the demand side> • Seventy-zero percent of the respondents were influenced by government-related factors in implementing CP (Section 5.3). <The role of government in the supply side> • Thirty-eight percent of the successful CP cases were directly provided by government or international organizations and twenty-eight percent of the successful CP cases were implemented to comply with regulations (Section 6.4). <Prioritized CP encouragement programs from survey results> • As the most required CP policy, Korean CP Program participants selected 'Public-private Partnership Program for New CP

	Technology', which is considered to be a 'Sustainability Program.'
H5. In order to effectively close the sustainability gaps which may be generated in the process of CP implementation, the governmental CP programs should be designed and implemented in adaptive and evolutionary ways to enhancing the sustainability of industry and business, based upon the framework of the *triangular knowledge cycle* for CP implementation.	<Development of the five guiding principles> • For the design and implementation of a sustainable CP policy, the five guiding principles were developed. (Chapter 7) • These guiding principles were tested and supported by the results from the case study of the Korean EFEC Program. (Chapter 9)

Based upon these results, the key findings of this thesis have been summarized as Table 10-2. Related conventional ideas on CP implementation were suggested in order to more clarify the findings.

Table 10-2: Simplified Findings of This Thesis Compared to the Conventional Ideas

Hypothesis Category	Conventional/Current Ideas on CP	Proposed Ideas Tested in This Thesis on CP
H1: Firms' Behavioral Patterns of CP Implementation	• Firms may act according to the principle of profit maximization in implementing CP.	• Firms may act according to the four evolutionary motives for CP implementation: compulsory, financial, communal, and pioneering motives.
H2: Existence of Sustainability Gaps	• CP can be a good tool to internalize the environmental externalities of firms.	• CP can close the sustainability gaps between the CP demanders and CP suppliers for helping to achieving a sustainable society.
H3:Cooperation for CP Implementation	• Sustainable development requires collaborations between government, businesses, and civil society.	• CP implementation requires 'triangular knowledge links' among contextual, technological, and reconciliatory knowledge and collaboration among the societal sectors in the process of utilizing these knowledge links.
H4: Role of Government	• Governmental support for CP may be a sufficient condition for its implementation.	• Government support may be a necessary condition for evolutionary implementation of CP towards a sustainable society.
H5: Desirable Policy of Governments	• Governments need to take voluntary approaches to promote CP implementation.	• Governments should implement an evolutionary sustainability policy for CP compatible with the four developmental stages of implementation of CP.

10.2 Conclusions and policy insights from applying the five proposed, guiding principles

Based on the findings from the two empirical studies, this thesis author developed the policy model for CP which is characterized by the five proposed, guiding principles. This model is based on the assumption that firms' psychosocial motives for CP may evolve through four developmental stages. The "Evolutionary Cleaner Production Policy Model" proposes how the three different societal subsystems could effectively cooperate and interact in order to

upgrade the level of CP implementation. This cooperation could eliminate or reduce the sustainability gaps at each stage. In this framework, the governmental policies for CP should evolve from 'Soft Compliance Program' to 'Voluntary Program', and on to 'Sustainability Program.'

In the process of developing the evolutionary policy model, it was revealed by the data from the surveys that the central driving force to move from the lower level of CP policy to the higher levels of CP policy is not a single, independent social sub-system's unilateral effort, but should be based upon a multi-lateral, sustainability-oriented, societal cooperation, which can be supported and fostered by the proposed, five guiding principles, where the related knowledge and technologies can be provided.

Now the author summarizes insights gained from assessments of the value of the five, proposed guiding principles for generating/selecting appropriate policy options for improvement of the current CP policies in Korea.

Application of the Five Guiding Principles for improving Korea's CP policies

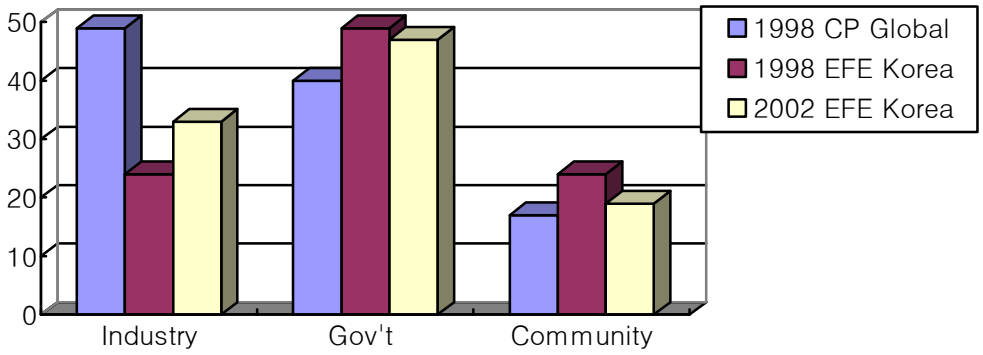
Based on the empirical studies reported on in Chapters 5 and 6, this author has developed the five Guiding Principles for developing "Evolutionary Sustainability Policy Model for CP." They function as the five guiding principles for a sustainable society to implement the continuous improvement of CP:

(i) **The Aspiration Principle**: Identifying whether or not the Korean society maintains anticipative, positive, and balanced motivational structure for continuous implementation of CP;
(ii) **The Adaptation Principle**: Designing new governmental policies in a dynamic manner that are adjusted to the appropriate evolutionary stages of companies in their journey of implementation of CP, focusing on the realization of firms' communal motive and the pioneering motive for CP implementation;
(iii) **The Knowledge Principle**: Invigorating potential CP markets of Korea by developing and effectively applying the triangular knowledge links for continuous implementation of CP as their effective driving forces;
(iv) **The Program Principle**: Diversifying CP suppliers and users through a varied and integrated array of governmental programs and policies designed to eliminate/close diverse sustainability gaps;
(v) **The Sustainability Principle**: In order to achieve the goal of having all Korean companies implement CP, the government should establish a 'Long-term Sustainability Program for CP Implementation' to ensure that the environmentally friendly needs of society are met and all sectors work toward a sustainable society.

These characteristics of the sustainability policy model for CP were tested against the current Korean CP policy by using the triangulation method. The following points summarize the conclusions and insights obtained:

(i) The Aspiration Principle:
Figure 10-1 presents the degree of responsibility of social actors for CP according to the results from three different surveys. These results are consistent with the Aspiration Principle, while the weight of each social actor varied according to the time and the situation. The Korean CP-firms exhibited more of a government-dependent behavioral pattern in implementing CP than did the global CP-firms. The social responsibility of industry in Korea is increasing, over time.

Figure 10-1: The Relative Importance of Different Social Actors' in Catalyzing Implementing of CP (%)



Based upon the survey results, different from the proposed Aspiration Principle, the societal motivational structure does not have to have equal responsibilities among the three social actors. Although, all three social actors should help to ensure implementation of CP, the industrial sector and other facets such as time, context and aspiration of the society.

(ii) The Adaptation Principle:
The Adaptation Principle of a sustainable CP policy (Guiding Principle 2) is one of the most essential conditions of the evolutionary sustainability model for CP, which assumes that CP policy should evolve through the evolutionary stages of the CP supplier (or program) in parallel with the developmental stages of firms' motives for CP: the compulsory or financial motive, the communal motive, and the pioneering motive. Being adapted to this sustainability model, government has to pass through four developmental action-programs over time: Hard Compliance program, Soft Compliance program, Voluntary program, and Sustainability Program (see Figure 7-1, Chapter 7).

It was identified by the results of the 1998/2002 questionnaire surveys that the behavior of participating firms was shifting positively from the command-and-control paradigm to the compulsory motive for CP or more upgraded level of CP motive. The 2002 rate in support of CP is increased sharply to 63%, more than double the 1998 level (25%). This evolutionary transition of Korean firms' behavior from the command-and-control paradigm to the Cleaner Production paradigm required government to take different industry-environment policies being adjusted to their new demands. The rate of most required policy for 'Voluntary approach program' increased from 42% in 1998 (ranked 4th among 9 options) to 59% in 2002 (ranked 1st among 9 options) and the rate for 'R & D program for green technology and knowledge' also increased from 41% in 1998 (ranked 5th) to 50% in 2002 (ranked 3rd), while the rate of most required policy for 'Environmental public infrastructure' fell from 58% in 1998 (ranked 2nd among 9 options) to 45% in 2002 (ranked 4th) and the rate for 'Direct control program' decreased from 8% in 1998 (ranked 8th) to 6% in 2002 (ranked 8th). (See Table 9-5) Program-participants require government to take more negotiation-oriented policy instruments and more knowledge-and-technology-oriented policy instruments rather than the current regulation-oriented tools.

However, the EFEC Program in Korea has not developed new policy instruments adapted to the evolutionally upgraded demands of current and potential program participants for the continuous improvement of CP implementation. According to historical records of the EFEC Program, the policy improvements which were used in 1998 were the same as those used in 2002 (see Chapter 8). The current Program does not provide any appropriate incentives to satisfy those requirements for the upgraded level of CP program.
This methodological triangulation of three different approaches (the Adaptation Principle

drawn from empirical studies, historical data of the EFEC Program, and the results of the 1998/2002 questionnaire survey) enables us to recognize that the current CP program of Korean government, the EFEC Program, does not meet sufficiently the requirement for the more upgraded level of CP implementation, e.g. the Adaptation Principle, which might lead to the non-active state or failure of the current EFEC Program.

(iii) The Knowledge Principle:
The Knowledge Principle for a sustainable CP policy is that CP should be invigorated by exploring 'Triangular Knowledge Links' to CP between industry, community, and government. This third characteristic of the sustainability policy model for CP is the practical driving force for upgrading the level of CP implementation.

It was identified that in the case of 'More Risky CP options' the policy preference rate of program participants for 'Development and support of Technology Co-development between government and industry' increased from 33% in 1998 to 41% in 2002, while their policy preference rate for 'Public awareness and education' was merely 1 % in 2002 (the results of the 1998/2002 questionnaire survey, see Chapter 9). By contrast, in the case of 'Less Risky CP options' the policy preference rate of program participants for 'Development and Support of Technology Co-development between government and industry' fell to just 13 % in 2002 from 20% in 1998, while their policy preference rate for 'Provision of Public awareness and education' still remained 24% in 2002, which was almost similar to 25% in 1998.

Figure 10-2: Different Policy Preferences Between 'Less Risky CP-options' and 'More Risky CP-options' (%)

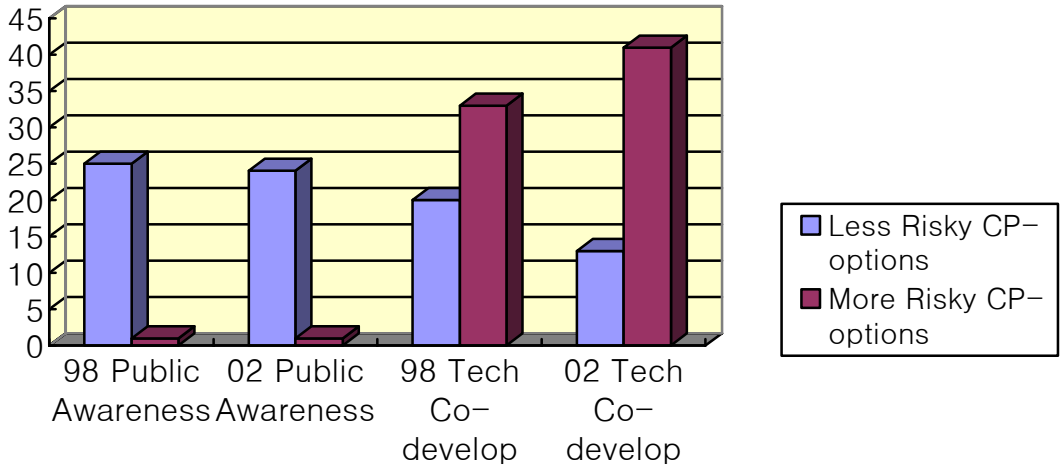


Figure 10-2 presents the significant difference of the policy preference rates between 'Less Risky Options' and 'More Risky Options.' (See Section 9.2) It indicates that the firms to implement 'Less Risky Options' prefers constantly 'Public Awareness Policy', while the firms to implement 'More Risky Options' requires increasingly 'Technology Co-development Policy.' Assuming that a shift from 'Less Risky CP-options' (This is called 'low-hanging fruits.') to 'More Risky CP-option' is an evolutionary process of CP implementation, government has to take progressively active measures to develop 'knowledge and technology' in parallel with evolving demands of firms to upgrade the level of CP implementation. In this sense, these results of the 1998/2002 surveys support the proposed Knowledge Principle (Government's leading role to explore the 'Triangular Knowledge Links for implementation of CP') for continuous implementation of CP.

However, historical data shows that Korean government has not developed appropriate policy instruments which could meet evolving demands of current and potential program participants for the continuous improvement of CP implementation. Accordingly, the CP Program which

started in 1995 has not pass through the developmental stages of CP implementation. This methodological triangulation of three different approaches (the Knowledge Principle developed based upon empirical studies, historical data of the EFEC Program, and the results of the 1998/2002 questionnaire survey) enables us to recognize that the current CP program of the Korean government, the EFEC Program, does not also meet sufficiently the requirement for the Knowledge Principle.

(iv) The Program Principle:
The empirical data in Chapter 6 indicated that the majority of industry and business which implemented non-compliance CP program had their own '*maximum action threshold* for CP implementation.' In this situation, in order to implement the continuous improvement of CP it is necessary for government or external CP providers to take an action for overcoming such '*maximum action threshold* for CP implementation,' which normal firms intrinsically face. This may be an actual existence of the sustainability gaps and the practical objective of governmental policy for continuing CP.

From the perspective of the suggested evolutionary sustainability policy model, government needs to take additional or newly adaptive actions. However, each sustainability gap has its different context and goal being associated with the communal motive and pioneering motive of firms. Therefore, the government program needs to be diversified in order to narrow such sustainability gaps which might be generated differently according to their different financial, technological, political, and ecological context.

Figure 10-3 and 10-4 present two examples of diverse combinations of policy instruments by different CP options based on the 2002 Survey Results of the EFEC Program participants and ISO 14001 certified firms as a comparison group. As indicated in the two tables, different CP areas require government different policy-instruments. These results are compatible with the Program Principle.

Figure 10-3: Desired Mix of Policy Instruments for implementing CP Options based upon the 2002 Survey Results (the EFEC Program Companies)

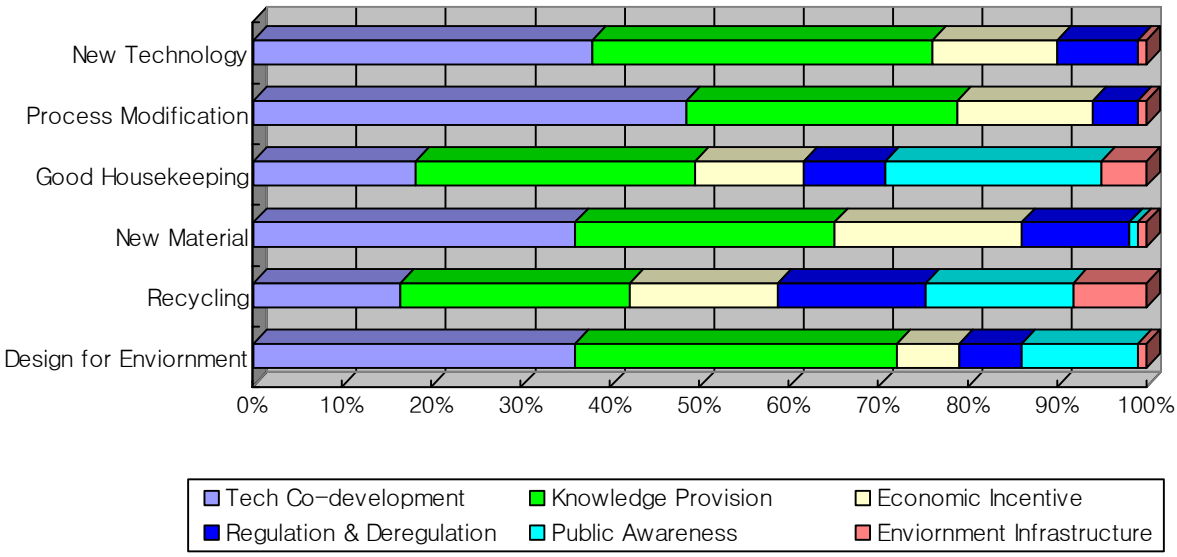
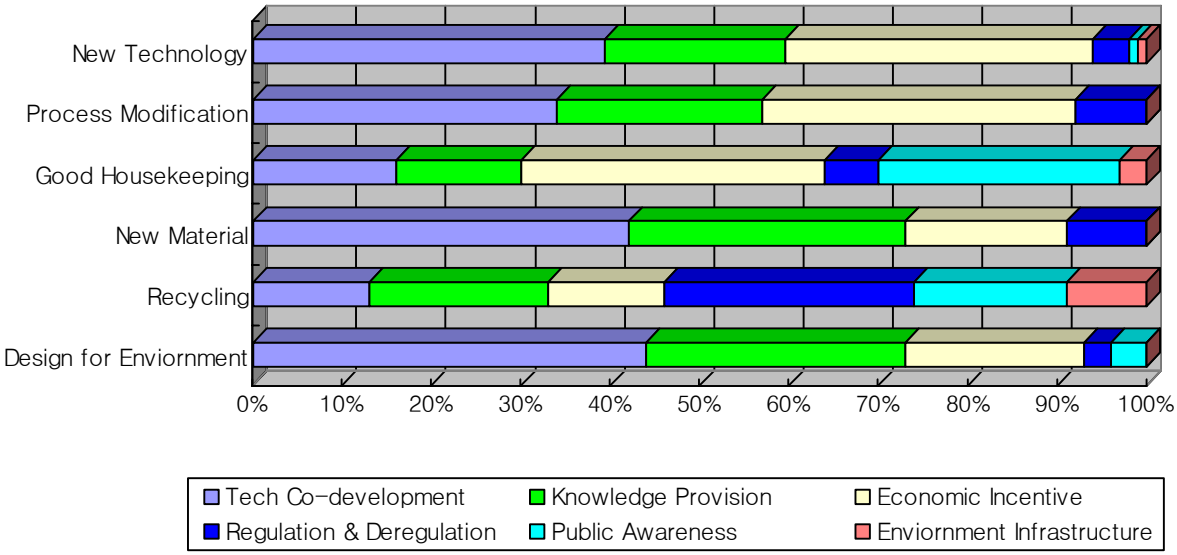
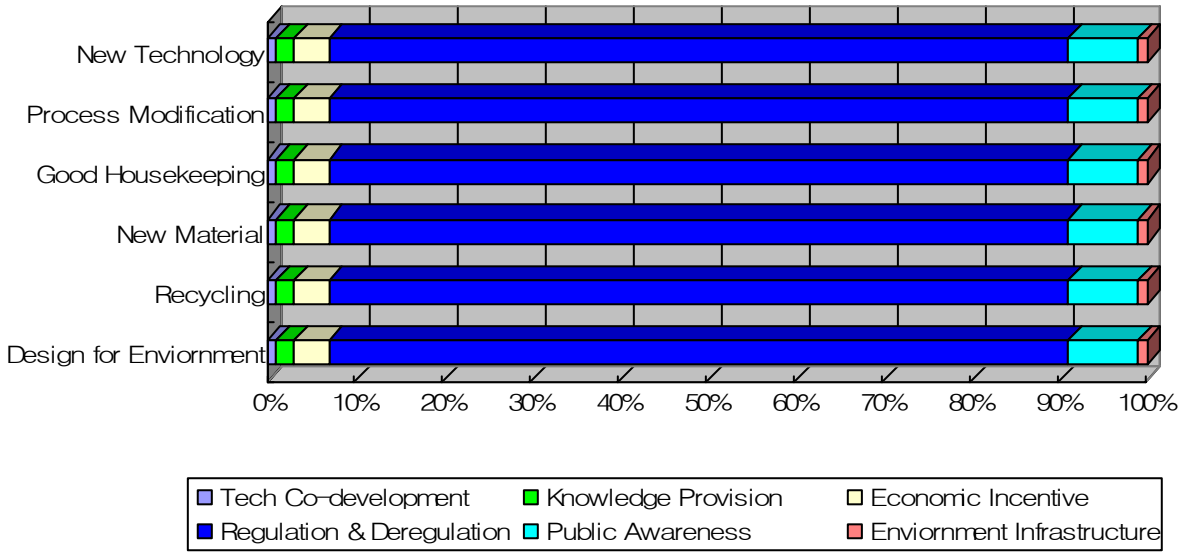


Figure 10-4: Desired Mix of Policy Instruments for implementing CP Options based upon the 2002 Survey Results (ISO 14001 Certified Companies)



However, the substantial elements of the 2002 EFEC Program do not meet these diverse policy demands. They do not include different policy instruments by different CP areas. They do not include specific co-development program, special knowledge provision programs. The central policy instruments they are taking are mainly 'Regulation and Deregulation' instrument, and partially 'Economic Incentive' instrument and 'Public awareness' program. The following Figure 10-5 – which is envisaged by this thesis researcher based on the historical records and the degree of weighing (such as number of related articles) each policy instrument in the program guideline (KMOE, 1997) – illustrates the big gaps between the required policy instrument and the providing policy instrument for CP in Korea.

Figure 10-5: Assumed Mix of Policy Instruments of the Current EFEC Program based upon the 2002 Guidelines of the EFEC Program



(v) The Sustainability Principle:
This Sustainability Principle' is not only the last characteristic of the sustainability policy model for CP but also the long-term goal which the model pursues. It implies that in order for CP to continue, the government should establish the 'Sustainability Program for CP' to support or facilitate the environmentally friendly needs of the private sector. The essential objective of the CP programs should be shifted from 'Regulation and Infrastructure' to 'Knowledge and Technology' for sustainable development as suggested in the previous conditions.

The thesis author tested the Sustainability Principle also by employing triangulation method: (i) Four evolutionary motives of firms for CP implementation (see Sub-section 2.2.1 Chapter 2) identified by worldwide motivations survey (see Chapter 5); (ii) Guiding Principle 5 drawn from empirical analysis of 100 UNEP CP database (see Section 7.2 Chapter 7); (iii) Prioritized policy-options for CP based upon the 1998/2002 Surveys of the EFEC Program participants. Based upon these survey results of the EFECP participants, 'Fifteen Prioritized CP Programs from the 1998/2002 Surveys' (see Table 9-4 in Chapter 9) was suggested.

Table 10-3 is highlighted by the logical consistency between the psycho-social motives of firms for CP implementation, the evolutionary sustainability policy model for CP, and the characteristics of 'Fifteen Prioritized CP Policy-options' in light of the evolutionary policy model. Table 10-3 presents that the progressive rise of ranking in policy priorities for CP, which was supported by the EFEC Program participants, is overall in parallel with the developmental stage of the suggested theoretical policy model for CP. This may suggest that the role of government should be progressively and adaptively increased as the level of CP in a given society evolves. This inductive reasoning is consistent with the Sustainability Principle for the continuous development of CP.

This reasoning is also related with the analyses of successful CP cases in Chapter 6 that most CP practitioners were showing their serious limitation in implementing 'More Risky CP Options.' This means that the higher the level of CP implementation is, the bigger the sustainability gaps are. This author called it a 'certain threshold level' of CP implementation within the framework of voluntarism. (See Chapter 7) Therefore, it may be reasoned from these analyses and data that continuous implementation of CP can be finally achieved when existing and potential firms have the pioneering motive for CP and governments have adequate 'Sustainability Program' to facilitate the realization of firms' pioneering motive for CP. Further, in light of 'triangular knowledge links' for CP, the aspiration of the community for CP constitutes one of the necessary conditions for jumping a 'certain threshold level of CP implementation.'

In this context, it is indicated from Table 10-3 that the 2002 EFEC Program, the CP Program of Korean government, is in the stage of 'Soft Compliance Program' according to the category of the evolutionary sustainability policy model and that the program elements of the Program do not include the policy instruments which are required for implementing the 'Sustainability Program' as well as the 'Voluntary Program.' By adopting the adaptive policy instruments to the upgraded level of CP which are illustrated in Table 10-3, Korean government can reconcile 'the increasing needs of public sustainability' with 'corporate responsibility for sustainable development', overcoming the sustainability gaps between the CP demand of community and the CP supply of industry.

The results of surveys, however, indicate that governmental policies for continuing CP do not always pass through the four developmental stages exactly as showed in the survey results. Therefore, as stressed in the theory of the 'Triangular Knowledge Links for implementation of CP', the most required policy for CP should be designed and driven as a result of the continuous communication between industry, government, and community for encouraging effective 'Triangular Knowledge Cycle for continuous implementation of CP.' [4]

Table 10-3: Conclusive Framework of the Proposed Sustainability Policy Model for CP and Proposed CP-Program Options for Each Developmental Stage

Theoretical Assumptions		**Empirical Results**
Firm's Evolutionary Psycho-social Motives for CP	Evolutionary Levels of Gov'tal CP Program	Required CP Program Options in Korea (Prioritized based upon the '98/'02 Surveys)
Pioneering Motive	**Sustain-ability Program**	1. Public-private Partnership Program for Development and Implementation of 'New Cleaner Technologies'; *2*. Provision of 'New Cleaner Technology Information';* 3. Public-private Partnership for making better 'Process Modification'; 4. Managerial and Technical '*Green*' Training for the Firm's 'Managerial Group'; 5. Public-private Partnership Program for making better 'Material Substitution'; *6*. Provision of Technical Knowledge on 'Design for the Environment';* 7. Public-private Partnership Program for improved 'Design for the Environment.'
Communal Motive	**Voluntary Program**	2. Provision of 'New Cleaner Technology Information'; *4*. Managerial and Technical 'Green' Training for the Firm's 'Managerial Group';* 6. Provision of Technical Knowledge on 'Design for the Environment'; 8. Provision of Technical Knowledge on improving 'On-site Recycling'; 9. Public Awareness & Education for the firms' 'Managerial Group'; 11. Provision of Technical Knowledge on 'Material Substitutions'; *12*. Provision of Technical Knowledge on 'Process Modifications.'*
Financial Motive	**Soft Compliance Program**	13. Regulation/deregulation Program on 'On-site Recycling' – the EFEC Program - ; 14. Economic Instruments (taxes, subsidies, etc,) for developing New Cleaner Technologies; 15. Economic Instruments (taxes, subsidies, etc.) for implementing 'Process Modifications'.
Compulsory Motive	**Hard Compliance Program**	10. Public-private Partnership for improving 'End-of-pipe' Management – the EFEC program -; • Various compliance programs based upon Legal environmental standards and guidelines; • Command-and-control approach.

10.3 Policy recommendations for the evolutionary, sustainable CP Policy of Korea

When current laws and regulations concerning the industry-environment policies in Korea are reclassified into the four program-types of the evolutionary sustainability policy model for CP (Chapter 7), it was identified that most of them belong to the 'Hard Compliance Program.' The EFEC Program is almost a unique non-compliance CP program provided by the Korean central government, which can be classified as the 'Soft Compliance Program.' It could be inferred from this research that the CP policy of Korea may be placed in the initial stage of the suggested evolutionary policy model. Therefore, policy recommendations for the sustainable CP policy of Korea need to be focused on how can the Korean industry-environmental policies for CP be shifted from the level of the 'Hard Compliance Program' or the 'Initial Soft Compliance Program' to the 'Advanced Soft Compliance Program' or the 'Voluntary or Sustainability Program' in terms of the suggested sustainability policy model.

One of the most serious problems the 2002 EFEC Program is facing is that the total number of participating companies in the program has remained approximately constant around 110 companies for the last seven years since 1998. It is in contrast to the number of ISO 14001 Certified companies in Korea, which has been increasing rapidly. Furthermore most of the SMEs have not been willing to become EFEC companies. (See Chapter 9)

The results of both the 1998 Survey and the 2002 Survey indicate that the three most important weaknesses of the Program are i) "Unexpected risk or gap which 'the 3-year environmental improvement plan' would make" (44% for the 1998 Survey, 51% for the 2002 Survey), ii) 'Too much time/money for implementing the planning' (41% for the 1998 Survey, 33% for the 2002 Survey), and iii) 'Too much cost for too little benefit'. It was identified that the participating firms in the Program seemed to have invested more money in processing procedural requirements than they expected and in implementing the suggested environmental improvement plan for themselves. 80% of EFEs are from 'the Big Business Groups' and the percentage of SMEs among EFEs has been less than 5%. These data indicates that the EFEC Program lacks the balanced motivational structure which facilitates diverse social actors to join the CP program (The Adaptation Principle).

Therefore, the Korean government needs to develop CP program with more diverse and balanced motivational structure so that broader social actors may join the program. Some firms can be driven by the compulsory motive in joining the new governmental program, others by the financial motive or the communal motive or the pioneering motive. The thesis author suggested in Chapter 5 that this balanced motivational structure for CP is one of the best conditions for the continuous improvement of CP.

The results of both the 1998 Survey and the 2002 Survey suggested that as long as the sustainable CP implementation is concerned, the essential substance of the governmental CP program would be shifted from issuing regulations/deregulations and governmental guidelines to promoting/providing knowledge and technologies (see Chapter 9, Section 6.4). Government is no more a regulator. Government should be a generator of CP knowledge as well as a provider of CP program. Therefore, Korean government should make efforts to invigorating potential CP markets by developing and effectively applying the triangular knowledge links for continuous implementation of CP as their effective driving forces (The Knowledge Principle).

To this end, the Korean government needs to change its basic approach to promoting CP from the current regulation-oriented package to the knowledge-and-technology-oriented package (Chapter 9). Further, governmental programs to promote knowledge and technology for CP need to be extensively underpinned by 'triangular knowledge link for CP' (Section 4.2 Chapter 4), which requires the harmonization of three types of knowledge (the contextual

knowledge, the technological knowledge, and the reconciliatory knowledge) for creating an adaptive and evolutionary policy.

The suggested evolutionary sustainability policy model assumes that the practical objective of governmental CP policy is to bridge the sustainability gaps between social demand for CP and actual investment and performance of CP. The survey results of CP-implementing firms in Korea as well as outside Korea identified that the sustainability gaps had a variety of different contexts and many alternative solutions to fill gaps (Chapter 6, Chapter 9). The survey results identified respondents-firms required government to use different policy-instruments according to their different CP needs (see Figure 10-2 & 10-3). For example, some firms expected governmental CP program to support for technical knowledge, some firms expected CP program to support for technology development, some expected CP program to support for public awareness, according to their own needs. Therefore, the governmental CP program needs to be diversified or include comprehensive instrument so as to meet different needs of different firms, because each firm can face its own sustainability gap (The Program Principle).

It is strongly required for the Korean government to diversify the policy instruments of the 2002 EFEC Program much more than the current ones in order to bridge the sustainability gaps which the Korean industrial society is facing and to implement the continuous improvement of CP in Korean society.

This thesis researcher tested 'the Sustainability Principle' for a sustainable policy by examining the results of 1998/2002 CP Program Survey, where related key question was "What do you think the most required governmental policies in implementing your company's 'environmental improvement plan?" It was identified from the survey results that the degrees of necessity of the suggested CP programs were overall consistent with the assumption of the suggested evolutionary sustainability policy model for CP. (See Chapter 9)

As indicated in Table 10-3, fifteen prioritized policy options for promoting CP are clustered into the three developmental levels of CP policy. Their rankings of necessity are almost progressively in parallel with the developmental stage of the suggested evolutionary sustainability model for CP. The EFEC Program of the Korean government undertook only two options among fifteen policy options with relatively low priority rankings: the 10^{th} option (Public-private Partnership for 'End-of-pipe' Management) and 13^{th} option (Regulation/deregulation Program on 'On-site Recycling'). These two programs belong to the stage of 'Soft Compliance Program' according to the categorization of the suggested evolutionary model.

The Korean government needs to adopt the other highly prioritized policy options (see Table 10-2) including 1) Public-private Partnership Program for 'New Cleaner Technology' 2)Provision of 'New Cleaner Technology Information'3) Public-private Partnership for 'Process Modification' 4) Technical 'Green' Training for 'Managerial Group' in the policy area of CP. To this end, the Korean government should progressively shift its central paradigm of environmental policy from the current "Compliance Program" towards the "Sustainability Program" via the "Soft Compliance Program" and the "Voluntary Program" along with its long-term vision for a sustainable society.

10.4 Generalizations and limitations of this thesis

Broader application of the "Evolutionary Sustainability Policy Model for CP"

One of the key empirical findings of this thesis is that a firm's behavior of in implementing CP has a tendency of evolving according to the developmental stages of sustainability. Assuming that CP practices means are characterized by a preventive, voluntary, and environmentally friendly fashion of industrial production, the continuous improvement of certain CP programs may not be implemented without some external social organizations'

supporting activities. Because ecological improvements in society are beyond the realm of natural, short-term economic behavior of companies, new paradigms of SD require that community and corporate leaders work together to develop and to implement regional SD plans and programs that transcend the short-term interest of the corporations. Therefore, under the conventional profit maximization assumption of private firms, it might be natural for industry to face various kinds of sustainability gaps. Government needs to identify where such sustainability gaps are and to implement adequate CP policies to help to close the gaps so that a society may evolve in an environmentally sustainable way.

This thesis's two integrated theoretical frameworks – the "Evolutionary Sustainability Policy Model for CP" and the "Triangular Knowledge Cycle for Continuous Implementation of CP" can be used as a tool to appraise or evaluate certain policies/programs from the perspective of design and implementation of integrated sustainability policy, especially where there seems to exist a significant 'sustainability gap' between the paradigm of economics and the paradigm of ecology.

As the responsible manager of ecological systems, government must have a vision for a sustainable society, which makes it possible for them to identify sustainability gaps, and to make efforts to reconcile the demands of the current economically oriented society and the aspirations for environmentally sustainable society. They may wish to do this by taking adaptive and effective actions. In some circumstances the Government has taken a lead in providing some stimuli to make '*Corporate Social Responsibility'* more widespread. (Douglas Alexander, 2002)

Limitations of this thesis

This thesis focused on exploring the evolutionary governmental sustainability policy model to encourage corporations to implement CP as part of the process of transforming their societies to become more sustainable. The recommendations are based upon analyses of data sets derived from CP cases and three surveys of CP practitioners: the first sample for environmentally friendly companies worldwide, the second group for Korean EFE Certified companies, and the last group of Korean ISO 14001 Certified companies. While the survey results are consistent with the suggested hypotheses, these survey analyses contain several methodological limitations.

Firstly, the numbers of companies included in the surveys were relatively small and in some cases were not sufficiently large to provide statistically significant data to fully support the findings and recommendations presented in this thesis. For example, one of the key findings from the 100 CP cases (UNEP database) presented in Chapter 6 was that the average pay-back periods of 'Non-compliance CP Program participants' is far shorter than that for the 'Compliance CP Program participants'. However, the available sample for each program category ranged from 4 companies to 35 companies. Therefore, more empirical research on this area must be performed.

Secondly, this thesis author could not avoid the bias of respondents to answer the questionnaire. Major respondents of the questionnaire for EFEC companies were identified as environmental officers or engineers in the environmental sector of the respondent companies. It could be ascertained from this that they might provide more environment-oriented opinions than management-oriented opinions.

Thirdly, this thesis may have limits due to operational definitions and categorizations. For example, in the analysis of 100 UNEP CP cases, this author categorized the supply of CP-program into four types: Compliance and Non-compliance, Internal and External. However, many CP programs were not so clear and some showed mixed characteristics of more than one of these categories.

Further, the proposed policies for improving the Korean EFEC Program are not specific policies, but could be suggestive policy directions. Therefore, in the real world, more specified and more adaptive CP policies on those areas should be designed, discussed, implemented and their effectiveness monitored very closely, over time.

Fourthly, supposing that CP is a mixed good of a private one and a public one, this thesis focused on analyzing the characteristic of CP as a public good, mainly because the more CP is market-oriented, the less the need of governmental involvement is required, and partially because it was designed to suggest an appropriate policy model for CP, mainly based upon the conventional environmental policy tools such as regulations, economic incentives, and environmental infra-structure, which can be controlled by environmental agencies. Therefore, the short-term economic cycle, the issue of international competition, and many other external factors were not dealt with in this thesis in relation to appropriate governmental CP policies.

However, governmental CP policies need to be adapted to the changing short-term economic cycle and the issue of international economic competition among countries. They are considered as contextual factors in designing and implementing governmental CP policies. From the perspective of the proposed *Evolutionary Sustainability Policy Model for CP Implementation*, these two factors influence the range of *sustainability gaps for CP implementation*, which are theoretical objectives of governmental policies for CP implementation (See Figure 3-5, Chapter 3). It can be simply assumed that economic recession would discourage firms' investment in CP, therefore, the role of government needs to be increased for a sustainable society. On the other hand, rapid economic growth may expand firms' investment in CP and therefore, the role of government might be decreased.

For example, in late 1997 when many Asian countries, including Korea faced the financial crisis, according to the previous assumption, in case where firms rapidly reduce investment in CP due to economic recession, government needs to strengthen CP policy to avoid deteriorating the environment due to reduction of firms′ investment in CP. However, in relation to that economic cycle, the firms′ investment in CP, and related governmental policy in the real society were not so simple. In Korea, during the Asian Crisis from 1997 to 1998, the average air quality of Seoul was dramatically improved and the water quality of Han River also improved even though government did not take any stronger environmental actions. It was determined that most of the improvement of environmental quality was caused by drastic decreases of overall national production and consumption including less use of cars. [5]

Therefore, for a broader understanding of CP implementation and CP policy in relation to the short-term economic cycles or due to international competition, in-depth research is required from the macro-economic viewpoint.

In conclusion, this thesis author hopes that more integrated research will be conducted with regard to sustainability improvements of industry and business. Such studies need to be associated with the areas of sustainable culture and sustainable communities, because a successful CP policy will only be sustained with 'the higher aspirations for ecological sustainability' or 'higher environmental ethic' of industry and communities.

NOTES

1. Otherwise, they may or most probably will pay for the negative benefits or costs of ill health, etc. due to the externalized consequences of the companies' non-internalized risks and costs released upon society.
2. Adam Smith mentioned the role of government as follows:
   'The last duty of the state is that of erecting and maintaining those public works, which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature that the profit could never repay the expense to any individual or small

number of individuals, which it therefore cannot be expected that any individual or small number of individuals should erect or maintain. …Those public works are necessary for facilitating the commerce of the society…' (Adam Smith, 1776, The Wealth of Nations)

3. This thesis focused on the last two alternatives, (ii) and (iii).

4. It is noteworthy that not a few firms in Korea still require environmental agency to take an action for encouraging 'Public-private Partnership for End-of-pipe Management ', which was ranked 10th prioritized policy in the 2002 survey results.

5. It was confirmed in the governmental report to National Assembly (2000, KMOE) that during the Asian Financial Crisis major companies' environmental staff and institutes were more reduced than other department or were changed from environment-department to non-environment-department.

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Appendices

- **Appendix 1: List of Respondents Companies to 1998/2002 Questionnaires**
- **Appendix 2: Results of Motivation Survey of CP companies worldwide (Chapter 5)**
- **Appendix 3: Water-quality Management of 30 EFEC Companies (Chapter 8)**
- **Appendix 4: Other results of the 1998/2002 Survey (Chapter 9)**

Appendix 1: List of Respondent Companies to 1998/2002 Questionnaires

< 1998 CP-Motivation Survey Worldwide>

1. IBM Corporation, USA
2. Crystal Flash Ltd. USA
3. Patagonia, USA
4. Union Camp Technology INC., USA
5. SC Johnson, USA
6. Noranda Inc. Canada
7. Continuous Colour Coat Ltd., Canada
8. SAMSUNG Electronics, Korea
9. LG Electronics, Korea
10. LG Chem, Korea
11. POSCO, Korea
12. SK Chem, Korea
13. Yuhan-Kimberly Ltd., Korea
14. Hanwha Chem (Yochon), Korea
15. LABIOMAR S.A., France
16. CHIMIO Technic, France
17. Lubrizol, France
18. S.C. Raoul-Duval & Cie, France
19. PEC•RHIN S.A., France
20. MSD, France
21. Lucas Diesel, Mexico
22. The Bahrain Petroleum Company, Bahrain
23. Aluminium Bahrain B.S.C, Bahrain
24. Huta Ferrum S.A., Poland
25. IHW, China
26. Gamma International, SA, Argentina
27. Evoluir, Brazil
28. CETESB, Brazil
29. Czech Cleaner Production Centre, the Czech Republic
30. Yantai Second Distillery, China
31. Dezhou, China
32. RFFPP, Romania
33. HWMA, Croatia
34. FCCE, Slovenia
35. ITRI, Taiwan
36. BHP, Australia
37. Volkwagen, Germany
38. N.V. ISOCAB S.A., Belgium
39. Danfoss, Denmark
40. Novotex A/S, Denmark
41. CESAR, Denmark
42. The Unilever Foods, the Netherlands
43. UBS, Switzerland
44. Hitachi. Co., Japan
45. Separem S.p.a., Italy
46. Roche, France
47. Elf Atochem, France

48. PNR, France
49. METALEUROP, France
50. MESSER, France
51. Oril Industrie, France

* *In addition, nine unanimous companies worldwide*

< **1998/2002 EFEC Program Evaluation Survey in Korea>**

1. LG Electronics*
2. Samsung Electronics
3. Doosan Brewery
4. KEPCO
5. Hanwha Chem
6. Samyang Corporation
7. Mando
8. ChipPack Korea
9. LG Micron
10. SK Chem
11. Basf-Korea
12. LG Chem
13. Hyundai Electronics
14. SK Complex
15. Hyundai Motor
16. Samsung BP Chem
17. Cheil Industries
18. Hansol Paper
19. SsangYong Heavy Industries
20. Hanwha
21. Volvo Korea
22. Kemco Ltd.
23. Green Cross (Pharmacy)
24. Samsung Techwin
25. Samsung Heavy Industries
26. Doosan Electronics
27. Hansol Chemicals
28. Samsung Corning
29. Doosan Beverage
30. Asiana Airline
31. Samwha Crown & Closure

* *Many large companies in Korea have their several local workplaces. They answered the questionnaire separately*.

Appendix 2: Detailed Results of Motivation Survey of 'Green' Firms (Chapter 5)

*Question I: What **was** the most decisive Motivation for your company to implement cleaner production? Choose three items according to priority. (N=59)*

Experienced Motivation Patterns of 59 '*Green*' Companies for CP

Ranking*	Motivation item**	Priority 1 (P1)	N=P1+P2+P3***	Weighed Scores (WS=P1x3+P2x2+P1x1)
1	● Top-manager's environmental leadership	N=18 30.5 %	N=18+12+5=35 19.6 %	WS=83 23.4 %
2	● Profit incentive	N=9 15.3 %	N=9+5+10=24 13.4 %	WS=47 13.2 %
3	● Government regulation	N=10 16.9 %	N=10+4+8=22 12.3 %	WS=46 13.0 %
4	● Good public image	N=4 6.8 %	N=4+10+13=27 15.1 %	WS=45 12.7 %
(accumulated percentage)		(69.5 %)	(60.4 %)	(62.3 %)
5.	●International standardized guideline	N=2 3.4 %	N=2+9+3=14 7.8 %	WS=27 7.6 %
6	● In-house engineer's Creative input	N=0 0.0 %	N=0+7+7=14 7.8 %	WS=21 5.9 %
7	● Government's economic incentive	N=3 5.1 %	N=3+4+1=9 5.0 %	WS=18 5.1 %
8	● Cleaner Production cases o other companies	N=2 3.4 %	N=2+1+5=8 4.5 %	WS=13 3.7 %
9	● Scientific reports on certain pollutants discharged	N=3 5.1 %	N=3+1+1=5 2.8 %	WS=12 3.4 %
10	● International environmental convention	N=2 3.4 %	N=2+2+2=6 3.4 %	WS=12 3.4 %
11	● Compliance with international trade order	N=3 5.1 %	N=3+1+1=5 2.8 %	WS=12 3.4 %
(accumulated percentage)		(95.0 %)	(94.5 %)	(94.8 %)
12	● Partnership with consultin company	N=1 1.7 %	N=1+1+0=2 1.1 %	WS=5 1.4 %
13	● Available cleaner producti information by environmental organizations	N=1 1.7 %	N=1+0+2=3 1.7 %	WS=5 1.4 %
14	● Activities of NGOs and media	N=1 1.7 %	N=1+0+1=2 1.1 %	WS=4 1.1 %
15	● Demand from a labor unio	N=0 0.0 %	N=0+1+1=2 1.1 %	WS=3 0.8 %
Open-ended		N=0 0.0 %	N=0+1+0=1**** 0.6 %	WS=2 0.6 %
Total		TN=59 100 %	TN=179 100 %	TWS=355 100 %

*Rankings in this column are based on the score of (P1x3+P2x2+P3x3)

** Suggested expressions are the abbreviations for motivation items (See Table 3-1)

*** P1, P2, P3 refer to priority 1, priority 2, priority 3 motivators of the company in question, respectively.

**** This N=1 means a respondent (Poland, metal) suggested 'accessibility to cheap credit' as a second-order priority.

*Question II: Which strategies do you expect to play an important role in improving your company's CP-performance **in future**? Choose three items according to priority. (N=59)*

Expected Motivation Patterns of 59 Companies for CP in the future

Ranking*	Motivation item**	Priority 1 (P1)	N=P1+P2+P3***	Weighed Scores (WS=P1x3+P2x2+P1x1)
1	● Top-manager's environmen leadership	N=13 22.0 %	N=13+10+3=26 14.8 %	WS=62 17.6 %
2	● Profit incentive	N=11 18.6 %	N=11+ 5+10=26 14.8 %	WS=53 15.1 %
3	● Government regulation	N=10 16.9 %	N=10+ 5+ 9=24 13.6 %	WS=49 13.9 %
4	● Good public image	N=4 6.8 %	N=4+ 10+ 6=20 11.4 %	WS=38 10.8 %
(accumulated percentage)		(64.3 %)	(54.6 %)	(57.4 %)
5.	●International standardized guideline	N=2 3.4 %	N=2+ 10+ 4=16 9.1 %	WS=30 8.5 %
6	● In-house engineer's Creative input	N=2 3.4 %	N=2+ 5+ 8 =15 8.5 %	WS=24 6.8 %
7	● Government's economic incentive	N=4 6.8 %	N=4+ 3+ 5=12 6.8 %	WS=23 6.5 %
8	● International environmental convention	N=3 5.1 %	N=3+ 3+ 1 =7 4.0 %	WS=16 4.5 %
9	● Scientific reports on certain pollutants discharged	N=2 3.4 %	N=2+ 3+ 2=7 4.0 %	WS=14 4.0 %
10	● Compliance with international trade order	N=3 5.1 %	N=3 +1 +3=7 4.0 %	WS=14 4.0 %
11	● Cleaner Production cases of other companies	N=3 5.1 %	N=3 +0 + 3=6 3.4 %	WS=12 3.4 %
12	● Available Cleaner productio information by environmental organizations	N=2 3.4 %	N=2 + 2+ 1=5 2.8 %	WS=11 3.1 %
(accumulated percentage)		(100 %)	(97.2 %)	(98.2 %)
13	● Partnership with consulting company	N=0 0.0 %	N=0 + 1 + 1=2 1.1 %	WS=3 0.9 %
14	● Demand from a labor unior	N=0 0.0 %	N=0 + 0 + 2=2 1.1 %	WS=2 0.6 %
15	● Activities of NGOs and media	N=0 0.0 %	N=0 + 0 +1=1 0.6 %	WS=1 0.3 %
Open-ended		N=0 0.0 %	N=0 0.0 %	WS=0 0.0 %
Total		TN=59 100 %	TN=176 100 %	TWS=352 100 %

*Rankings in this column are based on the score of (P1x3+P2x2+P3x3)
** Suggested expressions are the abbreviations for motivation items.
*** P1, P2, P3 refer to priority 1, priority 2, priority 3 motivators of the company in question, respectively.
**** This N=1 means a respondent (Poland, metal) suggested 'accessibility to cheap credit' as a second-order priority.

Appendix 3: Water-quality Management of 30 EFEC Companies (Chapter 8)

(KMOE, 1998)

Companies*	Primary environmental target	Cleaner technology	Capital investment	Payback periods	Eco-efficiency
1	Wastewater reduction	PM	700 M won	3 year	61%
2	Wastewater reduction	GH	20 M won	0.5 month	26%
3	Wastewater reduction	RE	65 M won	0.3 month	100%
4	Wastewater reduction	MS	24 M won	At once	84%
5	Zero waste water	PM	36 M won	1.2 year	100%
6	Change of water use	PM/RE	16 M won	2 year	13%
7	Wastewater reduction	PM/RE	2 M won	0.6 year	-
8	Efficient treatment system	RE/PM	35 M won	1.5 year	1%
9	Zero hazard wastewater	PM	500 M won	4.3 year	100%
10	Wastewater reduction	PM	30 M won	0.5 year	25%
11	Wastewater reduction	PM	19 M won	0.5 year	-
12	Wastewater reduction	RE	13 M won	0.3 year	-
13	Wastewater reduction	PM/RE	0	0.3 year	-
14	Wastewater reduction	PM/RE	8 M won	-	-
15	Wastewater reduction	PM	12 M won	2.9 year	25%
16	Safe hazard wastewater	PM	350 M won	-	90%
17	Wastewater reduction	RE	30 M won	2.5 year	-
18	Zero waste water	PM	17 M won	2.4 year	100%
19	Wastewater reduction	GH	0.5 M won	At once	90%
20	Wastewater reduction	GH	0.5 M won	At once	90%
21	EF-pipeline development	PD	400 M won	1 year	-
22	Efficient Bio-PC tech.	PM/NT*	450 M won	3.2 year	-
23	Wastewater reduction	MS	0	At once	9%
24	Wastewater reduction	PM/NT	85 M won	At once	-
25	Water conservation	PM	6 M won	0.1 year	-
26	Drinking water recycling	RE	37 M won	1.1 year	-
27	Zero waste water	RE/PM	500 M won	(More 15 years)***	100%
28	Wastewater reduction	GH	0.5 M won	At once	12.5%
29	Drinking water recycling	GH	0.9 M won	0.6 year	-
30	Wastewater reduction	GH	1 M won	At once	-

* Names of participants here are not their legal names. They are abbreviated names.

** NT: development of new technology

*** The report does not indicate the payback period. The number was estimated by given data.

Appendix 4: Other results of the 1998/2002 Survey (Chapter 9)

1. Participants' psychological recognition on water and air pollution

Q . How do think about environmental problems around your workplace?

< The percentage of respondents to answer 'very serious' and 'serious' among five scale items >

	1998 EFEs	2002 EFEs	2002 ISOs
Water pollution	16.6%	7.5%	14.5%
Air pollution	11.5%	12.5%	28.9%

2. The effectiveness of the EFEC Program by technological type

[Water]

Ranking	1998 EFEs (N=78)	2002 EFEs (N=80)
1. Process modification for less water pollutants	71.8% (22+34)	75.0% (26+34)
2. Good Housekeeping such as water conservation	53.8% (10+32)	53.8% (7+36)
3. Efficient onsite wastewater treatment system	46.2% (4+32)	40.0% (5+27)
4. Material substitution for better water quality	44.9% (6+29)	38.8% (6+25)
5. Product design for less water pollutants	37.2% (6+23)	43.8% (9+26)
6. Recycling wastewater	35.9% (6+22)	36.3% (11+18)
7. Technology outsourcing for better water quality	32.1% (6+19)	33.8% (7+20)
8. New technology development for water quality	24.4% (5+14)	38.8% (6+25)

[Air]

Ranking	1998 EFEs (N=78)	2002 EFEs (N=80)
1. Material substitution for better air quality	74.4% (16+42)	72.5% (23+34)
2. Process modification for less air pollutants	62.8% (12+37)	67.5% (19+35)
3. Good Housekeeping such as energy conservation	48.7% (3+35)	58.8% (7+40)
4. Efficient onsite equipments to improve air quality	30.8% (4+20)	45.0% (7+29)
5. Product design for less air pollutants	29.5% (6+17)	41.3% (9+24)
6. Technology outsourcing for better air quality	25.6% (4+16)	42.5% (14+20)
7. New technology for improving air quality	14.1% (1+10)	31.3% (12+13)
8. Recycling airborne waste	12.8% (4+6)	15.0% (3+9)

[Waste]

Ranking	1998 EFEs (N=78)	2002 EFEs (N=80)
1. Process modification for less waste	69.2% (15+39)	71.3% (21+36)
2. Good Housekeeping like material conservation	66.7% (7+44)	60.0% (5+43)
3. Material substitution for less waste	62.8% (11+38)	60.0% (14+34)
4. New technology for less waste	57.7% (16+29)	46.3% (13+24)
5. Onsite recycling of waste	53.8% (11+31)	53.8% (14+29)
6.Better management of onsite landfill or incinerator	35.9% (2+26)	31.3% (6+19)
7. Product design for less waste	32.1% (7+18)	47.5% (10+28)
8. Technology outsourcing for less waste	32.1% (3+22)	36.3% (8+21)

3. Change of internal communication for environmental improvement and summary

	1998 EFEs (N=78)	2002 EFEs (N=80)
Internal communication to improve water quality	51.3% (5+35)	51.3% (10+31)
Internal communication to improve air quality	47.4% (1+36)	52.5% (6+36)
Internal communication to reduce waste	57.7% (6+39)	57.5% (6+40)

4. Difference of EFE Effectiveness by community (example)

< 1998 EFE Survey>

	Seoul/Geonggi area (N=17)	Gyeong-sang area (N=37)
Process modification for less water pollutants	76.5% (5+8)	75.7% (12+16)
Process modification for less air pollutants	41.2% (2+5)	73.0% (6+21)
Process modification for less waste	58.8% (3+7)	73.0% (8+19)

<2002 EFE Survey>

	Seoul/Geonggi area (N=21)	Gyeong-sang area (N=24)
Process modification for less water pollutants	71.4% (4+11)	79.2% (10+9)
Process modification for less air pollutants	52.4% (3+8)	75.0% (10+8)
Process modification for less waste	66.7% (4+10)	75.0% (12+6)

5. An example of different policy preference by different community

i) Policy preference for 'Material Substitution' for cleaner production

< Seoul Community >

	Economic incentives	**Regulation/ deregulation**	**Knowledge provision**	**Technology development**
1998	29%	29%	24%	18%
2002	35%	20%	20%	20%

< Gyungsang Community>

Economic incentives	**Regulation/ deregulation**	**Knowledge provision**	**Technology development**
17%	11%	33%	39%
14%	5%	33%	43%

ii) Policy preference for 'Good Housekeeping' for cleaner production

< Seoul Community >

	Knowledge provision	**Public awareness**	**Technology development**	**Economic incentives**
1998	29%	29%	18%	6%
2002	26%	26%	16%	5%

1998	53%	33%	7%	0%
2002	42%	25%	5%	2%

< Gyungsang Community>

Knowledge provision	**Public awareness**	**Technology development**	**Economic incentives**
25%	19%	39%	11%
33%	25%	17%	13%

19%	69%	4%	0%
21%	47%	11%	11%

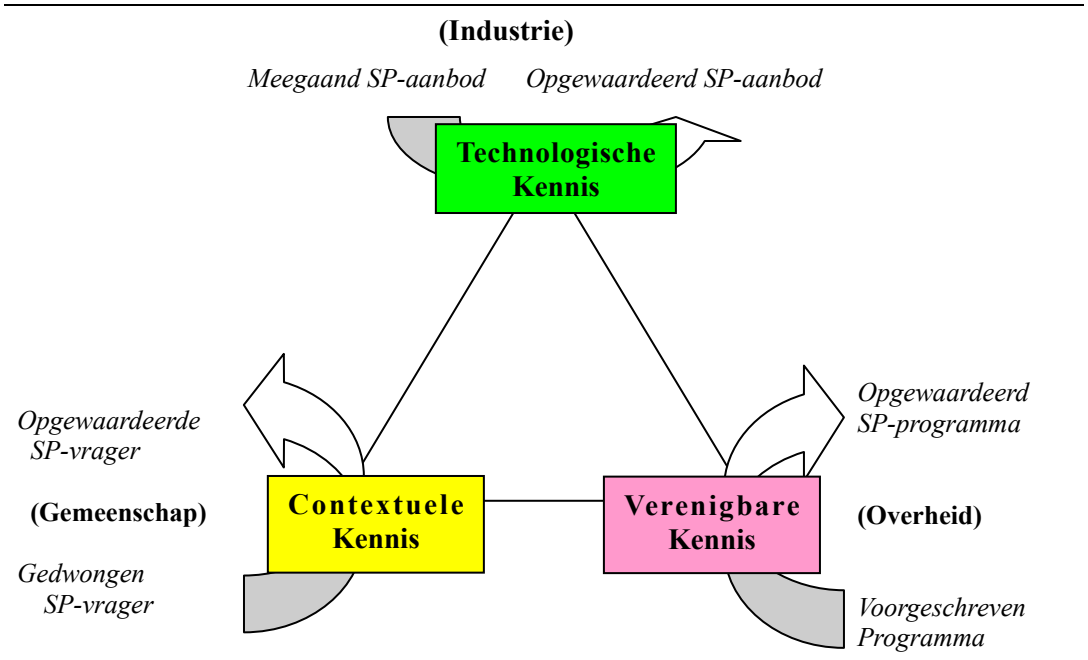
Samenvatting

I. Theoretisch Raamwerk

Schonere Produktie (SP) kan een noodzakelijke voorwaarde voor de maatschappij zijn om duurzame produktiesystemen in te voeren en in stand te houden. Op basis van de significante uitdagingen om vooruitgang in de richting van duurzaamheid en de huidige stagnatie in SP-implementatie mogelijk te maken, vraagt deze auteur zich af, '*Welke typen overheidsbeleid adekwaat zijn om de voortdurende implementatie van SP te faciliteren?'. In antwoord op deze vraag presenteert de auteur een door hem ontwikkeld evolutionair duurzaamheids beleidsmodel* voor het ontwerpen en implementeren van SP.

Om tot dat stadium vooruitgang te boeken, formuleert de auteur als hypothese dat het gedragspatroon van bedrijven zich ontwikkelt in vier ontwikkelingsfasen van SP-implementatie: het motief op basis van dwang, het financiële motief, het gemeenschaps motief, en het pioniers motief (Hypothese 1). Hij formuleert verder als hypothese dat verbindingen tussen drie typen kennis – contextueel, technologisch, en verenigbaar – (Deze auteur noemt dat 'Driezijdige Kennis Cyclus' in figuur A) cruciale rollen spelen als drijvende krachten voor het opwaarderen van het huidige niveau van SP-implementatie (Hypothese 3, zie figuur A).

Figuur A: SP Evolutieproces zoals weergegeven door de 'Driezijdige Kennis Cyclus'



♣ *Elk van deze drie kennistypen kan dienen als trekker van de adoptie en implementatie van SP. De andere twee kennistypen voorzien in een toegevoegd momentum voor de continuë implementatie van SP.*
♣ *Door de samenwerking tussen deze drie kennistypen wordt de grondslag van de kennis die essentieel is voor de implementatie van duurzaamheid, voltooid.*

Op basis van de herkenning dat SP-kenmerken van economische en ecologische activiteiten op weg naar een duurzame maatschappij mengt, heeft de auteur gevonden dat de SP-implementatie vragen van de gemeenschap gebaseerd zijn op hun contextuele kennis en hun wens van een duurzamere maatschappij. De bereidheid van bedrijven om SP te implementeren voorziet in de essentiële elementen van technische kennis. Het overheidsbeleid om SP-implementatie te bevorderen voorziet voornamelijk in *verenigbare* kennis (zie figuur A). Door de samenwerking tussen deze drie kennistypen wordt de grondslag van de kennis, die essentieel is voor de implementatie van duurzaamheid, voltooid.

Binnen het raamwerk van de driezijdige kennisverbindingen voor de implementatie van SP, veronderstelt deze auteur dat er een sociaal-economische afstand bestaat tussen de aspiraties van gemeenschappen inzake SP-implementatie en de bereidheid van bedrijven om te voorzien in de implementatie van SP-technologieën en diensten, omdat er twee verschillende drijfveren voor de implementatie van SP in een duurzame maatschappij zijn: het economisch paradigma en het ecologisch paradigma. Daarom zal continuë SP-implementatie niet worden bereikt zonder voortdurende pogingen om deze afstand te overbruggen. Deze auteur noemt dit de 'duurzaamheidsafstand' (Hypothese 2).

In de veronderstelling dat samenwerking tussen de drie voornaamste sociale subsystemen – industrie, gemeenschap, overheid – noodzakelijk is voor de continuë implementatie van SP (Hypothese 3), hangt het overheidsbeleid voor SP in een duurzame maatschappij af van hoe effectief overheden die duurzaamheids afstand, welke de basis is voor de theoretische doelstellingen van het overheidsbeleid voor SP-implementatie, kunnen dichten. Overheden moeten actie ondernemen om duurzame SP-aspiraties van de gemeenschap met de praktische bereidheid van bedrijven om SP-activiteiten te implementeren, te verenigen (Hypothese 4).

Vanuit dit normatieve raamwerk voor continuë SP-implementatie, heeft deze auteur zich op de ontwikkeling van het evolutionaire beleidsmodel gericht. Welk beleid kan worden ontwikkeld en geïmplementeerd teneinde de continuë implementatie van SP te helpen verzekeren? In overweging nemend dat SP-beleid niet op *command-and-control* activiteiten gebaseerd moet zijn, maar moet worden ondersteund op basis van vrijwilligheid en innovatie, heeft deze auteur verondersteld dat het SP-programma van de overheid een 'adaptieve en evolutionaire benadering' moet aannemen om SP-implementatie aan te moedigen als de *verenigbare kennis* van de overheid om milieu-effectiviteit en economische efficiency te verzekeren. (Hypothese 5, zie figuur A).

II. Empirische Studies

Gebaseerd op het theoretisch raamwerk, heeft deze auteur zich gericht op het identificeren van de voornaamste kenmerken van het voorgestelde evolutionaire duurzaamheids beleidsmodel voor continuë SP implementatie door drie empirische studies van SP-cases en SP-beleid uit te voeren (zie deel III & deel IV).

- Het motivatieonderzoek van 59 bedrijven die wereldwijd succesvol SP hebben toegepast, was ontworpen om inzichten in *contextuele kennis* van SP-implementatie te verkrijgen (*de vraag naar SP-implementatie*). Het omvat de gegevens om de 'functionele samenwerkings-mogelijkheid van sociale subsystemen', de 'noodzaak van de overheidsrol inzake SP', en de 'evolutionaire fasen van motieven om SP te implementeren', te ondersteunen;
- De UNEP-documenten met 100 CP-cases zijn geëvalueerd om de data die de *technologische kennis* van SP inhoudt, te verkrijgen (*het aanbod van SP-aktiviteiten*), om zich te vergewissen of die data het bewijs leveren van het 'bestaan van de duurzaamheidsafstand tussen SP-vragers en SP-aanbieders'. Dit is onderzocht om achter de uitwerking van de verschillende

'evolutionaire fasen van bedrijven' op hun motivatie voor de implementatie van SP te komen';
• Het onderzoek van het Milieuvriendelijk Bedrijfscertificerings Programma 1998 - 2002 (het EFEC Programma van de Koreaanse overheid) met 80 gecertificeerde bedrijven was uitgevoerd om data over de *verenigbare kennis* van SP te verkrijgen (SP-*beleid*), om het testen van de eigenschappen van het voorgestelde 'evolutionaire duurzaamheidsmodel' in de Koreaanse context te betrekken, alsmede de 'efficiency van het huidige SP-beleid van de Koreaanse overheid' te evalueren.

1. De resultaten van het motivatieonderzoek ondersteunen het belang van functionele samenwerkingsbereidheid inzake SP-implementatie door de sociale subsystemen – industrie, gemeenschap, en overheid (92% van de respondenten) - en onderstrepen de noodzaak voor betrokkenheid van de overheid bij het bevorderen van SP-implementatie (beslissend 34%, bemiddelend 69%). De data gaven aan dat de overheid zowel één van de meest actieve CP motivators was als moet blijven.

De onderzoeksresultaten hebben aangetoond dat 25% van de respondenten SP vanwege het 'winst motief', 39% vanwege het 'dwang motief', 23% vanwege het 'gemeenschapsmotief' and 13% vanwege het 'pioniersmotief' implementeren. Bedrijven uit ontwikkelingslanden hebben een relatief groter percentage bedrijven dat aan het 'dwang motief' (32%) beantwoordt. Bedrijven uit ontwikkelde landen hebben een relatief groter percentage bedrijven had dat aan het 'pioniers motief' (22%) beantwoordt. Dit ondersteunt indirect de assumptie van het 'evolutionair duurzaamheids beleidsmodel' dat het SP-motief zich in vier ontwikkelingsfasen ontvouwt. Voorts laten de onderzoeksresultaten als de overheersende motivators voor SP-implementatie zien: het 'Top-manager's Milieuleiderschap' (23%); de 'Winstprikkel' (13%); 'Regulering door de Overheid' (13%); en het 'Goede Publieke Imago' (13%). Deze factoren waren beslissend in zes van de tien SP praktijkgevallen.

De sleutelbevindingen van het motivatieonderzoek van succesvolle SP-cases voorzagen in basale contextuele kennisbronnen van SP-implementatie vanuit het perspectief van SP-motivators. Het gaf aan dat er een evolutionair patroon van motivaties van bedrijven voor SP-implementatie is, en dat de bedrijven vertrouwen op een diverse en onderling verbonden motivatiestructuur om hen bij de SP-implementatie te helpen. De resultaten van dit onderzoek stelden ook de volgorde in het belang van elke SP-motivator vast. Daarbij werd de belangrijke rol van de overheid bij de implementatie van SP in bedrijven benadrukt (zie hoofdstuk 5).

2. De evaluatie van de 100 UNEP SP-cases voorzagen in belangrijke technologische kennisbronnen van SP-implementatie vanuit het perspectief van de SP-praktijk. De data toonden aan dat het aantal, per bedrijf ingevoerde technologische SP-typen, gedurende langere tijd is uitgebreid, hetgeen sterke aanwijzigingen oplevert dat sommige SP-benaderingen een sterke drijfveer blijken te zijn om bedrijfsleiders aan te moedigen om het niveau van SP-implementatie op te waarderen. In termen van kapitaalinvestering in SP-implementatie waren de goedkoopste technologische opties voor SP de '*good housekeeping* benaderingen,' terwijl de relatief dure technologische opties voor SP in het algemeen de 'materiaalsubstitutie benaderingen' en het `milieu produktontwerpen' waren. In termen van payback perioden werden in 95% van de SP-cases de initiële investeringen binnen vijf jaar terugverdiend. De data toonden echter ook aan dat de meerderheid van bedrijven de implementatie van SP-benaderingen met een payback periode van meer dan drie jaar, en/of een eco-efficiency graad van minder dan 50%, trachtten te vermijden.

De data toonden aan dat er vier typen van SP-programma `leveranciers' zijn: 'Interne *Compliance* SP-aanbieders', 'Interne *Non-compliance* SP-aanbieders', 'Overheids (of Externe)

SP-aanbieders', en 'Internationale SP-aanbieders.' De analyses toonden aan dat de voornaamste aspecten van SP-implementatie in de private sector beperkt waren tot een zeker drempelniveau van een 'klein' risico nemen. Dit fenomeen werd beschouwd als een 'duurzaamheidsafstand' aan de aanbieder's kant.
De data hebben aangetoond dat:

(i) 'Interne *Non-compliance* SP-aanbieders' significant 'minder risicovolle SP-cases' prefereerden dan 'Overheids SP-aanbieders' of '*Compliance* SP-aanbieders';
(ii) 'De *Compliance* SP-aanbieders' adopteerden een veel risicovriendelijker benadering dan 'de *Non-compliance* SP-aanbieders.'

Deze feiten ondersteunen indirect de vier dialectische typen programma's van de overheid voor duurzaamheids (of SP) beleid parallel aan de ontwikkelingsfasen van het SP-motief: het 'Harde *Compliance* Programma', het 'Zachte *Compliance* Programma', het 'Vrijwilligheids Programma', en het 'Duurzaamheids Programma.' Deze vier programma' zijn de theoretische kernelementen van het *'Evolutionaire Duurzaamheids Beleidsmodel voor SP-implementatie.'*

De bevindingen in de documenten over succesvolle SP-cases voorzagen in belangrijke technologische kennisbronnen van SP-implementatie zoals de gedragspatronen van SP-praktijkmensen, de identificatie van bepaalde drempelniveaus voor SP-implementatie, de verschillende typen SP programma `leveranciers' en evolutionaire beleidstypen voor SP-implementatie, die door bedrijven waren toegepast gedurende hun evolutionaire en motivatiefasen voor SP-implementatie.

3. Gebaseerd op twee soorten empirische bevindingen: (i) een set *contextuele* kennisinzichten inzake SP-implementatie vanuit het perspectief van SP-motivators, en (ii) de data die betrekking hebben op *technologische kennis* van SP vanuit het perspectief van SP-praktijkmensen, ontwikkelde deze auteur vijf leidende principes in het SP-beleid van de overheid, die het evolutionaire duurzaamheids beleidsmodel voor SP breeduit karakteriseren. Volgens het `driezijdige kenniscyclus raamwerk' liggen deze vijf leidende principes ten grondslag aan de voorwaarden van *verenigbare kennis* voor SP-implementatie die beleidsmakers kan helpen bij het werken aan milieubemiddeling tussen de SP-vragen van de gemeenschap en de SP-implementatie door bedrijven om zo de duurzaamheidsafstand te verkleinen.

Deze principes houden in:

- Het Aspiratie Principe: het onderhouden van een uitgebalanceerde of pioniersmotivatie structuur voor SP tussen de drie voornaamste sociale subsystemen;
- Het Adaptatie Principe: het opzetten van overheidsbeleid voor de verschillende 'evolutionaire fasen in bedrijven op hun SP-implementatiepad';
- Het Kennis Principe: het versterken van SP-markten gebaseerd op de driezijdige kennisverbindingen (b.v. samenwerking);
- Het Programma Principe: het onderscheiden van SP-aanbieders (b.v. programma-aanbieders);
- Het Duurzaamheids Principe: het tot stand brengen van een 'SP Duurzaamheids Programma' om het niveau van SP implementatie voortdurend te ondersteunen teneinde zo de maatschappij te helpen vooruitgang te boeken op weg naar een duurzame maatschappij.

4. Deze principes van het SP Duurzaamheids beleidsmodel zijn getest in een Koreaanse SP-beleidscontext door middel van de driezijdige methode. Drie typen data zijn op basis van verschillende bronnen verzameld: (i) op basis van empirische data over de hele wereld; (ii) op basis van historische gegevens en documenten van de cases binnen het SP-programma; (iii) op basis van onderzoeksresultaten van participanten in het EFEC Programma 1998 - 2002. Dit testproces was nuttig voor zowel de wetenschappelijke doelen van dit proefschrift als voor de

herformulering van het Koreaanse SP-beleid, omdat het huidige Koreaanse SP-beleid, het EFEC Programma dat in 1995 was gestart, geconfronteerd werd met veel problemen. Daarom moesten de volgende vragen worden beantwoord:

- Voldoen de richtlijnen van het lopende EFEC Programma aan de vijf leidende principes?
- Ondersteunen de inzichten en opvattingen van het EFEC Programma aan de leidende principes?
- Helpen de vijf leidende principes – individueel en gezamenlijk – om nuttige en innovatieve inzichten te generen om een meer evolutionair en duurzaam SP-beleid voor Korea te ontwerpen?

5. Deze auteur heeft op basis van de historische data en de onderzoeksresultaten vastgesteld dat het lopende Koreaanse EFEC Programma niet aan alle vijf leidende principes voldoet. Het is verder duidelijk geworden dat er een logische consistentie is tussen de vijf leidende principes en de onderzoeksresultaten van de participanten in het EFEC Programma 1998 - 2002 dat voorziet in inzicht in het succes en de problemen van het lopende EFEC Programma (Hoofdstuk 9). Op basis daarvan is de conclusie getrokken dat de vijf leidende principes behulpzaam kunnen zijn bij het genereren van nuttige en innovatieve inzichten om een nieuw SP-beleid voor Korea te ontwerpen. Het is afgeleid van de onderzoeksresultaten dat het lopende SP-beleid van Korea geplaatst kan worden in de initiële fase van het voorgestelde evolutionaire beleidsmodel. Het lopende EFEC Programma heeft geen nieuwe beleidsinstrumenten ontwikkeld die ontworpen zijn als evolutionair antwoord op de toenemende vragen van de huidige en potentiële participanten in het programma voor de voortdurende verbetering van de SP-implementatie.

III. Aanbevelingen

Gebaseerd op het voorgestelde evolutionair duurzaamheids beleidsmodel om de voortdurende SP implementatie te bevorderen, alsmede de empirische bevindingen, geeft tabel A aanbevelingen weer voor SP-beleid in Korea. De vijftien geprioriteerde beleidsopties om SP-implementatie te bevorderen (de rechter kolom van tabel A) zijn geclusterd tot de drie SP-beleid ontwikkelingsniveaus (de linker kolom van tabel A) volgens de vier motivatiefasen. De volgorde in noodzaak komt overeen met de ontwikkelingsfase van het voorgestelde evolutionaire duurzaamheidsmodel voor SP. De informatie in tabel A legt de nadruk op de logische consistentie tussen de psycho-sociale motieven van bedrijven inzake SP-implementatie, het evolutionaire duurzaamheids beleidsmodel, en de kenmerken van de 'Vijftien Geprioriteerde SP-Beleidsopties' in het kader van het evolutionaire beleidsmodel.

- Volgens dit voorgestelde duurzaamheidsmodel omvatte het lopende EFEC Programma van de Koreaanse overheid slechts twee van de vijftien beleidsopties met een relatief lage prioriteitsvolgorde: de 10^{e} optie (Publiek-privaat Partnerschap voor *End-of-pipe* Management) en 13^{e} optie (Regulerings/deregulerings Programma betreffende *On-site Recycling*). Daarom moet de Koreaanse overheid de andere hoog geprioriteerde beleidsopties, te weten 1) Publiek-privaat Partnerschap Programma voor 'Nieuwe Schonere Technologie' 2) Verstrekking van `Informatie over Nieuwe Schonere Technologie' 3) Publiek-privaat Partnerschap voor 'Proces Modificatie' en 4) Technisch Training in 'Vergroening' voor het 'Management' in hun nieuwe SP-beleid adopteren.

- Het wordt sterk aanbevolen dat de Koreaanse overheid haar beleidsinstrumenten in het EFEC Programma veel meer zou moeten diversificeren om zo de verschillen in duurzaamheidsafstand te overbruggen. Onder de assumptie van conventionele winstmaximalisatie door private bedrijven zou het voor de industrie een natuurlijk proces kunnen worden om verschillende soorten duurzaamheidsafstand onder ogen te zien. De

Koreaanse overheid, als de verantwoordelijke manager van ecologische systemen, moet daarom de visie voor een duurzame maatschappij hebben, die het mogelijk kan maken om de duurzaamheidsafstand te identificeren en pogingen te ondernemen om de vragen van de huidige economisch georiënteerde maatschappij en de aspiraties voor een milieu-duurzame maatschappij te verenigen.

• De Koreaanse overheid zou haar centrale milieubeleid paradigma van het huidige "*Compliance* Programma" progressief moeten veranderen in het "Duurzaamheids Programma" met behulp van het "Zachte *Compliance* Programma" en het "Vrijwilligheids Programma." Voorts zouden overheidsprogramma's, die de kennis en technologie van SP te bevorderen, in hoge mate ondersteund moeten worden door de 'Driezijdige Kennis Cyclus' voor SP-implementatie. De drie kennistypen die noodzakelijk zijn voor het verminderen van de duurzaamheidsafstand, moeten daarvoor harmonisch verbonden worden.

Samenvattend kan gesteld worden dat de twee gecombineerde theoretische raamwerken van dit proefschrift bevredigend getest zijn in de verschillende empirische studies. Het "Evolutionaire Duurzaamheids Beleidsmodel voor SP" dat is gebouwd op de voorgestelde vijf leidende principes en de "Driezijdige Kennis Cyclus voor SP-Implementatie" kunnen samen voorzien in drijfveren om boven het huidige niveau van SP-implementatie in Korea uit te stijgen. De combinatie van de twee theoretische raamwerken kan ook nuttig zijn voor andere maatschappijen, waar de maatschappelijke wil bestaat vooruitgang te boeken op weg naar een duurzame samenleving, om SP-beleid te ontwerpen en implementeren om aldus de `duurzaamheidsafstand' tussen de gemeenschap en industrie te verkleinen.

Tabel A: De Voorgestelde Elementen van het Evolutionair Duurzaamheids Beleidsmodel om de Voortdurende SP Implementatie in Korea te bevorderen.

Theoretische Assumpties		**Empirische Resultaten**
Evolutionair Psycho-sociale SP-Motieven In bedrijven	Evolutionaire Niveau's van S Overheidsprogr.	Vereiste SP-Programma Opties in Korea (Geprioritiseerd op basis van de onderzoeken in de periode 1998 - 2002)
Pioniers Motief	**Duurzaam-heids Programma**	1. Publiek-privaat Partnerschap Programma voor de Ontwikkeling en Implementatie van 'Nieuwe Schonere Technologieën'; *2*. Verstrekking van `Informatie over` Nieuwe Schonere Technologie';* 3. Publiek-privaat Partnerschap om betere 'Proces Modificatie' te maken; 4. Management en Technisch Training in '*Vergroening*' voor het Management van bedrijven; 5. Publiek-privaat Partnerschap Programma om betere 'Materiaalsubstitutie' mogelijk te maken; *6*. Verstrekking van Technische Kennis over 'Milieu Ontwerpen';* 7. Publiek-privaat Partnerschap Programma om 'Milieu Ontwerpen' te verbeteren.
Gemeenschap motief	**Vrijwillig-heids Programma**	2. Verstrekking van `Informatie over` Nieuwe Schonere Technologie'; *4*. Technisch Training in 'Vergroening' voor het Management in bedrijven;* 6. Verstrekking van Technische Kennis over 'Milieu Ontwerpen'; 8. Verstrekking van Technische Kennis om 'On-site Recycling' te verbeteren; 9. Publieke Bewustwording & Educatie voor het Management van bedrijven; 11. Verstrekking van Technische Kennis over 'Materiaal Substituties'; *12*. Verstrekking van Technische Kennis over 'Proces Modificaties'.*
Financieel Motief	**Zacht Compliance Programm**	13. Regulerings/deregulerings Programma inzake 'On-site Recycling' – het EFEC Programma; 14. Economische Instrumenten (belastingen, subsidie om Nieuwe Schonere Technologieën te ontwikkelen 15. Economische Instrumenten (belastingen, subsidies) om 'Proces Modificaties' te implementeren.
Dwang Motief	**Hard Compliance Programm**	10. Publiek-privaat Partnerschap om '*End-of-pipe*' Management – het EFEC Programma – te verbeteren • Verschillende *compliance* programma's gebaseerd op Wettelijke milieustandaarden en richtlijnen • *Command-and-control* benadering.

한국어 요약 (Shin Dongwon, 2005, Executive Summary in Korean of Ph.D thesis, Erasmus University)

제목: 청정생산을 위한 進化的 지속가능 政策모델 개발

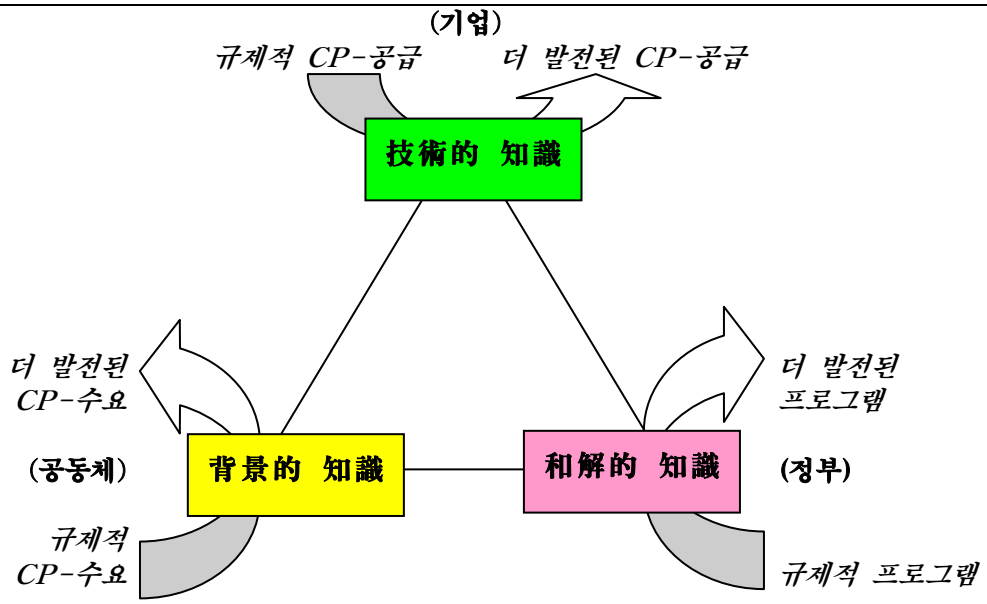
- 부제: 지속가능성갭(Gap)의 확인과 삼각지식(三角知識)에 바탕을 둔 新환경정책

I. 이론적 기본틀

청정생산은 한 사회가 지속가능한 생산체제를 확립하고 유지하기 위한 필수조건이라 할 수 있다. 침체되어 있는 청정생산에 활력을 불어넣어 지속가능사회를 향한 전진을 이루기 위해, 필자는 한가지 단순한 의문을 제기하였다. '어떤 형태의 정부정책이 지속적인 청정생산을 이루는데 가장 적합할까?' 여기 제시한 '淸淨生産을 위한 進化的(evolutionary) 持續可能政策모델'은 이에 대한 본 연구의 답이다.

이 논의의 진전을 위해, 본 연구에서는 기업은 청정생산을 위해 4단계의 進化的 動機化 과정(가설1: 規制的 동기, 利潤的 동기, 共同體的 동기, 및 先驅的 동기)을 거친 다고 가정했다. 나아가 필자는 한사회의 청정생산의 수준을 단계적으로 높이는데 있어 세가지 지식의 連結構造(가설 3: 背景的 지식, 技術的 지식, 和解的 지식)가 實質的 추진력을 가진다고 가정했다. 필자는 이를 '三角知識'이라 불렀다. (그림 A)

그림 A: **'三角知識'의 순환에 의한 청정생산의 발전과정**



♣ 이 세가지 지식형태 중 어느 것이라도 청정생산의 도입과 실천을 위한 촉매의 역할을 수행할 수 있다. 나머지 두 형태의 지식은 이에 추가적 모멘텀을 공급하여, 지속적인 청정생산을 가능케 한다.

♣ 따라서, 이 세 형태의 지식으로 된 三角知識은 함께 연합함으로써만 청정생산의 계속적인 실천을 기능케 하며, 持續可能의 實踐을 위한 必須的 知識의 基礎를 完成한다.

청정생산은 개념상으로 기업의 경제적 활동과 지속가능사회를 향한 생태학적 활동이 혼합되어 있다는 전제하에, 필자는 청정생산실천을 위한 공동체의 수요는 그들의 배경적 지식과 지속가능한 사회를 향한 그들의 열망에 달려있다는 사실을 확인했다. 기업의 청정생산을 실천코자 하는 의지는 공학적 지식의 핵심적 요소를 형성한다. 정부의 청정생산진흥정책은 화해적 지식의 주요부문을 형성 한다. (그림 A 참조) 이에 따라, 이 세 형태의 지식은 서로 연합함으로써 지속가능성의 실천을 담보하는 실천적 지식의 토대를 완성한다.

淸淨生産實踐을 위한 三角知識連合의 틀 안에서, 필자는 청정생산실천에 대한 지역공동체의 수요와 기업의 청정생산 실천의지 사이에는 사회경제적 차이(gap)이 존재한다고 가정했다, 왜냐하면 지속가능한 사회에 있어 청정생산의 실질적 추진력 은 經濟的 패러다임과 生態的 패러다임이라는 본질적으로 서로 다른 두 힘이 함께 작용 하고 있기 때문이다. 따라서 계속적인 청정생산의 실천은 이로 인한 사회경제적 갭을 줄이려는 끊임없는 노력이 없이는 이루어 지기가 어렵다. 필자는 이 차이를 '持續可能性갭'(Sustainability Gaps)이라 불렀다. (가설 2)

이러한 맥락에서, 지속가능한 사회에 있어 청정생산을 위한 건전한 정부의 정책은 – 지속적인 청정생산의 실천은 기업, 지역공동체, 그리고 정부라는 세가지 중심적 하부체제들의 협력이 필수적 조건(가설3)이라고 볼 때– 정부가 이러한 '지속가능성 갭'을 줄이기 위해 얼마나 효과적으로 정책적 노력을 하느냐에 달려있다. 여기서 '持續可能性갭'을 줄이는 것은 政府政策의 理論的 目標이며, 정부는 효과적 정책을 통해 이 갭을 줄여 나감으로써 지역공동체의 지속가능한 사회를 향한 바램과 기업의 청청생산을 실천코자하는 의지를 화해시키려는 노력을 하여야 한다. (가설4)

지속적인 청정생산의 실천을 위한 이와 같은 이론적 틀 안에서, 본 연구는 진화적인 지속가능정책모델을 개발하는 일에 본 논문의 초점을 맞추었다. 어떤 정책이 지속적인 청정생산을 보장하기 위하여 설계되고 실천되어야 하느가? 청정생산 정책은 정부의 규제적 조치의 일환이 아니라 기업의 자발적 참여와 혁신을 장려하는 조치라는 점을 고려할 때, 필자는 정부의 청정생산정책은 '需要者指向的이고 進化的 接近方法'을 취해야 한다고 제안했다. 다시말하면, 정부는 환경상의 효과성과 경제적인 효율성을 동시에 제고할 수 있는 '和解的 知識'의 創出을 통하여 지속가능사회로 가는 청정생산의 실천을 제고해야 한다. (가설5)

II. 경험적 연구

본 연구에서는 진화적 지속가능성 정책모델을 개발하기 위하여 제시된 이론적 틀에 기초하여 기업의 청정생산사례와 정부의 청정생산정책사례에 관한 다음의 세가지 경험적 연구를 하였다. (제III부 및 제 IV부 참조)

• 먼저, 세계적으로 청정생산기업으로 알려진 250기업 (UNEP선정)을 대상으로 청정생산을 실천하게 된 동기를 조사했다. (세계59개기업 응답, 응답율: 24%)
이 동기조사는 청정생산실천의 '背景的 知識'을 얻기 위해 초점을 맞춘 경험적 연구다. 어떠한 동기부여가 청정생산을 실천케 하였는가를 세계적 기업을 통하여 확인하는 것은 청정생산의 실질적 수요를 파악하는 자료와 '背景的 지식'을 얻기 위한 통찰력을 제공한다. 충분한 '背景的 知識'은 정부환경정책을 보다 현실적 토대 위에

서 설계될 수 있게 한다. 이 조사자료는 아울러 가설1 (기업의 청정생산을 위한 進化的 段階)과 가설 3 (청정생산을 위한 社會下部體制간 협력의 불가피성) 등을 입증하는 자료로 활용되었다.

• 둘째로, 본 연구에서는 UNEP의 청정생산 우수사례 100가지 경우를 청정생산에 관한 공급자의 관점에서 자료를 조사·분석하였다. 이 자료는 청정생산에 관한 '技術的 지식'을 얻기 위한 통찰력을 제공하고, 청정생산의 수요자와 청정생산의 공급자 간의 '持續可能性갭'을 확인하는 자료로 (가설2) 활용하는 데 목적이 있다. 또한 이 조사의 자료는 '기업의 進化的 단계'에 따른 청정생산의 실질적 변화를 확인하는 데도 또 하나의 목적이 있다.

• 본 연구에서는 청정생산에 관한 위의 두 가지 실증적 분석을 통하여 지속적 청정생산을 위한 다섯가지 指導原理(Five Guiding Principles)를 찾아내고, 이를 통하여 進化的 지속가능성 정책모델을 제시하였다.

• 마지막으로, 제시한 '進化的 지속가능성 정책모델'의 다섯가지 지도원리를 검증하고, 청정생산의 '和解的 知識'의 창출을 위한 경험적 자료를 확보하기 위하여, 청정생산정책의 사례로 한국의 '環境親和企業指定制度 (1998/2002)'를 선정하고, 이 제도에 참여한 80여 기업체에 대한 설문조사결과 분석자료를 중심으로 제시한 모델을 검증했다. 아울러, 이에 기초하여 한국사회의 지속가능성을 향상시킬 수 있는 새로운 淸淨生産 政策方向을 제시했다.

1. 청정생산 동기조사

59개 세계적 기업들에 대한 청정생산동기조사에 따르면, 응답자의 92%가 청정생산의 실천은 기업, 지역공동체, 정부의 기능적 협력이 필요하다는 사실을 지지했다. 그 중 34%는 정부의 개입이 결정적으로 필요하다고 했고, 69%는 정부의 개입이 대체적으로 필요하다는 사실을 인정했다.

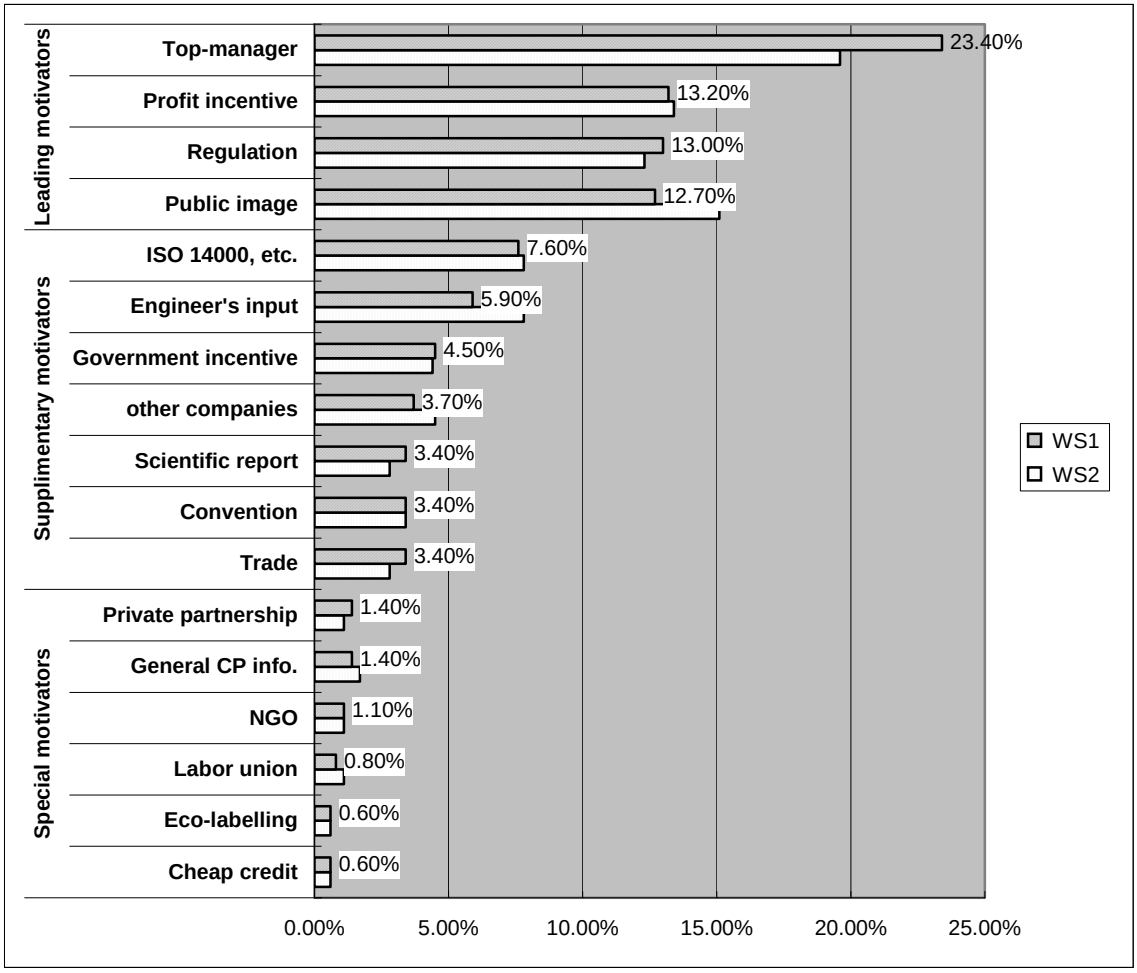
또, 응답자의 39%는 '規制的 동기'에 따라, 25%는 '利潤的 동기'에 따라, 23%는 '共同體的 동기'에 따라, 13%는 '先驅的 동기'에 따라 각각 청정생산을 실천했다고 응답했다. 개도국가의 기업들은 '規制的 동기'가 많은 반면(선진24% - 개도43%), 선진 국가의 기업들은 개도국가에 비하여 '先驅的 동기'가 비교적 많았다 (선진 22% - 개도8%). 이 자료는 – 선진국기업이 개도국기업에 비하여 청정생산의 실천이 앞서고 있다는 가정아래 - 기업의 청정생산실천에 대한 동기는 제시된 네가지의 단계별로 진화적으로 발전되고 있다는 사실을 간접적으로 뒷받침 해준다.

이와함께, 제시된 15개 동기유형별 순위를 보면, 1) 최고경영자의 환경리더쉽 (23%), 2) 정부규제 (13%) 2) 이윤 인쎈티브 (13%) 2) 좋은 사회적 이미지 (13%) 가 각각 주요한 동기로 부각되었다. 10기업중 6기업은 이 네가지 동기중의 하나에 의하여 청정생산을 실천하였다. (그림 B 참고)

세계적 청정생산기업들에 대한 청정생산동기에 관한 설문조사는 청정생산의 수요를 가늠할 수 있는 '背景的 지식'을 제공하였고, 이를 통하여 청정생산의 동기에는 진화적 요소가 있슴을 확인했고, 기업들이 청정생산을 실천하는 데는 한가지의 요인만 작용하는 것이 아니라 다양한 요소가 서로 연계되어 있슴을 발견했고, 정부도

청정생산의 실천에 하나의 중심적 動機附與者임이 발견됐다. (제5장)

그림 B: 여러가지 動機類型별 청정생산실천 영향력 순위 (WS1: 현재, WS2: 미래)



2. 청정생산 프로그램과 '持續可能性갭'(Sustainability Gaps)

UNEP의 100청정생산 케이스에 대한 분석은 실천자 혹은 공급자의 관점에서 바라본 청정생산에 대한 '技術的 지식'의 한단면을 제공하였다. 자료에 의하면, 한기업당 도입한 技術工學的 차원에서의 청정생산의 가짓수는 시간이 지날수록 늘어났다. 이 사실은 어떠한 청정생산접근방법은 회사경영자로 하여금 또 다른 청정생산방법을 개발하는데 기여하고 있다는 사실을 강하게 반영하고 있다.

청정생산의 初期投資費의 관점에서 볼 때, 가장 비용이 적게 드는 기술적 대안은 '청결 및 물자절약 접근방법' (Good Housekeeping Approach)이었고, 비교적 초기투자비용이 많이 드는 기술적 대안은 '환경친화적 원료대체 접근방법' (Material Substitution Approaches)과 '환경친화적 제품설계 접근방법' (Design of Products for the Environment). 한편, 투자비회수기간 (Payback Period)의 관점에서 볼 때, 조사대상의 95%는 5년내에 초기투자비를 회수한 한 것으로 나타났다. 반면, 조사자료에 의하면, 대상기업의 80%이상은 3년이 넘는 투자회수계획과 50%이하의 환경 효율성을 목표로 한 청정생산계획은 회피하려는 경향이 있는 것으로 드러났다. 이는 세계적

인 청정생산기업에 있어서도 나타나는 '持續可能性갭'으로 볼 수 있으며, 이에 따라 중장기적 청정생산계획이나 低環境效率性을 목표로 하는 환경투자계획은 정부나 외부의 지원, 혹은 별도의 綜合的 프로그램이 없으면 개별기업 차원에서는 쉽지 않은 것으로 드러났다.

한편, 자료에 의하면, 청정생산프로그램 공급에는 규제적-비규제적, 내부적-외부적 기준에 따라 네 가지로 유형화 시킬 수 있는 것으로 나타났다. 즉 내부적•규제적 청정생산 프로그램, 내부적•비규제적 청정생산 프로그램, 외부적 혹은 정부적 청정생산 프로그램, 국제적 청정생산 프로그램이 그것이다.

자료분석결과, 민간부문에서의 대부분의 청정생산 프로그램은 위험부담이 비교적 가벼운 '일정수준의 臨界水準 (Threshold Level) 안에 국한되어 있는 것으로 나타나, 이는 초기투자비의 관점에서 조사한 내용과 같은 맥락이었다. 아울러,

(i) '내부적•비규제적 청정생산 프로그램'은 '외부적 혹은 정부적 청정생산 프로그램' 이나 '국제적 청정생산 프로그램'에 비하여 현격하게 위험도가 낮은 청정생산 프로그램을 선호하였고;

(ii) '규제적 청정생산 프로그램'은 '비규제적 청정생산 프로그램'보다 훨씬 위험친화적인 접근방법을 택하였다.

이러한 조사결과는 공급자 측면에서의 '持續可能性갭 (Sustainability Gaps)'이라 간주될 수 있으며, 이 사실은 정부의 청정생산프로그램은 청정생산동기의 진화적 발전단계와 병행하여 추진하여야 한다는 '청정생산을 위한 進化的 지속가능정책 모델'의 기본가설과 궤를 같이 한다. 진화적 지속가능정책모델에 따르면, 정부의 청정생산 프로그램은 淸淨生産動機化의 발전단계에 맞추어 '非彈力的 規制 프로그램,' '彈力的 規制 프로그램,' '自發的 프로그램,' 그리고 '持續可能性 프로그램'으로 辨證法的으로 발전되어야 한다. (가설 1, 가설5)

요약하면, 성공적인 100가지 청정생산사례의 분석을 통하여 청정생산실천기업의 행동양식, 청정생산실천의 臨界수준, 청정생산 프로그램의 유형, 청정생산을 위한 진화적 정부정책유형 등 청정생산의 '技術的 지식'의 일단을 발견할 수 있었다.

3. 進化的 持續可能政策모델의 5대 지도원리 (Guiding Principles)

두 가지의 경험적 연구결과에 기초하여 – (i) 청정생산 동기부여자 (Motivators)의 관점에서 청정생산의 '背景的 지식'에 관한 경험적 통찰력, (ii) 청정생산 실천자 (Practitioners)의 관점에서 청정생산의 '技術的 지식'에 관한 경험적 이해 – 본 연구에서는 청정생산을 위한 정부의 바람직한 정책수립을 위한 다섯가지 지도원리를 제시했다. 이 지도원리들은 청정생산을 위한 '진화적 지속가능 정책모델'의 기본적 특징을 이루고 있다. 지속가능성을 위한 '三角知識'의 구조에서 볼 때, 이들 다섯가지 지도원리들은 청정생산의 '화해적 지식'이 되기 위한 기본적 조건이 된다. 청정생산을 위한 '和解的 지식'은 政策立案家들이 '지속가능성갭' (Sustainability Gaps)을 축소하거나 제거케 함으로써 지역공동체의 청정생산에 대한 수요와 기업의 청정생산의 공급사이에서 持續可能을 위한 和解가 가능토록 하게하는 觸媒者의 역할을 한다. 이럼으로써 지속가능성에 관한 '和解的 지식'은 '三角知識'의 구조에서 또 하나의 가장 중요한 축을 형성하고 있는 것이다.

다섯가지 지도원리 (Five Guiding Principles):

- 動機化의 원리: 사회의 주요 하부구조사이에 청정생산을 위한 균형된 (balanced) 동기적 구조(Motivational Structure)를 갖추어야 한다;
- 적응의 원리: 정부정책은 청정생산의 진화적 단계와 사회적 수요에 맞추어 탄력적으로 운영해야 한다;
- '三角知識' (Triangular Knowledge Cycle)의 원리: 청정생산을 향한 정부의 '和解的 지식'의 창출은 청정생산에 대한 '背景的 지식'과 청정생산에 대한 '技術的 지식'의 三角적 連繫構造속에서 통합적으로 설계되고 실천되어야 한다.
  지식은 정보, 통계, 억측과는 달리 과학적 과정을 거치므로 이에 따른 사회적 행동은 최소한의 정당성을 담보하기 때문이다;
- 프로그램 多樣性의 원리: 기업의 청정생산동기가 매우 다양하며 진화적이므로 정부는 다양한 청정생산 프로그램을 제공하여 企業이 스스로 選擇할 수 있는 幅을 넓혀야 한다;
- 持續可能性의 원리: 정부는 地球的 生態界의 온전성과 次世代의 환경권을 고려한 지속가능사회를 위한 청사진을 확립하고, 그 틀 안에서 청정생산의 수준을 제고하려는 노력을 계속해야 한다.

4. 한국 2002 環境親和企業지정제도(EFEC Program) 사례분석

제시된 청정생산 실천을 위한 지속가능성 정책모델의 원리들을 한국의 최초의 청정생산진흥정책이라 볼 수 있는 환경친화기업제도 (Environmentally Friendly Enterprise Certification Program, EFEC Program, 1995)의 경험적 사례분석을 통하여 검증해 보았으며, 이 검증의 과정을 통하여 새로운 차원의 淸淨生産提高政策의 방향을 제시했다.

한국의 환경친화기업지정제도를 사례분석하기 위해 사회조사기법상의 '삼각측량법 (the Triangulation Method)'을 시도했다. 이를 위해 조사관점이 다른 세가지 자료가 수집•분석되었다:

i) 1995년이후 지정업체수등 통계자료와 우수사례집등 관련 기록물 (정부기록물);
ii) 1998년과 2002년 두 번에 걸친 본제도의 평가를 위한 설문조사
(조사대상: 모든 친화기업지정업체, 응답률:74%);
iii) 2002년 ISO14000지정업체를 대상으로 한 본제도의 평가를 위한 설문조사 (조사대상: 250여 ISO14000 지정업체, 응답률: 33%).

이 검증의 과정은 과학적인 의미가 있을 뿐만 아니라 한국의 청정생산정책의 새로운 좌표를 제시하는 데도 유용하다고 볼 수 있다. 왜냐하면, 한국의 친화기업지정제도는 1995년 도입이후 상당한 성과를 거둔 것은 사실이지만, 지정업체수의 정체, 다른 유사제도와의 연계장치 미흡등 적지 않은 문제점이 있어 지속가능 정책의 관점에서 새로운 제도로 리모델링하는 것은 한국의 환경정책 발전에 의미있는 일이기 때문이다. 이를 위해, 필자는 다음의 세가지 문제점을 제기하고, 경험적 자료를 통해 답을 구하거나 새로운 대안을 모색했다.

- 2002 EFEC 프로그램의 운영방침은 제시된 다섯 가지 지속가능성 정책의 지도원리들을 만족하고 있는가?
- EFEC 참여기업들의 견해와 의견들은 제시된 다섯 가지 지속가능성 정책의 지도원리들을 지지하고 있는가?
- 제시된 다섯 가지 지도원리들은 점진적이고 지속가능한 한국의 청정생산정책을

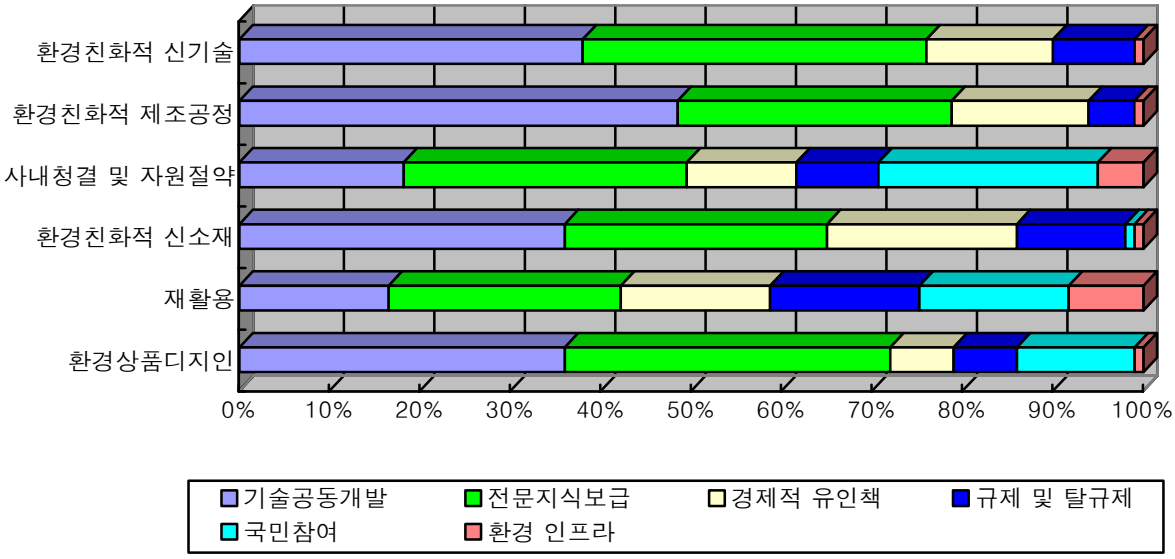
설계하는 데 유용하고 혁신적인 통찰력을 제공하고 있는가?

현재 추진중인 EFFC 프로그램은 8년 전 전통적인 규제적 정책의 패러다임을 벗어나 한국에 새로운 참여적 환경정책의 기반을 마련하였지만 (고 재영, 1996, OECD), 현 제도가 기업의 비규제적 청정생산 동기에 부응하는 다양한 프로그램을 제공하지 못하는 등 제시된 다섯가지 지속가능 정책 지도원리를 모두 충족시키지 못하는 것으로 역사적 통계자료와 설문조사결과 나타났다. 반면, 1998/2002 두 번에 걸친 설문조사 결과는 제시된 다섯가지 지속가능정책의 지도원리와 논리적 일관성이 매우 있는 것으로 본 연구결과 나타났다. (제9장 참조)

이에 따라, 제시된 다섯 가지 지도원리를 중심으로 한 지속가능성 정책모델은 새로운 환경정책을 입안하고 실천하는 데있어 유용하고 혁신적인 통찰력을 제공하고 있음이 설문조사와 정책사례분석을 통하여 입증되었다. 그간의 연구결과로 추론하여 볼 때, 2002 EFEC 프로그램은 진화적 청정생산정책모델의 초기발전단계에 나타나는 정책의 형태로 보아지며, 이 제도가 한국사회가 지속가능한 사회로 나아가는데 지속적으로 기여를 하기 위해서는 지속가능성 정책모델에서 제시된 여러 원리들과 점증하는 프로그램 참여자들의 합리적 요구들을 만족시킬 수 있도록 많은 연구와 노력이 수반되어야 할 것이다.

〈참고〉

* 참여기업들이 제시한 바람직한 淸淨生産類型별 Policy-mix (설문조사결과)



III. 정책적 권고

제시된 '進化的 지속가능 정책모델'과 청정생산 실천기업들에 대한 설문조사 결과에 기초하여, 테이블 A는 한국의 청정생산정책을 위한 정책적 권고사항을 제시하고 있다. 테이블 A의 오른쪽 컬럼에 제시된 청정생산 정책의 발전단계에 따라 테이블 A의 왼

쪽에는 청정생산 실천을 위한 15가지 정책적 대안들이 그 우선순위에 따라 제시되어 있다. 청정생산의 실천에 대한 기업의 사회심리적 동기와 진화적인 지속가능성 정책모델, 그리고 15개 청정생산정책의 우선순위 사이에는 논리적 일관성이 있음을 알 수 있다.

제시된 지속가능정책모델에 의하면, 2002 EFEP 프로그램은 15개 우선순위 정책수단중 비교적 우선순위가 낮게 평가되어 있는 두 개의 정책수단만(재활용에 대한 규제조치 및 방지시설개선을 위한 공동연구)을 간접적으로 채택 하고 있다.
- 한국정부가 청정생산정책을 제고시키기 위해서는 먼저 우선순위가 매우 높게 나타난 1) 새로운 청정기술개발을 위한 민관협력사업 2) 청정생산기술에 관한 전문지식제공 3) 환경친화적 제조공정의 개발을 위한 민관 공동프로젝트개발, 4) 기업경영자층에 대한 청정생산 훈련프로그램의 개발 등에 관한 정책수단들을 검토할 필요가 있다.

복잡다기한 '持續可能性갭'을 유형별 (예컨데, 산업별, 지역별, 기업규모별)로 확인할 필요가 있으며, 정책수단들은 구체적이고 다양한 지속가능성갭을 인지하고 줄여나갈 때 정책의 상승적 효과가 나타나며, 기업, 지방 자치단체, 그리고 지역주민의 참여도 기대할 수 있다.

한국정부를 포함한 신흥선진국정부 혹은 중국, 폴란드등 선진개도국들은 청정 생산을 추진함에 있어 점진적으로 현재의 "규제적 프로그램"에서 "자발적 프로 그램"을 거쳐 "지속가능성 프로그램"으로 근본적 정책패러다임의 변화를 시도하여 야 한다.
- "규제적 프로그램"으로 청정생산 추진과정에서 나타나는 '持續可能性갭'을 줄이기에는 본질적 한계가 있음이 본 연구에서 드러났다. 특히 청정생산은 기업의 自發的이고도 創意的인 參與없이는 성공적인 정책을 집행하기 어려우므로, 본 연구에서 경험적으로나 이론적으로나 검증되고 있듯이, 정부는 광범위하게 지속 가능성제고를 위한 '三角知識'의 창출에 많은 노력과 자원을 투입해야 한다. 청정생산이나 지속가능성에 관한 지식•기술은 市場에만 맡겨 둘 수 없는 公共性과 未來志向性이 많이 내포되어 있기 때문이다.

결론적으로, 본 연구의 이론적 假設들은 많은 경험적 사례와 연구를 통하여 성공적으로 검증이 되었다. '다섯가지 지도원리, 지속가능성갭확인을 위한 정부의 의무, 그리고, 청정생산을 위한 '三角知識'의 필연성'을 중심으로 한 '進化的 淸淨生産政策모델'은 청정생산의 수준을 한 단계 더 높여 持續可能社會로 지향하는 한국을 포함한 다른 나라에도 정책적 추진력 (Driving Forces)을 향상시킬 것으로 본다.

표 A: 제시된 진화적 청정생산 정책모델과 단계별 정책수단 권고

이론적 가설		경험적 결과
기업의 진화적 청정생산동기	단계별 정책모형	설문조사결과에 따른 단계별 권고적 정책수단들(*숫자는 우선순위*)
先驅的 動機	지속가능성 프로그램	1. Public-private Partnership Program for Development and Implementation of 'New Cleaner Technologies'; *2. Provision of 'New Cleaner Technology Information';* 3. Public-private Partnership for making better 'Process Modification'; 4. Managerial and Technical '*Green*' Training for the Firm's 'Managerial Group'; 5. Public-private Partnership Program for making better 'Material Substitution'; *6. Provision of Technical Knowledge on 'Design for the Environment';* 7. Public-private Partnership Program for improved 'Design for the Environment'.
共同體的 動機	자발적 프로그램	2. Provision of 'New Cleaner Technology Information*';* *4. Technical 'Green' Training for the firm's "'Managerial Group';* 6. Provision of Technical Knowledge on 'Design for the Environment'; 8. Provision of Technical Knowledge on improving 'On-site Recycling'; 9. Public Awareness & Education for the firms' 'Managerial Group'; 11. Provision of Technical Knowledge on 'Material Substitutions'; *12. Provision of Technical Knowledge on 'Process Modifications'.*
利潤的 動機	탄력적 규제 프로그램	13. Regulation/deregulation Program on 'On-site Recycling'; 14. Economic Instruments (taxes, subsidies) for developing New Cleaner Technologies; 15. Economic Instruments (taxes, subsidies) for implementing 'Process Modifications'
規制的 動機	비탄력적 규제 프로그램	10. Public-private Partnership for improving 'End-of-pipe' Management – the 2002 EFEC Program - • Various compliance programs based upon Legal environmental standards and guidelines • Command-and-control approach

About the Author, SHIN Dongwon

Mr. Dongwon Shin is currently on the senior staff of Korean Ministry of Environment (KMOE). He also works for Department of Natural Resources Science, McGill University Montreal as Adjunct Professor, where developing new Master's degree program in environmental assessment from August 2005, particularly in strategic environmental assessment (SEA) and sustainability appraisal (SA) as an integrated approach. He had been the Senior Programme Officer of UNEP/Economics and Trade (Geneva) from 2002 to 2005. He coordinated four thematic multi-institutional sustainability policy research projects in an integrated approach in cooperation with UNEP, relevant policy institutions worldwide, and KMOE. He was deeply involved in starting "UNEP Network of Institutions for Sustainable Development" (NISD), the first meeting of which was held on March 2004, Jeju Island, South Korea.

Prior to joining UNEP/DTIE/ETB, he was Director for the International Cooperation Division of KMOE from 1999 to 2002, where he played an important role in setting up the "Tripartite Environment Ministers Meeting" for China, Japan, and Korea (TEMM) and "World Bank Knowledge Partnership Project for EMS with South Asian countries." He served as Senior Consultant for Cleaner Production Programme of UNEP/DTIE (Paris) from 1996 to 1998, where he played an important role in hosting the 5th UNEP High Level Seminar of Cleaner Production at Phoenix Park, South Korea, 1998. At the Conference, UNEP launched a famous International Declaration on Cleaner Production. Working for UNEP/DTIE Cleaner Production Programme, he joined Erasmus University Rotterdam, Ph. D Program on Sustainability Policy.

He has been working for KMOE since 1984. Where he has undertaken a variety of environmental projects such as 'Drinking water resources protection project of the Han River Basin and Guem River Basin'(1991), start of an 'Environmental Statistics Yearbook,' approval of environmental impact assessment statements (1986 ~1989), establishment of 'Central Environmental Disputes Coordination Commission'(1988), a clean-up campaign of local sewage facilities in Gangwon areas for tourism(1992). He further co-developed an air quality improvement project in industrial cities(1994) and a theoretical guidebook on environmental economics (1985, National Institute of Environment Research, Korea).

He has a Diploma in Social Studies from Seoul National University and a Master of Science Degree in Urban Planning (based on ecological economics) from Environmental Planning Graduate School, Seoul National University. He served as a lecturer on environmental laws and economics at four universities in Korea (Han-Yang University, Kwang-Un University, Kang-Won University, and Sang-Ji University).

He was chosen as one of the *beautiful environmentalists* by the magazine of Korean-UNEP Committee (2001) and currently lives in Montreal, Canada with his wife, Sunsuk Kim, and two children, Sung-bok and Sung-eun.