

FOREWORD

Supply chain management is a very important factor directly related to the productivity and the overall business competitiveness. Greening of Supply Chain is an emerging concept for Asia and the Pacific region. It advocates that the purchaser uses its purchasing power to demand an improved environmental performance from the supplier upstream in the supply chain. It is also implied that the purchaser - which in many cases is a big corporation - will play a facilitator's role towards its suppliers - which are usually small and medium enterprises - and help them in their efforts for becoming a more environment-friendly organization. This effect is expected to trickle down throughout the supply chain so that the entire supply chain becomes "green" or more environment-friendly.

The APO has been promoting Green Productivity (GP) as a strategy for simultaneous improvement in the productivity and the sound environmental management. GP thus helps organizations in increasing their overall competitiveness. It is well recognized that the Greening of Supply Chain constitutes a very important aspect of Green Productivity efforts of any organization.

With this background, the "Top Forum on Green Productivity - A Management Strategy to Enhance Competitiveness by Greening the Supply Chain." was organized from May 25-27, 2000 in Taipei, Republic of China. The forum brought together experts from Japan, Taiwan, Europe, and North America to share experiences and discuss the issue of Greening the Supply Chain. The forum addressed several key aspects of supply chain management, including:

1. The importance of enhancing Green Productivity (GP) by taking consideration of environmental characteristics in the purchasing decisions, including: dematerialization, minimizing the energy intensity of goods and services, enhancing recyclability, and maximizing the use of renewable resources;
2. Approaches to developing new partnerships among firms enhancing environmental and sustainable performance;
3. Identification of new roles for government such as promotion of eco-labeling programs and adoption of ISO 14000 that will provide a framework for firms to practice green purchasing;
4. Strategies for stimulating the creation of new consumption patterns; and
5. Technological breakthrough needed to encourage green purchasing.

I am very happy to present this document, which is the compilation of the proceedings of this important forum. I hope that this book will provide the readers with valuable information on the emerging issues of Greening of Supply Chain and will encourage the industries in the APO member countries to implement the activities for greening their own supply chain.

Takashi Tajima
Secretary-General

Tokyo
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INTEGRATED SUMMARY

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BACKGROUND

This document is a compilation of papers presented at the “Top Forum on Green Productivity” from May 25-27, 2000. The forum brought together experts from Japan, Taiwan, Europe, and North America to share experiences and discuss the issue of greening the supply chain. The conference addressed several key aspects of supply chain management, including:

1. The importance of enhancing Green Productivity (GP) through incorporating consideration of numerous environmental characteristics in the purchasing of material and products, including: dematerialization, minimizing the energy intensity of goods and services, enhancing recyclability, and maximizing the use of renewable resources;
2. Approaches to developing new partnerships among firms that enhance environmental and sustainability performance;
3. Identification of new roles for government such as developing eco-labeling programs and promoting ISO 14000 that will provide a framework for firms to adopt green purchasing;
4. Strategies for stimulating new consumption patterns; and
5. Technological breakthroughs needed to increase green purchasing.

WHAT IS “GREENING THE SUPPLY CHAIN”?

Broadly speaking, greening the supply chain is the process of incorporating environmental criteria or concerns into organizational purchasing decisions and long-term relationships with suppliers. The value of greening of the supply chain depends very much on the nature of the organization. Governments view it as a useful tool for stimulating the development of environmentally friendly products to reduce overall environmental loading and help move economies along the path of sustainable development. Businesses tend to see greening the supply chain as a competitive or image issue; initiatives to green supply chains can stimulate the development of “greener” products, decrease risks and liabilities, and lower costs of the chain as a whole.

As the papers presented in this document demonstrate, there are a number of initiatives underway in both the public and private sector to stimulate the greening of supply chains. Initiatives generally fall into two categories. The first involves improving coordination with suppliers on environmental efforts to facilitate the development of

greener or more environmentally friendly products. The second type is: demanding improved environmental performance at suppliers' operating facilities, such as requiring suppliers to obtain ISO 14000 certification or achieve a set standard of performance. The key distinction between the two types of initiatives: the first emphasizes the role of the supplier in assisting the customer with product design and resolution the customer's environmental problems; the second focuses on the suppliers' internal performance combined with customers' desire to reduce risks/liabilities or to lower costs through implementation of better environmental management throughout the supply chain.

WHY GREEN SUPPLY CHAINS?

Greening the supply chain represents a tremendous opportunity for all stakeholders concerned with issues of sustainable consumption and business environmental performance. As several of the authors point out, the heart of the sustainability challenge lies in changing our patterns of mass production and mass consumption. In his essay, Kuo Zhong Liu discusses many of the conflicts between current business principles and global ecological sustainability.

As companies and consumers, we must rethink our product designs and manufacturing techniques to develop more environmentally friendly products that generate a lower environmental burden in their use and manufacture; we must increase the "eco-efficiency" and "eco-effectiveness" of our products and businesses, in the words of William Shireman and Niven Huang. Several authors, including Takeo Takagi and Hiroaki Koshibu, also describe the need to develop closed loops within societies to recycle and reuse products at the end of their functional life as a strategy for reducing demand for new raw materials and resolving our waste disposal dilemma. These changes will have profound implications for all companies, and a company's long-term success will depend on its ability to manage and coordinate supplier relationships, and, most importantly, to green its supply chains.

From a macro-perspective, greening is important both as a mechanism for strengthening our ability to design green products and as a vehicle for creating markets for eco-friendly industrial products. Supply chain greening will require a range of new inputs and materials that, in turn, will create a market for companies willing to invest in the design and manufacture of products to meet sustainability needs. Most importantly, this market will include not just consumer products, but also upstream industrial inputs manufactured by SMEs, thereby drawing them into the emerging green markets.

THE VALUE OF A GREEN SUPPLY CHAIN

Supply chain greening initiatives have benefits on the level of the individual firm as well as on the national level. For individual firms, supply chain greening programs bring distinct competitive advantages in terms of lower costs, greener products, and better integration with suppliers. On a national level, greening of supply chains can stimulate markets for green products, while also creating incentives for SMEs to adopt better environmental practices.

At its most basic, greening a supply chain can improve the overall competitiveness of a company by lowering costs. As many case studies have already documented, smaller companies often have substantial opportunities to reduce costs through the implementation of GP, industrial waste minimization (IWM), or other environmental programs. The papers on the Republic of China's CSS program show the financial benefits accrued by several companies who drove IWM implementation in groups of suppliers. Pushing suppliers to become more efficient often helps lower the overall production costs for a given item, thereby increasing the overall competitiveness of the entire chain. For companies in industry sectors with low margins, lower supply chain costs can translate into a significant market advantage.

In addition to lowering costs, closer cooperation with suppliers can also lead to greener products. Most manufacturers rely on a wide array of suppliers to provide the inputs necessary to produce their goods. As Lynn Johanssen noted, LCA studies have indicated that up to 70 percent of a product's environmental impact and resource demands are determined by its design. Improving design, however, requires close cooperation with suppliers to identify inputs or changes to make products more recyclable, to reduce the amount of toxic materials used in design, to enhance reusability, to dematerialize the goods, and apply other similar principles. Indeed, as William Shireman points out, virtually all companies will have to rethink their products to make them more eco-effective as the global economy continues to be transformed by new technologies and the demands of sustainability. Companies will require strong cooperative relationships with suppliers to succeed.

Green supply chains can also open new markets for companies. As the papers by Ning Yu, Loretta Legault, and Lynn Johanssen describe, governments in Taiwan, Indonesia, the United States, and Canada are developing programs to purchase environmentally friendly products. Hiroaki Koshibu describes the emergence of the Green Purchasing Network in Japan which is comprised of both public and private sector buyers. In all cases, the passport to entry into the market is having a product that is competitive in terms of performance and offers desirable environmental characteristics. Indeed for companies seeking to export to large buyers in Japan, Europe, and the U.S., environmental criteria are becoming highly important as consumer expectations and new product take-back laws are forcing companies such as Fuji-Xerox to rethink their product design. The growth of eco-label programs around the world is part of this overall trend.

On a broader level, many of the benefits of greening a chain also relate to the increasingly integrated nature of manufacturing supply chains. In an era of growing global competition, companies no longer compete alone in the market, but rather engage on the basis of their entire production chain and its ability to innovate. The emerging competitive environment requires strong cooperation between a company and its suppliers and the ability to rapidly improve product design and quality while still controlling costs. As sustainability emerges as a major force in the market due to new regulations and consumer expectations, the ability to efficiently manufacture products that provide both functional and environmental value (e.g., resource efficient, non-toxic, etc.) will become the key to success. Indeed even if one doesn't believe in an emerging "green market," one of clear lessons of the last five years is still relevant: improved environmental performance typically is a sign of higher efficiency and therefore lower costs. In this context, greening the supply chain offers an opportunity to gain competitive advantage.

On a national level, green supply chains will also be important to governments in assessing the overall international competitiveness of their country's industrial sector. As Lung Sheng Chang describes, the Republic of China's National Science Council has targeted eco-materials as a strategic industry for the future. The leading companies in Japan have already made a clear commitment to eco-design out of a conviction that it is the key to long-term competitiveness. As economies seek to meet the challenges of sustainability, the ability of a nation's industry to design and manufacture green products that minimize resource demands will become central to maintaining its market position.

For national-level organizations seeking to promote eco-design, private sector initiatives to green their supply chains are important for their role in establishing a market for green products. Government green procurement plans can also play an important role, although their significance varies depending on the product. Government procurement programs can help create baseline demand, but, as Hiroaki Koshibu points out, complementary efforts by the private sector to increase its green purchasing are also essential. Demand from green procurement and green supply chains can also help complete the recycling and reuse loops for products that are increasingly important to overall national sustainability strategy in countries such as Japan.

Increased demand for green products or green suppliers also offers an important mechanism for influencing the behavior of small and medium-sized enterprises. Traditionally, governments have found SMEs extremely difficult to regulate due to the limited resources within SMEs for environmental management. Furthermore, the vast number of SMEs in Asian countries (typically upwards of 60,000) makes it difficult to conduct routine inspections. Weaving environmental criteria into the fabric of the market provides a powerful and inescapable motivation for SMEs to improve their environmental performance. Furthermore, criteria can potentially influence a vast number of SMEs within a short time frame. The papers by Shen Yan Chiu and Wen Huei Chen describe the relationships between major purchasers and SMEs and the level of influence inherent in buying relationships. Their papers, along with that of Deng Ming Lee, describe some of the improvements in SME performance that can result from greening efforts. One of the key conclusions is that major buyers may have more immediate influence over the behavior of SMEs than do government agencies.

MECHANISMS FOR SUPPLY CHAIN GREENING

The clear message arising for those interested in supply chain greening (SCG) is that it starts with establishing demand for greener products. It is important to remember that demand can come from users of products including consumers, government agencies, or corporate purchasers as well as regulatory expectations. Companies such as TECO, an appliance and electronics manufacturer in Taiwan, will undertake SCG initiatives when there is a clear need due to direct consumer interest, green bid specifications from corporate or government clients, or regulatory demands for product take-back. The demand then begins a cascade effect down the value chain as TECO passes its "green" needs to its suppliers who, in turn, send the demands further upstream to their suppliers. Clear demand and expectations provide the incentive for companies to establish purchasing criteria for suppliers, which in turn creates an incentive for suppliers to develop environmentally friendly products.

However, even in situations where demand is present, there are often barriers to implementing SCG and green procurement initiatives. The first is a shortage of information about the environmental aspects of products. Assessing the life cycle impacts of products is a highly complex task requiring access to substantial amounts of technical data and environmental expertise. Many companies lack the resources to conduct life cycle assessments (LCA) for their products, and national LCA research infrastructures in many countries are still weak. In situations where purchasers have significant buying power, it is possible to work directly with suppliers to develop information on key aspects and request changes based on the results. Some large buyers have developed internal eco-design standards to guide both purchasing decisions and suppliers' product engineering efforts. However, in markets where individual buyers have less leverage over companies, information on the environmental characteristics of products might not be available.

Even when information is available, buyers need easy-to-use information tools to allow them to discriminate amongst products and suppliers. Eco-labels are a first step, but in most countries they still only cover a limited range of products and are relatively slow at developing specifications for new product categories. Organizations such as the Green Purchasing Network in Japan have begun to develop supplemental materials to allow companies to rank products against each other. In situations where individual companies do not have significant buying power to influence key suppliers, it is important to develop industry standards to consolidate buying power and give suppliers clear standards by which to design products.

For larger companies seeking to design environmentally friendly products, it is essential to develop frameworks or systems for transferring key skills to suppliers. Skills transfer can help improve efficiency leading to bottom line improvements and can also ensure the ability of suppliers to meet their customers' design needs. Takeo Takagi provides a detailed example of the types of internal systems that major Japanese companies use to guide their design efforts and which they hope to transfer to suppliers in the Asia-Pacific region. Several papers discuss the possibilities of cooperation between government and the private sector to establish skill-sharing frameworks through mechanisms such as center satellite or corporate synergy systems (Augustine Koh, Shen Yan Chiu, Chin Ho Su, and Wen Huei Chen).

The issue of frameworks for skill-sharing is also relevant for companies whose focus is helping suppliers upgrade their environmental skills to lower costs or reduce management risk, rather than green product design. Grace Liu describes the overall environmental strategy of Acer Inc. and the company's interest in seeing suppliers improve their on-site environmental performance. Companies wishing to see suppliers adopt ISO, IWM, or other environmental management practices may need to consider providing direct assistance or partnering with government agencies to help.

The role of government in supply chain greening is complex. As several writers point out, government purchasing represents a significant portion of demand in certain sectors of the economy. However, devising and implementing purchasing standards is often not an easy task. Loretta Legault describes the experience of Environment Canada and some of the issues that arose such as the need to balance green criteria against other issues such as guaranteeing purchases from minority businesses. Niven Huang also provides examples of recent efforts by the United States EPA.

In addition to its role as a buyer, government also plays an important role in setting the rules for the market. Regulations such as take-back requirements stimulate interest on the part of companies in developing green products because it simply makes good business sense. Governments also can provide a valuable service to the market by setting product standards through programs such as eco-labels. Beyond setting rules, government can also provide important support to the private sector as it seeks to implement supply chain greening programs.

CONCLUSION

Greening the supply chain undoubtedly represents a key component of both future national level sustainability strategies as well as business competitive strategies. As business competition becomes increasingly intense, companies are beginning to seek to leverage competitive advantages across their entire supply chain as opposed to solely their operations. As Tae Joo Hua discusses, overall product design needs are driving a closer integration of quality management just as pressure to supply greener products is requiring closer cooperation with suppliers. Companies are finding significant advantages in terms of improving both their own eco-efficiency and the eco-effectiveness of their products through such efforts.

Broadening the application of supply chain greening will require more dissemination of information about the practices and advantages. While there is strong anecdotal evidence for the business value of supply chain greening, more research is needed to quantify the business case. In addition, while not discussed in detail during the symposium, more work is needed in building the regional LCA infrastructure to allow companies to make good eco-design decisions. Companies such as Hitachi and Fuji Xerox have incorporated LCA into their product design, but many other companies are still unable to do so in a rigorous manner.

Lastly, excellent models for skill transfer have been developed in Taiwan and other locations, and the next step is to expand their scale. The CSS model represents one viable option, but the number of companies within CSS systems is still only a small percentage of the total number of enterprises in the country. Market forces will undoubtedly help push more companies to independently establish CSS systems or alternative arrangements. However, governments must also consider how they can help this process along.

Work on the area of supply chain greening is still in its early stages, but it is undoubtedly a key piece in the puzzle of sustainability. Greening efforts can serve as a catalyst for the development of environmentally friendly products as well as for helping drive improvements in business environmental management. The “Top Forum on GP” is just one step in the longer, but vital, process of learning how to harness this powerful force for change.

1. GREEN PRODUCTIVITY: THE NEW FRONTIER OF SUSTAINABLE DEVELOPMENT

Lung-Sheng Chang

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Chairman, Distinguished Guests, Ladies and Gentlemen:

Good morning to you all.

It is indeed a great honor and immense pleasure for me to be invited to address this distinguished group that has been brought together for the occasion of APO's Top Forum on Green Productivity. I wish to express my heartfelt appreciation for the invitation from the organizers of this event. I also wish to extend my sincere congratulations to APO and the co-sponsoring and implementation organizations for their efforts in bringing this forum to Taipei. The choice of the theme of this forum "A Management Strategy for Enhancing International Competitiveness by Greening Supply Chains" is particularly appropriate and visionary, as it points to the vital importance of proper supply chain management. By this I refer to the linking of effective supply chain management to efforts to enhance environmental protection, international competitiveness, and sustainable development.

Undoubtedly many of you are here to look for information on the latest developments and trends in environmental management and sustainable development. However, the occasion itself is meaningful in another way as well. This workshop is remarkable because it represents one of the first few attempts in the region to articulate green product design and green purchasing. Here in Taiwan, we have accumulated much experience in the promotion of pollution prevention and environmental management systems -- the two areas that constitute key aspects of the Green Productivity concept currently being promoted by APO. We have also begun to promote green purchasing by using supply chain management strategies which that I will discuss in more detail in a few minutes.

Before getting into the heart of the subject, I hope you will allow me to share with you our past experiences and future plans in the areas of economic development, pollution control, and environmental management.

TAIWAN'S ECONOMIC DEVELOPMENT IN RECENT DECADES

The economic development in the Republic of China on Taiwan has been referred to as a "miracle." Taiwan has been known for many years as one of the four "little dragons" in Asia. Our manufacturing industry, which developed at a very fast pace during the last forty

years, has played a key role in driving Taiwan's economic development. We have moved from a base of consumer commodity and light industries in the 1950s and 1960s, to capital and technology intensive industries in the 1970s, and finally to high-technology industries in the 1980s and 1990s. Industry is now further upgrading to raise the level of technology and to speed new development in the high-technology sectors.

During the period from 1950 to 1995, our economy grew at an average rate of over eight percent each year. Our average per capita GNP increased from approximately US\$ 100 dollars in early 1950 to nearly US\$ 13,000 dollars in 1998. The industrial segment of our GDP grew by 340 times from US\$ 260 million dollars in 1951 to almost US\$ 88 billion dollars in 1998. Some of our industrial sectors, especially chemicals, computers, and electronics, are doing so well that they are now world leaders. Furthermore, Taiwan is now the leading manufacturer (by volume) in several products areas. For example, Taiwan ranks number 1 in terms of global market share in the manufacture of mother boards, computer monitors, image scanners, PU leather, and ABS resin.

PROMOTION OF POLLUTION CONTROL IN THE INDUSTRIAL SECTOR

In the area of environmental management, our industrial sector has not done as well as product manufacturing. Like many developing countries, we focused most of our efforts on attracting new investment in manufacturing facilities without proper requirements for environmental control, especially during the early phase of our industrialization. As a consequence, our environmental quality has been adversely affected. A large portion of municipal and industrial waste does not receive proper treatment or disposal. Moreover, environmental disputes and lawsuits have often resulted in civil disturbances, interruption in operation, and even closure of manufacturing facilities.

In recent years, however, the environmental performance of our industrial sector has improved substantially, thanks to implementation of effective regulatory programs by the Environmental Protection Administration (EPA), promotion of appropriate assistance and incentive programs by government agencies, especially MOEA, and close cooperation with our industry.

Due to our constraints on time, I will not speak in detail about our environmental programs. Nevertheless, I would like to take this opportunity to point out a few key facts.

The industrial pollution control promotion programs initiated by the Ministry of Economic Affairs (MOEA) began in early 1980s with the goal of encouraging industry to practice proper pollution control. These programs consisted of five major elements that included: government commitment to research and development; public awareness initiatives; information services; on-site technical services; and financial incentives.

Among these activities, the most effective mechanism was the technical assistance program. In 1983, we established the Industrial Pollution Control Center (IPCC) to provide technical assistance to industry in implementing pollution control measures. Through the funding support of the MOEA, more than 200 well-trained, full-time engineers and scientists of IPCC provide free technical services to industrial firms on a year-round basis, including on-site audits, regulatory interpretations, and technical option evaluation and recommendations.

Promotion of Pollution Prevention and ISO 14000

During the first stage from early 1980s to 1990, the emphasis of the technical assistance program was to help industry apply proper pollution control processes, or so-called end-of-pipe treatment technologies. However, beginning in 1990, we added a program element to promote industrial waste minimization, or pollution prevention.

Specifically, an executive order was issued in 1988 by the Premier, requiring that waste minimization be adopted as a key strategy in solving environmental problems in the manufacturing sector. This executive order represents the government's commitment that priority should be given to promoting source reduction. Following this executive order, the MOEA and the EPA established the Joint Waste Reduction Task Force (the Task Force) in 1989 to take on overall responsibility for promoting source reduction in the country.

The program to promote source reduction in Taiwan officially commenced in 1990, with IPCC and other non-profit organizations under contract to the Task Force. The program has been running for more than 10 years now. During this period, the program's focus has switched from public awareness promotion, training, and technology demonstration to assistance to industry in implementing waste reduction options. Furthermore, since 1995, new program elements have been added to promote the ISO 14000 environmental management systems. The effort to promote EMS under ISO 14001 has been received with a great deal of enthusiasm thus far, with more than 700 Taiwanese firms certified as of April 2000, making Taiwan the 6th highest worldwide. We foresee continued increase in certification activities as more foreign buyers such as NIKE and Japanese electronic manufacturers began to demand that Taiwan suppliers become certified within the next few years.

To keep abreast of developments in ISO certification, MOEA conducts an annual survey of certified firms. Available survey data indicates that the ISO 14000 program is making a significant impact on the attitude of our industry toward environmental issues. The survey data indicates that certified firms have become more pro-active on environmental issues, and that certified firms have become more cooperative with regulatory agencies in tackling pollution problems. The certified firms are doing so well in terms of environmental performance that the EPA is considering offering regulatory relief to certified firms. It is indeed a wonderful change.

Supply Chain Management Through the Corporate Synergy System

In addition to promotion of ISO 14000 in Taiwan, a special effort is being implemented to encourage small and medium sized-enterprises (SMEs) to practice industrial waste minimization. Under this effort, many large companies have implemented a management system called "corporate synergy system" (CSS) to encourage companies in their supply chains to implement waste reduction. Since its inception in 1995, the program, initiated by MOEA, has helped establish 15 CSSs that include more than 200 SMEs. By working together with the large firms, SMEs apply Green Productivity measures and thus enjoy the benefits of being green. CSS has indeed contributed to encouraging SMEs to practice pollution prevention. I am sure you will hear more about CSS in later sessions in this forum.

Promotion of Waste Recycling and Green Purchasing

In Taiwan, responsibility for promoting green products lies with the EPA. In recent years, the EPA has promulgated numerous regulations to mandate recycling of consumer products ranging from used automobiles to used soft-drink bottles. The EPA has been also developing initiatives to promote environmental labeling of green products. As of August 1999, the Green Mark specifications (known as a Class I environmental label) had been developed for 53 product categories, with more than 721 products approved to carry Green Marks in the country. In addition, in order to encourage green purchasing, the EPA initiated a program in May 1999 that allows government agencies to buy green products with Type II environmental labels at a maximum price differential 10%.

I have so far mentioned many programs in Taiwan that capture the essence of Green Productivity, including industrial waste minimization, ISO 14000, corporate synergy system, environmental labeling, and green purchasing by government agencies. The impact of these programs is difficult to measure quantitatively. However, we are confident that these programs have successfully raised the awareness of technological and management aspects of Green Productivity. Instead of solely depending on end-of-pipe treatment technologies, thousands of firms now consider preventive measures a viable option for solving their environmental problems. Moreover, these programs have provided a great deal of solid evidence that government policy can be adjusted to effectively influence industry to take a preventive and proactive approach to solving environmental and resource conservation problems, thus leading to better product quality, lower production costs, and improved environmental performances. These results have greatly influenced the decision-making process on environmental issues in this country.

SUSTAINABLE DEVELOPMENT: A NEW PROGRAM BUILT ON THE SUCCESS OF WASTE MINIMIZATION AND ISO 14000 PROMOTION

Having described the results of our programs in the recent past, I now would like to talk to you about sustainable environmental programs in Taiwan.

The National Council for Sustainable Development (NCSD) was established slightly more than two years ago in August of 1997. The Council is commissioned to plan, coordinate, and oversee implementation of all pertinent tasks related to the goal of achieving sustainable development in the country.

The creation of NCSD signals the fact that the country is entering a new era in the management of environmental issues. It basically indicates that the nation is no longer just looking at control of pollutants after they are generated. The issue as we see it now is how to embark on prevention instead of managing pollution after it has occurred.

The creation of the NCSD also signals the fact that, as a citizen of the global village, the ROC on Taiwan is determined to play an active role in practicing and promoting pollution prevention and sustainable development. The United Nations Earth Summit held in Rio de Janeiro in 1992 strongly warned that current development path for the world is not sustainable. It specifically called for the development of an Agenda 21 by each nation with the goal of achieving a more sustainable development path. Cleaner production was recognized at the Earth Summit as one of the paths toward achieving sustainable development. Cleaner production is defined by the United Nations' Environment Program (UNEP) as the "continuous application of an integrated, preventive environmental strategy

to processes, products, and services to increase environmental protection and resource utilization, and reduce risks to humans and the environment.” Cleaner production requires changing attitudes, responsible environmental management, and constant re-evaluation of technology options. The waste minimization approaches that have been implemented in Taiwan since 1990 clearly serve the same purpose as the cleaner production initiative suggested by UNEP.

The NCSD is still relatively new; it has been in operation for slightly more than 2 years. However, I can assure you that this agency is equipped to make a major impact on the width and depth of the environmental conservation effort of the nation. It is commanding a prominent profile. The Council is chaired by the Vice Premier of the Executive Yuan, and co-chaired by the EPA administrator. Moreover, many cabinet members are invited to participate in the planning and coordination of NCSD’s activities. Many academic and research organizations and NGOs will also be involved. Thus, under the NCSD, one can expect an integration of both public and private sectors in the planning and implementation of environmental protection and economic development programs.

Key Area for Sustainable Development: Promoting Pollution Prevention in Non-Manufacturing Sectors

There are many tasks being carried out by the NCSD. One of the key tasks of the NCSD is to expand the frontiers of our waste minimization program. As I mentioned earlier, since the initiation of our industrial waste minimization program, many source-reduction technologies have been adopted by thousands of companies in the manufacturing sector. They have shown environmental and economic benefits resulting from savings on raw material inputs, savings on the costs of pollution treatment, reductions in potential liabilities, and improved overall image. Since this program has worked so effectively in our industrial sector, the NCSD has extended the same pollution prevention approach to many other sectors. To name just a few, this approach is being promoted for applications in energy conservation for the manufacturing and transportation sectors, in water conservation and pest control for the agricultural sectors, and the application of eco-materials for the construction industry.

Key Task for Sustainable Development: Eco-Design and Eco-Material

Another frontier of waste minimization is the promotion of green products, or, the life-cycle design of consumer products. During the past decade, abundant research evidence indicates that product design could significantly affect the quality of our environment and cost of environmental management. Life cycle analysis of domestic appliances, for example, shows that a majority of total lifetime energy consumption occurs during use, rather than in product manufacturing or transport. Environmental aspects of product design and development are coming under the more intense scrutiny of consumer groups, environmental organizations, and government regulators. Product designers in many countries are eagerly finding new design solutions to reduce energy consumption and pollutant generation before, during, and after product use. All are eager to see greener, safer, and more affordable products. Ample evidence suggests that approaches such as eco-design, design-for-the-environment, and sustainable product development are gaining momentum in many developed countries. The trend has spread to Taiwan as well. A growing number of companies here are looking to eco-design of products as a means of becoming more competitive and environmentally sustainable in the long run. In response to the trend, the

NCSD has taken the initiative in spreading the message and ideas and tools of green product design and urging more companies to join in.

Another issue key to sustainable development relates to eco-materials. Eco-materials are the material items that create less of an environmental burden in production and in usage with high recyclability and/or more effective utilization of material. In one area of application, the eco-material concept encourages development of materials that contain no or less harmful substances in the stage of usage and disposal or recycling. These materials are, for example, those used in batteries, product wrapping, soldering, or paint. The bulky materials for construction constitute another type of eco-material. These eco-materials either have lower environmental loading in processing, or are more easily recycled. An outstanding example that happens in Taiwan is the cement produced from residues generated in iron and steel foundries. Traditional cement production makes use of limestone as a raw material. Substitution of foundry residues for limestone not only reduces limestone usage, but also helps recycle waste material from the iron and steel industry, contributing to reduced environmental costs and lower green-house-gas generation.

In my opinion, material technologies will become more important in the coming era as we strive for sustainable development. Through proper R&D and promotion efforts, we could develop eco-materials that have these following important characteristics: (1) lower environmental loading, (2) flexibility of production, and (3) long life and the possibility of progressive maintenance. Development and promotion of eco-materials is one of the priority subjects of NCSD.

Key Task for Sustainable Development: Promotion of Reduced Consumption

Another area that the NCSD should focus on is the promotion of the simplicity movement toward reduced consumption by each and every citizen. Here in Taiwan, the population growth has been reduced and projected to stabilize at merely 0.28 percent per year for the next 50 years. However, like many nearly developed countries, the energy and material consumption to satisfy our ever-increasing life style is of a great concern. In terms of environmental burden, consumption increments are substantially more threatening than population growth. While industry and government are working hard to achieve reduction of supply side consumption by promoting source reduction and green product design, cooperation by consumers by reducing consumption is a necessary step toward sustainable development.

Thus, an important question remains to be addressed; that is: “*When is ‘more’ is enough by the consumers?*”.

This same question can be rephrased as: “*Is it possible to reduce consumption by “satiation?”* (meaning more satisfaction with what people already have) *or, by “sublimation?”* (meaning having more satisfaction with less to achieve some greater good).

In literature, we can find small but growing number of examples that fashion “simple living with a good and satisfying life.” Such examples may not have contributed to a significant reduction of the environmental burden by consumption, but they nevertheless provide possibilities of less demanding alternatives that could lead to a more sustainable life style.

A recent publication edited by Robert Rosenblatt, entitled “*Consuming Desires: Consumption, Culture, and the Pursuit of Happiness*” provides many essays that ask essential questions of why more never seems to be enough and why satiation and sublimation are so difficult to achieve in the culture of a consumption-oriented society.

These articles appear to tell us that we still have a long way to go before reaching a state that promises less resource-depleting and environmental damaging society.

SUMMARY

In summary, I wish to point out that the mission of the NCSD is indeed vitally important to the well-being and future of this country. The road ahead, however, could be lengthy and not very straightforward. Many factors in Taiwan are limiting the diffusion of ideas on Green Productivity and sustainable development. Let me highlight just some of them:

- There is a lack of awareness, knowledge and expertise on the part of government and private sector. Ongoing education and professional training must become the norm. Engineering and business schools must ensure that their graduates are “literate on pollution prevention and sustainable development.” Better systems for public education and information sharing have to be implemented. Special programs should be implemented to attract small and medium-sized enterprises to adopt environmentally sound production technologies.
- Another barrier to pollution prevention and sustainable development is the nature of environmental regulations. Current environmental legislation and regulatory systems often stipulate investments in end-of-pipe treatment technologies rather than promoting source reduction. I see a need in the ROC to reform environmental legislation to provide flexibility to encourage application of waste reduction measures. Additionally, economic instruments should be designed on the basis of polluter-pays principle, and producers’ responsibility for the product life cycle.
- Still another barrier to pollution prevention and sustainable development is a lack of technology and scientific information specifically developed for local application. In other words, we should emphasize implementation of research and development programs designed for local consumption. The key areas demanding immediate attention constitute eco-design of products and development and promotion of eco-materials.

CONCLUSION

Before I close, I wish to reiterate four key points:

First, Taiwan’s success in industrial development has contributed significantly to the wealth of the country. Today, we are on the verge of transforming this country into a developed country. During this process, we must not only search for competitive advantage, but also sustainable development.

Second, rapid industrialization has created a rather serious pollution problem. It degrades environmental quality and causes social instability and deters future economic development.

Third, the pollution prevention promotion program since 1990 and ISO 14000 program since 1995 have been quite successful. They have laid a solid foundation for mending industrial pollution problems and achieving sustainable development in the country.

Fourth, a new paradigm of environmental management has evolved in Taiwan as a result of the recent establishment of the National Council for Sustainable Development. Built on the solid foundation of pollution prevention and ISO 14000 programs in the manufacturing sector, the Council is seeking to promote preventive approaches to green product design, eco-material development, and source reduction in non-manufacturing sectors. The path to sustainable development is not easy. The program's success requires development and adoption of not only appropriate management tools and technologies, but also a new value system that champions a simple and good life style. Let us hope our start is a good one and in the right direction.

Finally, I would like to thank you all for your time and attention. My best wishes to the success of the Top Forum on Green Productivity that begins here this morning. My sincere thanks again to the organizers for giving me the opportunity of meeting all of you. I wish each and every of you a wonderful time here in Taipei while enjoying our culture and hospitality.

Thank you.

2. THE ECO-ECONOMY: ENHANCING PRODUCTIVITY AND ENVIRONMENTAL PERFORMANCE

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I first wish to thank you deeply for the honor of joining with you for this important gathering. Our meeting today reminds me of one that I was engaged in five years ago in the United States. I believe that the outcome of today's meeting can be at least as significant, if not more so.

Let me first summarize the points I plan to make, by describing that meeting five years ago. In Aspen, Colorado, 60 business leaders from the United States gathered to consider the implications of the New Economy, and its potential for environmental sustainability. We were united by a mutual belief that we were in the midst of an economic revolution –that the old industrial economy was approaching its end, and that in its place was emerging something new, different, and promising.

We called the revolution the Ecological Revolution –and you might call the economy that it introduced the Eco-Economy. We chose this name not because the new economy is ecologically sustainable, but rather because the new economy operates *much more like an ecosystem* than the old. The complex cauldron of ideas and technologies that we called the information age came together into an economy that seemed as complex, diversified, and dynamic as a rainforest, a prairie, a coral reef, or any of the complex systems of nature. From this cauldron or stew, ever so gradually, a new kind of economy and culture was beginning to take form, one that demonstrates another important attribute of nature: it can produce wealth without waste; affluence without effluence. It can enhance productivity *and* environmental performance. It can be *sustainable*. It can be an economy rich in ways that go far beyond the material –one that provides abundantly for the needs of today's generation, without undermining the ability of future generations to meet, in abundance, their own needs.

In nature, when conditions change, the plants and animals that make up an ecosystem have two choices. They can either adapt (sustain themselves) or they can die. Today in the human economy, we have the same choice. As the eco-economy spreads, it will undermine *every* existing company in *every* sector. Every company in this room will either become a member of the future 500 or the fallen 500 –the ones that adapted, and the ones that died.

So, let me give you a summary of the five questions I will try to answer today:

First, what is the eco-economy, and the revolution that is bringing it about?

Second, what is the new fundamental resource that makes that economic revolution possible?

Third, how does that new resource make it possible to enhance *both* productivity and environmental performance at the same time?

Fourth, which companies will be transformed by the ecological revolution?

Fifth, who will be the Future 500 - the companies that replace today's Fortune 500 and Global 500, and lead the eco economy?

Let me go straight to the first question: What is the economic revolution and the new economy?

Three centuries ago, we experienced another economic revolution. The industrial revolution transformed the global economy from one founded on agriculture to a new economy founded on industry and the use of machines to extract fossil fuels and raw materials to manufacture goods.

The industrial economy changed every aspect of our culture and our lives: where we lived, how we worked, what we believed, what we valued. As Taichi Sakaiya writes in *The Knowledge Value Revolution*, it overthrew old concentrations of power; it overthrew old belief systems; it even overthrew old social values and sources of status. Today's economic revolution is just as fundamental. Like the industrial revolution, it will overthrow old concentrations of power, old belief systems, and old values.

Question 2: What is the new core resource that dominates in the new economy?

We all probably know the answer. In the old economy, fossil fuels and raw materials were fundamental. Today, the new core resource is knowledge. How can knowledge be a resource? Consider the microchip. A microchip's physical content is not very valuable. It is made of sand –the most abundant substance on earth. What gives a microchip its value is not what it is made of, but how it is designed. The pattern etched into its surface. That pattern is a product of the human mind, a product of creativity, and a product of knowledge.

Question 3: How does the new resource –knowledge– make it possible to enhance *both* the economy and the environment?

How is it possible to design products or processes that use less energy, materials, and toxins? There is only one way –by being smarter. When Toyota or Hyundai makes a car that is just as good as a Ford, but is safer, cleaner, and gets more miles per gallon, they have found a smarter way to design it. The companies have replaced fossil fuels and raw materials with knowledge.

There are two ways to use knowledge as a substitute for resources in a product.

1. Make a product smarter; and
2. Make a smarter product.

Making a product smarter means making the same product as before, except designing it to use fewer resources. For example, we can now add a computer chip to a car to regulate its fuel use and improve mileage. We call this *eco-efficiency*.

Making a smarter product means making a product that is *different* from before, and one that provides the same service in a whole new way. As an example, think about how we now use a computer to work or shop at home, instead of using our car at all. We call this *eco-effectiveness*.

- Eco-efficiency means making a product better; and
- Eco-effectiveness means making a better product.

Let me explain the difference with a story about two chemical companies: Dow and DuPont. In 1970, Dow began a famous program to encourage employees to find ways to reduce pollution. In the first few years, hundreds of suggestions were implemented. They paid a return on investment of 183 percent. That means every dollar that they spent gave them a \$1.83 return in its first year.

Many people assumed that Dow had just found the most obvious sources of waste. Therefore, they thought, the 183 percent return would decline as the company tackled more difficult opportunities. Instead, just the opposite happened. Every idea led to another idea. People found more and more ways to improve. After 20 years, the program was not paying returns of 183 percent anymore. Instead, it was paying 300 percent meaning that every dollar spent brought \$3 in savings the first year.

Now let's look at DuPont. DuPont was one of Dow's main competitors. They knew that to stay competitive, and also to earn the support of the public and regulators, they needed to match or beat Dow's achievements in eco-efficiency. However, they took a different approach. They didn't just focus on eco-efficiency; they also focused on eco-effectiveness. Instead of just making the same products more efficiently, they focused on making *better* products - products that performed the same functions as the old ones, but in new ways that were radically more productive.

One of Dupont's biggest breakthroughs was in herbicides. At the start of their eco-effectiveness program, DuPont was the world's seventh herbicide manufacturer. They invented new herbicides that were 100 times less toxic than the old ones. The new products cost less in money, and less in negative health impact. As a result, DuPont moved from the seventh to the second position in the market. Those were two examples where companies improved their productivity mainly to reduce their impact on the environment.

But in the new eco-economy, green productivity does *not* require that we *try* to save the environment. Most Green Productivity happens by accident –as a natural side effect of the shift to the New Economy. The shift is from dependence on fossil fuels and raw materials to dependence on knowledge. That is because the Eco-Economy grows every time we use knowledge instead of resources to create value.

That means Green Productivity happens much more frequently than we had originally thought. It happens every day, almost every moment, in the New Economy. It is creating billions of dollars in new value and new wealth, even while it is reducing pollution and waste.

To find examples of that, let's answer Question Four: Which companies will be transformed by the ecological revolution?

The simple answer is: almost *every* company will be transformed by the Eco-Economy. Every company that is now listed as a Fortune 500 or Global 500 company. Every retailer, every wholesaler, every manufacturer, and every extractor will be transformed. Every one of them will either have adapt or decline and die. Every one of them will either become part of what we might call the Future 500 –the companies that will lead in the new economy, or become part of the Fallen 500 –the companies that failed to evolve successfully in the face of change.

Let's look at each of these sectors, one at a time, and see how they are changing already. First, let's look at retailers. Companies like Amazon.com have found ways to sell books, electronics, and other products, but eliminate the stores. Are they promoting Green Productivity? Yes. Consumers save 90% of the energy when they ground ship their books instead of driving to the store. They even save half the energy when they have books shipped overnight.

Internet commerce is growing at more than 100% per year. As it continues, what will happen to the world's largest retailers, companies like WalMart, Sears, Kmart, Target, Home Depot, Kroger, Safeway, and Costco? Will they change and be part of the Future 500? Or will they be replaced by companies with names like Amazon, eBay, and Soma.com?

Next, consider wholesalers. Home Depot has eliminated intermediate warehouses; 85% of its merchandise goes straight from manufacturers to its stores. Sales associates walk through the store aisles, ordering products that need to be restocked with handheld computers that send the orders over the Internet to 80% of the company's manufacturers.

As the Internet eliminates the need for middlemen, what will happen to the hundreds of thousands of Asian and U.S. wholesalers, agents, warehouses, and distributors? Will they change into new forms, and become part of the Future 500? Or will they decline and disappear?

Now consider manufacturers. Mass production is slowly being replaced by custom production. Dell Computer is selling computers that meet the specific needs of its customers. Levi's is making jeans designed to perfectly fit specific buyers. MP3.com is allowing millions of music buyers to make their own CD's, with just the songs they want, by downloading them directly off the Internet. What will happen to the world's mass manufacturers? Will they change to serve their customers in new ways? Or will they decline, and become part of the Fallen 500?

Finally, consider the extraction companies –companies like oil companies, mining companies, and timber companies that take resources from the earth. Today, Exxon, British Petroleum, and Mobil are the world's 8th, 19th, and 40th largest companies. Yet demand for oil is flattening. In the United States, the economy grew nine percent in 1997 and 1998, yet energy efficiency grew four percent each year. Overall, demand for energy stayed the same. That means we got nine percent more economic output, using zero additional energy.

Now, with oil prices higher than ever, many think the oil companies will grow in power. In my opinion, this will be only be a short term phenomenon. Today it is cheaper to save energy than to pay high prices. That means, just like in the 1970s, energy efficiency will grow in the years ahead. The demand curve for oil will decline, prices will fall again, and the oil companies will be forced to adapt or decline. Will they change and become part of the Future 500, or stagnate and join the Past 500?

That brings me to Question Five: Who will be the Future 500 –the companies that replace today's Fortune 500 and lead the New Economy?

In the U.S., many of the Future 500 will probably *not* be among today's Fortune 500. With a few exceptions like 3M, most companies are unwilling or unable to cannibalize their existing businesses to create new ones, even if the opportunities are extraordinary.

Consider that AT&T turned down packet-switching technology, the basis of data transmission over the Internet, because they were afraid it would undermine their investments in circuit-switching. They even turned down the Internet itself, when the U.S. government offered them its predecessor, essentially for free.

Busicomm, the Japanese calculator maker that owned exclusive rights to the first microprocessor, thought that all it had was a technology to make a better calculator. They sold the balance of rights to Intel. When they did, Japan lost its opportunity to dominate that industry.

So Intel gained from Busicomm's loss, but then Intel made a similar mistake. It turned down the personal computer. Thinking about when an Intel engineer approached Gordon Moore with the idea, Moore said, "It just didn't seem like it had any practical application at all." So Intel dropped an opportunity, and it was picked up by Apple, IBM, and Microsoft.

Most recently, Bill Gates turned down a huge opportunity. He could have dominated the Internet. However, he waited too long, until others had proven its power. For years, he even undervalued his operating system business. He was sure it could never be as valuable as programming languages.

But Xerox, the copier company, is the company that seems to have missed the *most* opportunities. It turned down all that and pretty much everything else in the cyber economy: Alto, the first personal computer; Bravo, the word processor that later morphed into Wordstar and Microsoft Word; Email, later the killer application for America Online; GUI, the graphical user interface that Xerox let Steve Jobs steal for free, and which Microsoft then stole again to create Windows; and Ethernet, the gateway that enabled PCs to tie into networks, and led to the growth of the Internet, and to world's most valuable company, Cisco Systems.

All those technologies were invented by Xerox. Yet did Xerox make a mistake in failing to pursue them? Maybe, but maybe not. Perhaps Xerox knew that to succeed, it needed to focus on its core competency, and let others focus on theirs. From the seeds Xerox planted, companies like Sun Microsystems, 3Com, Cisco, Apple, and Microsoft grew.

So which companies will be among the Future 500? And how can Asia's companies lead the new global economy? In my opinion, Asia is particularly well positioned to excel in the new economy, to surpass much of the world in Green Productivity. Beginning two generations ago, the economies of Asia mastered a new style of business management. Applying the ideas of the great Edwards Deming, Kaoru Ishikawa, Taiichi Ohno and others, over a period of just decades Japan's economy grew more than any in recorded history. Its success was followed by similar growth throughout much of Asia.

Today, Asia can master a *new* style of business management. A style that is just one step beyond the quality management systems implemented at companies like Toyota. That style of management is *living systems* management: the art of managing business like it is a rainforest, or a prairie, or any complex system of nature.

Yesterday, in the old economy, we managed business as a machine, a top-down hierarchy to quickly extract resources from the earth and turn them into billions of products, all the same. Today, in the Internet economy, no business can excel if it is managed like a machine. It must learn to operate like the systems of nature –to be adaptive, creative, resilient, and sustainable.

There is a secret to managing a business like a living system. It is a secret that every gardener knows. The secret is this: you cannot manage the business the same way at all times. Instead, you must manage it in four different ways –a different way for every season. Every living thing –every garden, every business, every person in this room– evolves through four seasons, four phases of life, over and over again. Like the seasons of spring, summer, fall, and winter; creation, growth, development, and renewal.

The essence of sustainability, in nature and in business, is learning to prosper not just in one season, but in ALL seasons –to complete the cycle of creation, growth, development, and renewal. Here is how to excel in each season. In a moment, I will describe how some of today’s leading companies are learning to profit by applying these principles.

To excel in the spring, the season of creation, we must know our objective, and plant many seeds that may contribute to it.

To excel in the summer, the season of growth, we must choose and nurture a very few seeds –those seeds best matched to their environment, those seeds most capable of extraordinary growth.

To excel in the fall, the season of development and challenge, we must learn to be thrifty –to improve our efficiency and our quality, our degree of perfection.

And to excel in the winter, the season of destruction and renewal, we must know again our objective –we must know the garden we intend to grow– and preserve the seeds, some the same and some different, from which to begin a new phase of creation and growth.

Asia has recently experienced an economic winter, a time of great challenges and limits. Yet within Asia, many of your countries, technologies, companies and people are in their creative, growth, and development phases. In particular, Asia has long been a master at the development stage. That is the stage when continuous improvements in efficiency and quality are the most important variable for success. The management methods of Deming, Ishikawa, and Ohno are particularly suited to this gift.

The genius of the United States, on the other hand, is in the stages of creation and growth –in innovation, and in the selection of seeds for growth. Combining the capabilities of the U.S. and Asia completes the cycle. As partners, the U.S. and Asia have the capacity to cultivate an economy that is dynamic, resilient, and sustainable. As partners our economy can be one where both elements of Green Productivity are fully harnessed: the innovation essentially to eco-effectiveness, and the continuous improvement essential to eco-efficiency.

We must have both of these if we desire a sustainable economy. If we simply improve efficiency, without changing the nature of the technologies on which we remain dependent, then we will simply enable the economy to speed faster and faster, extracting more and more resources from the earth. We must also advance eco-effectiveness. We must find ways to provide the services we all need, without the extractive consumption of the industrial era.

Many say that to succeed in the new economy, Asia must be more like the United States. You must consume more and more, in machinelike fashion, and grow your economy at the expense of shrinking the earth. However, that strategy alone would fail. To succeed, Asia must be Asia. It must express in contemporary form the pattern that is inscribed at depth in its seed.

My point is this: to excel in the economy now emerging, it would be a mistake to revert to the machine economy and its overriding focus on physical consumption. The companies that excel today are those that restructure themselves as adaptive, resilient, creative, and sustainable –living companies with the capacity to learn and change.

These companies are increasing their profits in new ways: turning wastes into new savings and products; leasing and remanufacturing billions of dollars of equipment that used to be thrown away; driving pollution and waste toward zero; and systematically eliminating products and even whole industries while continuing to provide the services that are what we actually want.

These are companies that know how to excel in the season of creation. Like 3M, one of the oldest major corporations in the U.S., 50% of whose products were introduced in the last three years. Like Xerox, which earns \$200 million per year in savings through an asset management program that takes back and continuously improves its line of copiers and office equipment. Like Hewlett Packard, which leads the world in the provision of office equipment while retaining the in-the-garage creative entrepreneurship of its founders, and recently had the courage to birth itself into two new companies to carry that capacity into a new century.

Many other companies know how to fully exploit the seasons of physical growth. Like Ford Motor Company, which early this century mastered the machine management principles of the great Frederick Taylor, the father of scientific management. Ford has made quality its focus in the latter part of the century, and is prepared even to move beyond the internal combustion engine to a new product line more reflective of its purpose in the new conditions of the century ahead.

Like Interface Carpets, which grew to be the world's largest maker of commercial carpet tiles like the ones in this room. Interface is now investing its profits to excel in what it calls the next industrial revolution, as a company that provides the services of floor covering, without needing to sell the product itself.

Like Nike, which achieved its goal to make the world's best footwear, and grew to become the world's largest as well. It has survived challenges from Reebok and others to enjoy whole new sales surges, and now has set its sites on becoming a sustainable company.

Like MacMillan Bloedel, recently purchased by Weyerhaeuser, which grew to become Canada's largest forest products company by consuming the trees of old growth forests. It is now setting aside vast regions of remaining ancient forests for preservation, and learning new methods of forestry that retain the ecological integrity of the forests.

There are also many companies that have known the two principles of success in the season of development –efficiency and quality. They manage themselves as learning organizations, seeking continual improvement, and measure the efficiency of their operations in terms of energy, resources, capital, and labor. Like Target Stores, which uses Activity Based Costing to measure the waste intensity of every one of its stores. This measure serves as a catalyst triggering the development of hundreds of efficiencies that together dramatically streamline the operations of its stores and its suppliers, saving money and resources.

Like Texaco and Shell, who in Bakersfield, California have turned an oil refiner into a complex industrial ecosystem, whose wastes from one process become money-saving resources for others.

Like Coors, which sees all waste as lost profit, and has recycled its wastes into everything from fertilizer and feed to aluminum cans, and recycled its ideas to create

through its spin-offs more than 10,000 products whose value comes from their advanced design.

And companies that have excelled through the most challenging of all business stages –creative destruction and renewal: like Royal Dutch Shell, whose visionary leaders like Arie DeGues first invented the term “living company,” and applied it to navigate Shell through periods when petroleum was challenged more fundamentally than ever before.

Like Mitsubishi Electric, which provided the electrical equipment that helped Japan’s economy grow early in the century, led in the electronics revolution of the middle century, and is now pioneering the ideas of industrial ecology that can foster growth in the living economy.

And like the familiar companies I have already mentioned who make the turn and excel in the creative stage of business, like 3M, Xerox, and Hewlett-Packard. These companies and others are breaking the association that we once made between consumption and quality of life –the iron law that once said that to provide for our needs today, we must sacrifice our capacity to survive tomorrow.

Now through the Internet, a new generation of companies is emerging that can provide for virtually any material need beyond food and housing, using a tiny fraction of the resources once required. These businesses are systematically eliminating the need for the products and processes that used to be required to deliver the services that we truly desire.

The key to business success in the Eco-Economy –the key to Green Productivity–, the key to being among the Future 500, is to systematically eliminate the need for the resource-intensive, environmentally destructive products and processes of the industrial era. These companies look to the industries that involve the most damage to the earth, and aim to take their market share away by creating more efficient products that reduce environmental costs, and more effective products that radically reduce costs.

VALUES?

These changes will do more than reduce our extractive draw from the earth. If the theories of Taichi Sakaiya are borne out, it will begin to change our values as well. It will shift the focus of our lives from the material half of existence to the other *hidden* half. Perhaps it will also break the addiction to materialism, which seems at the *root* of ecological decline.

Two generations ago, Asia began to master a new style of business management and led the world in economic growth. In the years since, the qualities of Asia have united with the qualities of America to trigger the emergence of a new economy. They have fomented a revolution as fundamental as the industrial revolution of three centuries ago. Now as we approach the end of the old industrial machine age, it is time to move beyond machine styles of business, and the materialism they foster. We must adopt new systems of management and measurement, and a new set of values that see businesses and the economy as living systems, sustained by profit, performance, and an underlying sense of purpose, long into the future.

Thank you.

3. GREEN PRODUCTIVITY AND SUPPLY CHAIN MANAGEMENT

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OUR ENVIRONMENT

Every type of economic activity involves utilization of environmental or natural resources. It has been recognized globally that production and consumption patterns have become unsustainable. Increasing awareness and growing public concern about the negative impacts on the environment and natural resource base has prompted the government to reconsider its strategy for growth and economic development. Most of the Asian countries are trying their best to balance the development and environmental needs based on the economic situation of their countries.

Prior to the 1950s, the common business response to environmental pollution was to ignore such problems. This was possible when the problems were relatively small and the awareness of the health and environmental impacts was low. In the 1960s, a common approach to pollution was to adopt “the solution to pollution is dilution” concept. Air pollutants were dispersed by tall smokestacks and water pollutants were discharged into the river/sea. However, these diluted pollutants accumulated in soil and water and eventually found their way into the food chain.

In 1970s, the government realized that pollutants had exceeded the assimilative capacity of the environment. There were efforts to establish environmental standards to regulate the discharge of pollutants. This resulted in the use of end-of-pipe (EOP) treatment systems. As the discharge standards became more stringent, the cost of such end-of-pipe treatment of wastes became more expensive and affected the economic viability of some industries.

Besides the high costs, the end-of-pipe treatment approach was found to be far from adequate. Pollutants were not eliminated, but merely transferred from one medium to another. The policy responses came in various forms, maturing gradually from command-and-control regimes to voluntary systems emphasizing prevention of pollution at its source, waste minimization, cleaner production, and environmental management systems such as the ISO 14000 series. These voluntary systems were found to be more cost-effective than using a command and control approach alone.

However, in 1994, the US Office of Technology reported to the Congress that:

“By considering pollution prevention separately from other manufacturing needs, such as productivity and quality improvements, most pollution prevention programs fail to develop the vital synergies and working relationships with manufacturers that are essential to drive both pollution prevention and manufacturing competitiveness.”

The Asian Productivity Organization (APO) recognized that if the Asian economy is to be steered in a sustainable direction, there was a need for a new paradigm that integrated environmental protection and productivity improvement. This recognition led to the development of a program called Green Productivity (GP) in 1994. The goal of GP is to attain higher levels of productivity to serve the needs of the society and to simultaneously protect and enhance the quality of both the local and global environment.

GREEN PRODUCTIVITY (GP)

Concept and Definition

The concept of Green Productivity is drawn from the integration of two important developmental strategies *viz.* productivity improvement and environmental protection.

Productivity provides the framework for continuous improvement, while environmental protection provides the foundation for sustainable development.

Therefore, Green Productivity is a strategy for enhancing productivity and environmental performance for overall socio-economic development. It is the application of appropriate techniques, technologies, and management systems to produce environmentally compatible goods and services.

Triple Focus of GP

GP aims to ensure environmental protection while making business profitable. GP is a multi-disciplinary, systematic, and holistic approach. GP emphasizes teamwork and the application of appropriate techniques and technologies.

GP recognizes that environment and development are two sides of the same coin. Extending this recognition, the concept of GP shows that for any development strategy to be sustainable it needs to have a focus on environment, quality, and profitability, which form the triple focus of GP.

The Distinguishing Characteristics of GP

The practice of GP is characterized by four distinguishing characteristics.

Environmental compliance

The heart of GP is environmental protection, the first step of which is compliance with regulations. GP emphasizes the practice of pollution prevention and source reduction. Residues must be managed using end-of-pipe treatments. It is the unique characteristic of GP that productivity will also improve while the organization achieves compliance with environmental regulations. These practices may lead to a situation beyond compliance with the ultimate aim of ensuring quality of life.

Productivity improvement

The other aspect of GP is productivity improvement. The concept of continuous improvement achieved by adopting the PDCA cycle is aimed at ensuring not only productivity improvement, but also environmental improvement. This is a dynamic and iterative process.

Integrated people-based approach

One of the strengths of GP is its worker involvement and team based approach. Its people based approach extends to improving the working environment, workers' health and safety, non-discrimination, and related social welfare issues. The approach involves multi-stakeholder participation.

Information driven improvement

Documentation and reporting are the strengths of GP drawn from systems such as QMS and EMS. The adage "what gets measured gets done" is one of the driving forces of GP.

GP Practices

Green Productivity (GP) is applicable not only to the manufacturing sector, but also to the agriculture and services sectors. GP also addresses the interaction between economic activities and community development. Another dimension of GP is the role of the public sector (government and education) in environmental protection and awareness. Within this framework, the APO particularly addresses the needs of small- and medium-sized enterprises (SMEs) to leverage scarce organizational resources to increase productivity and protect the environment.

An attractive feature of GP is that it leads to gains in profitability through improvements in productivity and environmental performance. Excessive use of resources or generation of waste is indicative of low productivity as well as of poor environmental performance. In many ways these are manufacturing defects that need to be set right. To improve the situation, GP pursues a strategy based on technical and managerial interventions. It is a process of continuous improvement.

- The first step is to identify ways to prevent pollution or waste at its source as well as to reduce the level of resource inputs by the process of rationalization and optimization. Possibilities for reuse, recovery, and recycling are investigated to salvage as much as possible of the wastes generated.
- Next, opportunities for substituting toxic or hazardous substances are explored to reduce the life-cycle impact of the product. At this stage, the product itself is examined (including packaging) in the framework of design for environment.
- Finally, the wastes in their residual forms are treated adequately to meet the regulatory requirements both from the perspectives of the workplace and the receiving environment. In order to ensure continuous improvement in productivity as well as in the level of environmental protection, a management system is developed, much along the lines of the Environmental Management System of the ISO 14000 series.

The benefits of GP are both immediate and long-term. Organizations realize immediate improvements in productivity that accrue to them over time in the form of: increased efficiency gains in resource use; lower costs of production; decreased waste disposal and end-of-pipe costs. In countries with complex regulatory systems, the GP techniques and methodology lower environmental compliance costs. The intended spill-over effect is a noticeable improvement in the social environment. Sustainability is a keyword in the GP vision, informing the methodology and strategies used by practitioners.

Windows of Opportunity

There are numerous areas where GP is applicable. Some of the windows of opportunity are as follows:

- Environmental protection & resource conservation;
- Legislation & regulations compliance;
- ISO14000, Environmental Management System (EMS), Environmental Labelling (EL), Design for Environment (DfE);
- End-of-Pipe (EOP), Waste Minimization (WM), Cleaner Production (CP), Pollution Prevention (P2), Clean Technology (CT), Eco-efficiency (EE);
- Toxic chemical & hazardous waste management;
- Energy management;
- Productivity and quality enhancement;
- Occupational health and safety;
- Community development;
- Agricultural activities;
- Eco-tourism;
- Service industry;
- Eco-industrial park management; and
- Supply chain management.

SUPPLY CHAIN MANAGEMENT (SCM)

With the liberalization of world trade, globalization, and emergence of new markets, many organizations have customers and competitors throughout the world, either directly or indirectly. Business communities are aware that international competitiveness is key to the success of a business. Competitiveness is the ability to produce, distribute and provide products and services for the open market in competition with others.

Effective procurement can reduce costs and add value to an organization by enhancing overall competitiveness. Procurement activities can be leveraged into a holistic approach to the supply chain management (SCM). SCM is an integrated philosophy to manage the total flow of a distribution channel from the supplier to the user.¹ SCM requires an assessment of the current supply chain members to determine their level of performance along the material flow continuum.

¹ Lynn Johansson, 1994, "How Can A TQEM Approach Add Value to Your Supply Chain?" In *Journal Total Quality Environmental Management*, pp. 521-530.

SCM is a strategic management process that begins with an assessment of the current strengths and weaknesses of the organization and identifies gaps where current performance fails to meet the organization's vision. SCM is an operational approach to procurement. It provides the necessary tools to bridge the gap between policy and procedure to operational management. SCM is a continuous improvement strategy to understand and manage the supply chain through differentiation based on risk and value. For effective implementation of SCM, skilled workers, good processes, vision, and continuous improvement are required.

GREEN PRODUCTIVITY AND SUPPLY CHAIN MANAGEMENT

With the launching of ISO 14000 in 1996, organizations are concerned about their environmental performance, not only with respect to gaining a market advantage, but also in respond to customer requirements. Organizations are required to improve their environmental performance in order to be eligible for the ISO 14001 certification.

Organizations are including environmental issues in their negotiation with suppliers to maintain their market share and sometimes even just to survive. However, in most Asian countries, environmental protection has also been treated as an "additional cost" to companies, particularly SMEs. Most SMEs do not have the resources to improve their environmental performance. Organizations are realizing that they can use their purchasing power to influence the suppliers. To terminate a long-term supplier relationship due to their poor environmental performance would be undesirable, and may create disaster for an organization. One option is to could provide training and technical support with special credit treatment to their suppliers to improve the environmental performance.

GP and SCM have synergies and provide organizations with a means to enhance their productivity, quality, and improve the environmental performance. To establish a GP program in any organization requires commitment from top management. GP will enhance companies' profit margin without compromising environmental quality.

GP will assist organizations in improving their environmental performance by, first reducing the waste at the source, and then reusing, recovering, and recycling waste. Any residual waste will be treated by the EOP system. The productivity and quality of products and services will be enhanced by the application of GP. GP, hence, improves the profitability of the organizations, and creates an advantage on competitiveness by reducing the cost of production and operation.

SCM provides the means for the organizations to establish continuous exchange of information and upgrading the performance along the material flow continuum. SCM initiatives will assist organizations, particularly SMEs, in acquiring technical knowledge, and receiving assistance from others on the improvement of their environmental performance.

The synergy of GP and SCM will create a win-win situation by enhancing the productivity, quality, profitability, and environmental performance of the entire supply chain. The GP-SCM applications will provide organizations with strong competitiveness for the global market.

SUMMARY

Green Productivity (GP) is a new paradigm that integrates the strategies of productivity improvement and environmental protection to produce environmentally compatible goods and services. Supply Chain Management (SCM) is an integrated concept to manage the distributors and suppliers. The synergy of GP and SCM provides an opportunity for the supply chain to assist organizations, particularly SMEs, to enhance their productivity, quality and environmental performance through the continuous flow of information, technical assistance and support, and sharing of knowledge. GP combined with SCM creates the win-win situation for organizations and helps create a strong advantage in the global market through cost reductions and enhanced competitiveness.

4. LINKING GREEN PRODUCTIVITY, GREEN PURCHASING AND QUALITY MANAGEMENT SYSTEMS: CONNECTIONS THAT MAKE WAVES

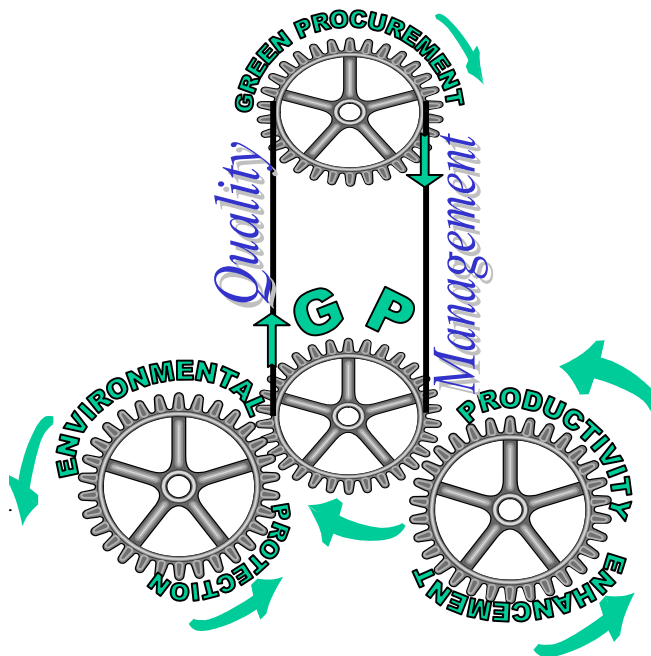
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“We cannot command nature except by obeying her.”

Francis Bacon, in Novum Organum

“Since 1900, the world’s population has multiplied more than three times. Its economy has grown 20 fold. The consumption of fossil fuels has grown by a factor of 30, and industrial production by a factor of 50. Most of that growth, about four-fifths of it, has occurred since 1950. Much of it is unsustainable. Earth’s basic life-supporting capital of forests, species and soils is being depleted and its fresh waters and oceans are being degraded at an accelerating rate” (McNeill, Winsenius, and Yakushiji, 1991).

The challenge that lies before managers today is to innovate activities, products, and services to be sustainable. This is the goal for any organization, in any regional economy, large or small, be it for or not for profit. This paper discusses the challenge of achieving sustainability by looking at current practices, around Green Productivity, green purchasing, and how to connect these two through a systematic approach using quality management. The flow of the discussion on these connections will be done by:

- Setting a destination;
- Articulating our current status; and
- Sharing the means and ways we will meet this challenge.

First, what is our destination? It is not a place we seek: our goal is a sustainable future. So to proceed we need to establish a simple, common definition of sustainability. The best definition is derived from the term sustainable development as defined in “*Our Common Future*,” also referred to as the *Brundtland Report*.

“Sustainability is a condition whereby the needs of the present are met without compromising the ability of future generations to meet their own needs.”

The World Commission on Environment and Economy, authors of the Brundtland Report, acknowledged poverty as a major cause and effect of global environmental problems. 80 percent of the world’s resources are consumed by 20 percent of the world’s population. Does the “20 percent group” really have more needs than the “80 percent group”? Is it that their perceived needs justify the amount of resource consumed? Is inefficiency in resource use really less damaging to the environment from either perspective? If so, one must understand that perceived needs are socially and culturally determined. Thus sustainability will require the promotion of social and cultural values to encourage consumption levels that are ecologically possible and to which all can reasonably aspire.

Most activity in environmental management that is undertaken still hovers around “end-of pipe.” In some cases the focus on the oxymora of waste “management” or “control” of emissions via dilution are still seen to be the only approaches, such practices should not be labelled as solutions or acceptable. Collectively around the world, managers of processes, products, and services do not operate in a sustainable manner. The game we play in delaying the revolution to sustainability is Russian Roulette, as we do not know which individual action or series of actions will bring the proverbial house of cards down, removing our future. Rest assured, the planet will remain and thrive without humans.

The barriers we face to improve to sustainable solutions are largely of our own creation. Humans are by nature toolmakers, tool-users, and in spirit, creative creatures. The time to innovate to make our future a sustainable one is now. There are several tools at our disposal that we need to investigate with an eye to how they can be utilized for the creation of solutions that will overcome existing barriers to change.

Where are we now? What are the barriers we face? Many are based on myths we have invented for ourselves and reinforced through the imposition of restrictive communication corridors. These challenges are a consequence of our scientific and technical illiteracy, which in turn led to the myth that humans can live outside or above

the laws of nature. Nothing could be further from reality. The proliferation of this myth has led to the destruction of our landscapes, our cultures, and our livelihoods. Easter Island provides us with an excellent contained case study of a society that wrought havoc on its environment and undermined its livelihood, conditions which ultimately led to its cultural demise. We have not heeded it well. This is an opportunity to change.

Perhaps the single most compelling recent example of this mythology is presented by Lebedoff in “*Cleaning Up*,” where he describes the mindset that led to the 1989 disaster off Prince William Sound, Alaska.

“For a company large enough to have, in effect, its own airline had also reached a state of self-sufficiency that enabled it to develop and maintain its own culture. This helped insulate it from much of the ferment that surrounded it. Exxon operated in more than eighty countries and did not regard itself as less than their equals. Loyalty to the company was to its officers akin to patriotism. There was always a religious tinge as well. The mission of the company was seen as essential to the maintenance of civilization. All the world was able to move and work by virtue of the fuel that was extracted from the earth’s depths and then distributed around the surface of the globe.”

The opportunity for dispelling this myth is within our grasp. The tools of change are at hand; the will and motivation for people to innovate, adopt new ideas, and re-engineer practices to be sustainable is nearing critical mass.

To be sustainable, a solution must balance environmental, social, and economic consequences and opportunities. Productivity must adopt the efficiency inherent in natural design to achieve this balance. Ideas that incorporate the three criteria for sustainability will lead to innovation and commercially acceptable products and services which are delivered by enhanced processes. These innovations will be created by the knowledge, skills, and attitude where we understand that success will come from emulating nature, and meeting the reality articulated by Francis Bacon. Innovation, supported by continual improvement, therefore plays an important role in this revolutionary shift. More importantly, innovation is seen as a primary engine of economic growth; therefore environmental improvements through GP will enhance economies, and provide competitive advantage for those who lead.

While even a decade ago, in the midst of activities like the promotion of the International Chamber of Commerce’s (ICC) Business Charter for Sustainable Development, the myth that environmental management was a cost burden to an organization was front and centre. Evidence to the contrary now exists. In the fall of 1999 the Dow Jones, representative of Blue Chip stocks, established proof and support of sustainability as a preferred business goal through an Index for Sustainability. The effort behind the Index indicated that they have proof that companies that manage the standard economic factors *and* the environmental and social factors affecting their business show financial performance that is superior to those that do not “adequately, correctly and optimally manage these important factors.” Their research dispels the myth providing the financial basis for drivers that support the acceptance and adoption of the tools for improvement, with emphasis on:

- The critical need for Green Productivity (GP);
- The essential role that green purchasing will have in supporting GP; and
- The connective effect that quality management systems will have on these and other important tools which exist today.

Green Productivity, as conceptualized by the Asia Productivity Organization (APO), encourages adopters *“to improve both productivity and environmental performance, thus achieving higher business performance”* (Gilbert, IGPA Newsletter). The concept of GP is intended *“to help companies, communities, farmers and service providers to identify ways to strengthen business performance either through or in conjunction with better environmental management.”*

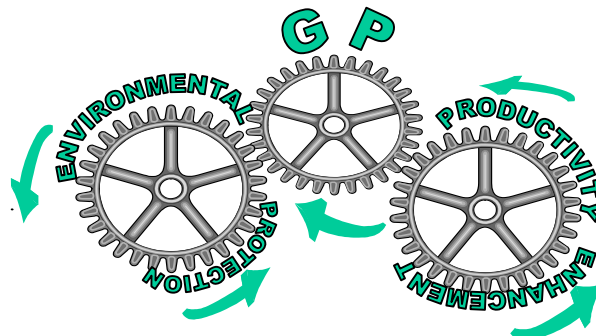
What one might find most encouraging in the concept of GP is the recognition of the ongoing process changes required to achieve continual improvement. GP also recognizes the necessity of adoption of such practices by small business (SMEs), which are the backbone of most national economies, and collectively and incrementally critical players in the revolution towards sustainability. As APO states, GP is not limited by size or by sector, large organizations can also participate. While APO’s GP is focused upon the needs and challenges of SMEs, large companies’ role and responsibility in sustainability should not be ignored or lessened.

GP currently focuses on a process of continual change geared to improving efficiency. Note that an organization that limits its scope to the four walls within which it operates is also limiting the opportunity for *real* improvement leading to sustainability. However, the APO’s concept of GP uses the phrase “production system,” opening the door to the next cycle of continual improvement. Imagine GP as one stream of activity, but keep in mind that it does not occur in isolation and it is not linear in nature.

What makes the application of green criteria to productivity an acceptable and intelligent approach is that improvements in productivity are directly linked to profitability. In reality, the more efficient an organization is, the closer it will come to mimic nature, natural flows, and a systems approach to production.

GP, as defined by APO, is a dynamic process that recognizes the value and importance of other tools, considered as subsets, component parts in a modular system. Of these, two tools require discussion. The first is life cycle assessment (LCA). Of particular interest to those wishing to attain higher efficiencies through GP is the knowledge of inefficiencies that LCA has revealed relative to glean the highest return.

Figure 1. Green Productivity as Depicted by the International Green Productivity Association

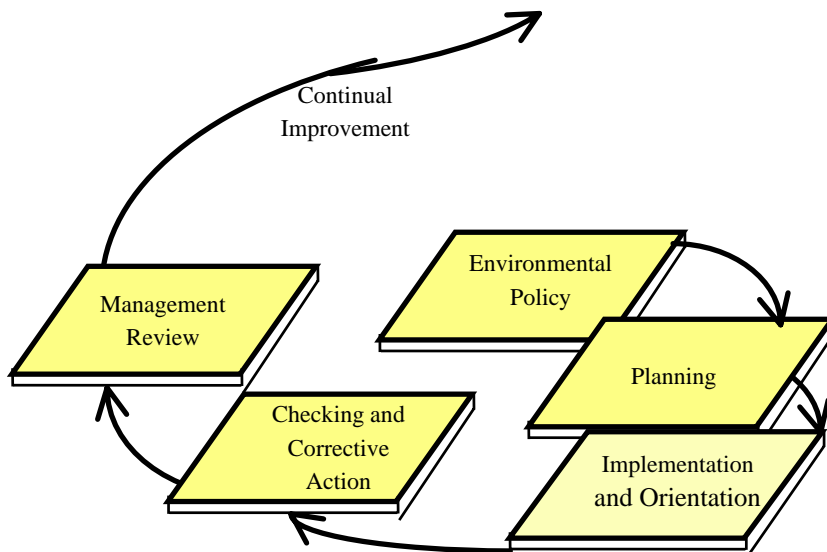


Seventy percent of the cost of a product's development, manufacture, and use is determined in the initial design of the product. This makes design a crucial determinant of the product's competitiveness. Environmental risk or value is also in the design; therefore it is critical to the success of GP to eliminate negative environmental impacts in the design phase. If design is under the control of the same organization as the producers, then communication tunnels, the first barrier, can be minimized. This allows the manager responsible for implementing GP to suggest design changes with substantial savings in cost, reductions in environmental impact and tremendous improvements in efficiency. However, this is not a systems solution, and therefore not sustainable, although it is beneficial.

Here is where the value of environmental management systems (EMS), often referred to as ISO 14001, comes into play. ISO 14001 is an internationally recognized framework for continual improvement, a process that addresses the management of an organization's relationship to the environment. While all five elements are important from a management systems perspective, it is the identification of environmental aspects, impacts and significance (Section 4.2.2 of ISO 14001), which is the single most critical sub-element for GP. The understanding of how one's activities, products, and services impact the environment, and in turn, how these impact on productivity is critical to allow real efficiency gains to be captured. It is not surprising that this one sub-element of the standard is where most users are having problems, which leads us to the second barrier to sustainability, ecological illiteracy. GP offers the potential for adopters, along with its "toolbox," which includes LCA, EMS and other tools, the opportunity to address this challenge and meet the requirements of a growing green global marketplace.

What evidence exists that supports the position that the marketplace is interested in activities, products or services that are "green"? There are two levels at which the evidence can be found. The first that we will address, as it sets the trends of things to come, is trade. Trade, or more accurately the fear of trade restrictions through non-tariff trade barriers, has been a driver of environmental management, as it was a driver of quality management starting in the late 80's and early 90's. As a result, international standards in general are becoming far more important for organizations today than in 1950 as local markets are moving to become one, or are clustering in regional economies. Clearly, business today is not just about selling a product or service to a customer around the corner. Any company today operates as part of a global network with direct customers and indirect clients (people affected by a company's activities, products and services). It is not surprising that those outside the historic customer base are taking an interest in what businesses do, as they can benefit from or be exposed to the impacts of a business' activities. With the growing recognition in the marketplace that a healthy environment and a vibrant competitive economy are mutually dependent, SMEs involvement is critical for a nation to remain competitive and for a regional economy to maintain its economic power and grow.

Figure 2. ISO/EMS Elements



In 1995, the 40 million SMEs throughout APEC economies accounted for well over 90 percent of all enterprises, and contributed 55 percent of the world's combined gross domestic product (GDP) of about US\$29 trillion. SMEs in APEC economies employed from 32 to 84 percent of the work force, contributed 30 to 60 percent of the GDP, and accounted for 35 percent of exports in the region. These statistics and descriptions for SMEs are paralleled in non-APEC economies, which accounted for 45 percent of the world's GDP. The APO's focus on and support for SMEs is particularly important; it is unfortunate that this is not matched throughout APEC and other regional economies. In Canada, for example, the economy is highly dependent on trade as one in three jobs is directly or indirectly tied to trade. The number of SMEs is growing; therefore their participation in sustainability is paramount.

What role can purchasing play in this revolution? Purchasers, awakening to the realization that buying green is a crucial component in their risk management process, need assurance *and* evidence that a supplier is managing environmental resources as carefully as cash flow. A quick review of the history of purchasing since 1950 is useful to understand where the profession has been and where purchasing as a process is headed before the discussion focuses its role on evolving sustainability.

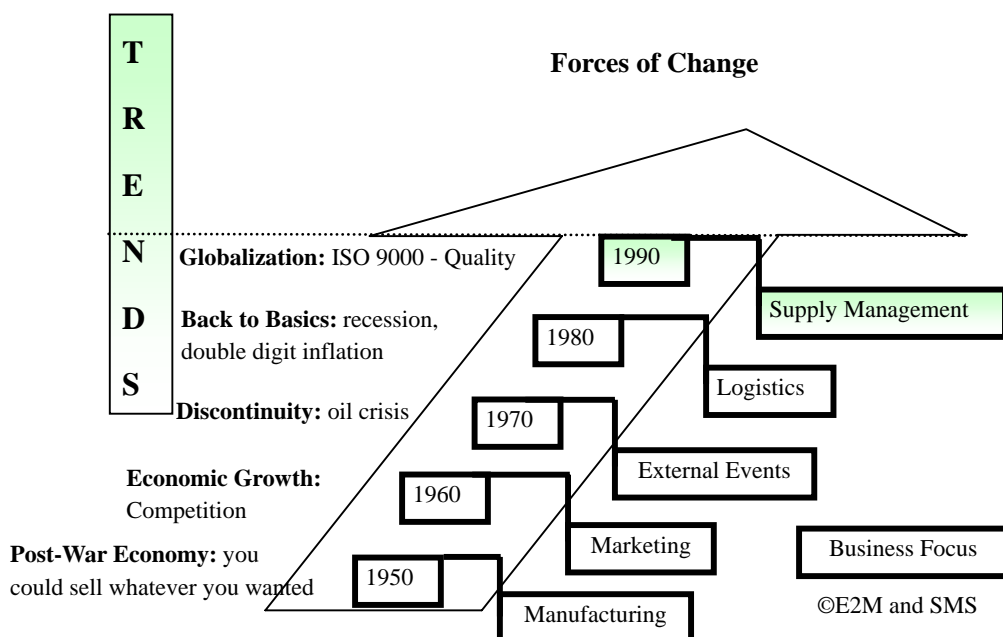
In the 50's, the purchaser's role was to execute requisitions in a market that was hungry to buy, in a world of isolated economies that were focused on rebuilding business after wartime. Decisions within an organization were made in other departments; purchasing was a clerical job in a department. In the 60's competition for purchasing dollars began and marketing to win a customer's favour grew (so did golf). In the 70's, the oil crisis caused disruptions that made purchasers concerned about the continuity of supply from vendors. Price, not cost, remained the focus of the purchasing function. In the 80's, purchasers had to deal with double-digit inflation. Vendors were squeezed each time there was a transaction in a "price fight" where little else seemed to matter. However,

coming through the 80's and into the 90's, there was the realization that quality and the management of suppliers to achieve a value-added product were the ticket to a growing international marketplace.

While isolated concerns for environmental goods and services started in the mid-80's with the Blue Angel process, followed by the Canadian Ecologo program, interest in green purchasing did not really start until the early 90's.

Attempts by business and governments to incorporate environmental considerations into activities within an organization's business processes, be it a for-profit or not-for-profit entity, did not start with procurement. They typically started with concerns around production, related to waste and emissions, the focus in the early days being on end-of-pipe practices. Like the salmon swimming upstream, many opted to move against the flow, struggling against the current as they were caught working on issues that were in the public eye. Litter, for example, was an eye catcher in Canada, particularly around the issue of soft drink containers. However, what evolved out of this concern was the blue box programme for multi-material recycling, which really has nothing to do with litter and everything to do with better use of resources and diversion of material from landfill.¹ However, waste diversion became the backdrop to the initial focus of green purchasing in governments and industry, which specifically targeted packaging. However, these efforts have had a limited return despite all the valiant efforts and energies applied.

Figure 3. Trends in Purchasing



Typically a purchaser, usually a junior person, was called upon by an engineer from production assigned with the task of waste diversion, to find someone who would take the packaging, treated as a waste, “away”. A parallel expectation was occurring in households; the public had the expectation that someone else was responsible for taking a package “away”.

Purchasing was a task involving the acquisition of goods and services, and the purchaser was, and in many cases still is, charged with finding the lowest price, not lowest cost. However, as we now know from LCA, 70 percent of the real opportunity for cost savings, and the related environmental benefits, comes in design. Therefore, at most the purchaser could only recoup 30 percent. Experience has shown that this is unlikely to occur except in rare situations since packaging material, treated as a waste conceptually and in practice, has minimal value. Waste by definition has no value. Purchasing approaches for greening, when initiated to deal with end-of-pipe challenges, do not make a formula for success; often it leads to a clamouring from those involved in waste management for subsidization.²

For the purposes of this discussion, ‘greening’ is a term used to refer to a trend in the global marketplace for-profit or not-for-profit entities to incorporate environmental considerations as criteria in core decision making in all personal and business decisions, concerning activities, processes, and products. The term greening has been applied loosely as it has wide application and has been used to refer to such activities as trade, i.e. “Greening the GATT” to greening specific consumer products.

Greening supports desirable objectives such as clean air, pure water, productive forests, fertile lands, and happy, healthy children. Adults work towards a positive, sustainable future by greening. It is a term that many in the public are comfortable with. Some specific audiences see the term as being abused and overused by those who have made unsubstantiated marketing claims. The term ‘green’, as with the term ‘greening,’ is used as an adjective with a broad reference to a product, service, or good, and/or a condition related to a process, having one or more environmental attributes. It is the definition that will be used to refer to the ‘greening’ of the supply chain in this paper, although it does not infer a strict definition of conditions, or performance levels.

In accepting end-of-pipe designations as green, many of the costs, both environmental and financial, are still acquired by the purchaser, willingly but without understanding the consequences. In some instances there may be the additional risk of liability being transferred to the purchaser.

Green procurement is still in its early days; there are no hard and fast rules for success, no perfect government or corporate case study to show one complete cycle of the change process and results. Often green procurement efforts to date have been initiated without the benefit of a strategy, and without the involvement of purchasing expertise. As a result of communication tunnels, a green stream exists and a purchasing stream exists, but the two fail to flow together. The consequence of this divergence is that green policies for purchasing and their accompanying guidelines remain words on a page. Thus no value is added. Therefore to promote synergy and success, a better understanding of the commonalities between greening and purchasing process must be explored.

¹ Unlike Singapore or Texas, litter management has remained a low priority in Canada.

² It could be argued that subsidies are not necessarily helpful to sustainability.

Quality management refers to the process of management, recognizing that the only constant in this world is change; therefore managing change is a core competency that all organizations must cultivate and grow in expertise. While some people are adverse to change, it occurs daily, i.e. weather, wellness, and the flow of water. Change is a natural phenomenon.

Quality management is not simply determined by the adoption of ISO 9000. However, many have adopted the international standard without ever embracing a quality philosophy, which is both costly and fruitless. However, in its simplest form, quality management is also referred to as Plan, Do, Check, Act or the PDCA Cycle, which is taken from Deming's work. While Edward Deming is credited as being the grandfather or guru of quality management, it was Japanese willingness to embrace the idea and hard work that proved the commercial and trade value of quality. There must have been the seeds of understanding even then of the application of quality to environment. Consider the natural metaphors in Ishikawa's *fishbone* diagram for determination of cause and effect, structure *trees* for problem analysis, *flow* diagrams, *stream-to-stream* analysis.

The existence of quality management can facilitate the adoption of environmental management standards and performance improvements. Similar terminology, concepts, tools and philosophies enable the mirroring of natural flows, critical to the revolutionary changes needed to move to a condition of sustainability. A synopsis of Indonesia's approach to greening procurement is provided as a case study.

BADEPAL'S STRATEGY FOR LEVERAGING THE OPPORTUNITIES IN GREENING PROCUREMENT

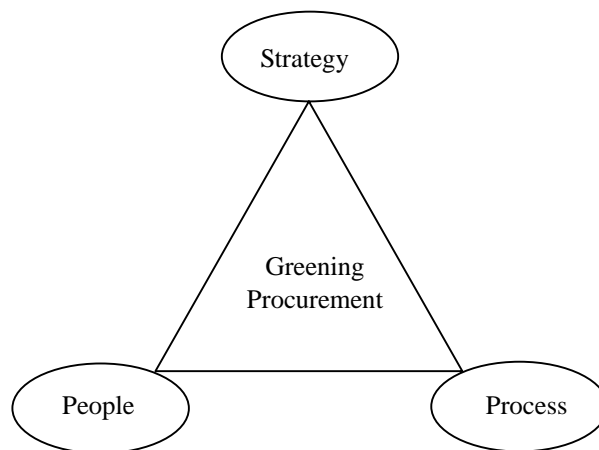
Indonesia is a country as rich in resources as it is diverse in its cultural makeup. BAPEDAL is the government agency responsible for establishing and implementing policies and regulations on environmental impact and environmental management in Indonesia. Bangtek is the Directorate for Technical Development, responsible for formulating technical policies on research and development for cleaner production and pollution control technologies, coordinating research and development of technology applications, standardisation of systems, and creating incentive programs for reducing environmental impact.

In 1997, Dra. Liana Bratasida, Director for Technical Development, published a booklet of its vision, mission, strategies, and programs that included green procurement as one of its program areas. Green procurement is scheduled to become a high level program in 2002. In preparation for this effort, Bangtek started its research efforts on green procurement in the summer of 1999. In the spring of 2000, a high level strategy was outlined. BAPEDAL recognizes that Green Procurement is an important tool in the process of creating "Indonesia yang berkelanjutan", a Sustainable Indonesia. The objective in initiating the project is to demonstrate leadership in managing the greening of its supply chains and to influence the greening of other government agencies' and industry supply chains. This is no small challenge for a country that is under significant pressure to reform its traditional institutional framework. However, as Indonesia is highly dependent on trade, to ignore the trend of a growing green marketplace would potentially damage its trade position and prolong the recovery period from its recent economic upheaval.

*Recent trends in economic growth and development toward globalization have increased national economic growth and the quality of life. These same trends, however, have results in a decrease in environmental quality as a result of pollution and diminishing natural resources. To respond to these issues it is necessary to have integrated environmental management policies which can achieve environmentally sound sustainable development.*³

The high level strategy was presented as a *purchasing* strategy, concerned with the identification of a holistic approach to support BAPEDAL's leadership objective. The research conducted in Indonesia included both internal and external stakeholders, soliciting the input of both public and private sector players. The vision merges the knowledge and skills from two streams; greening and purchasing, recognized as two independent processes.

Figure 4. Leadership Triad

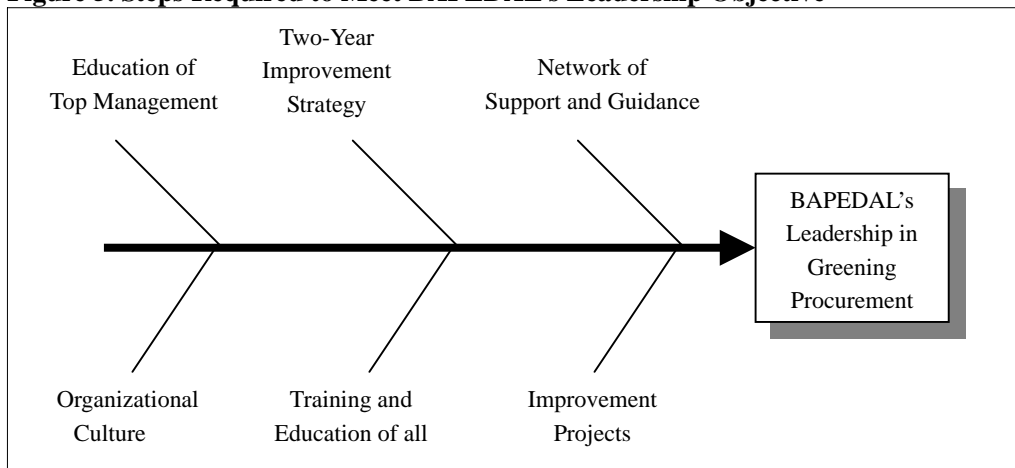


BAPEDAL's schedule is geared to a long-term plan of action. This is not to infer that efforts to leverage the power inherent in the green purchasing should be ignored today. In fact the reality is that many national economies, multinationals and small entities are moving to green their supply chains now, although industry is credited for taking leadership ahead of other entities in sustainability in global opinion polls.

The strategy addresses the critical role of process by acknowledging that both greening and purchasing are process related; the common bond between them is the quality management process. The third element, people, is necessary as people are the agents of change; as champions, as supporters and as members along one or more supply chains.

³ BAPEDAL, 1997.

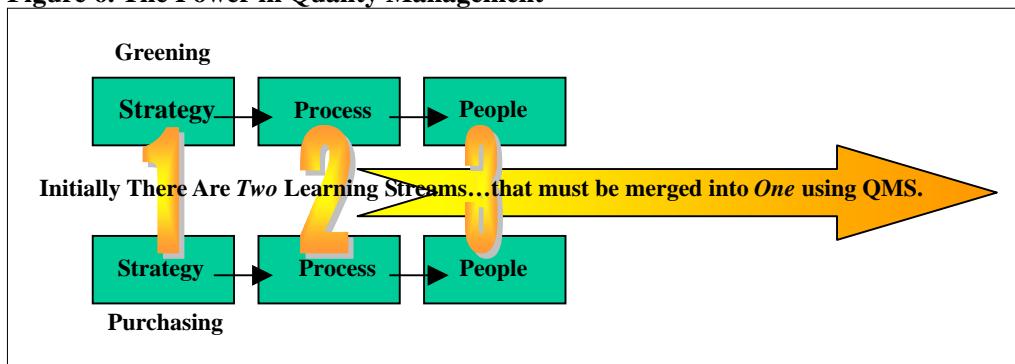
Figure 5. Steps Required to Meet BAPEDAL's Leadership Objective



Quality management can not only pull greening and procurement into a river of opportunity, it can lead other tools from isolated attempts at improving environmental performance to sustainability. By using quality management as a driver in Indonesia, the power of purchasing can be applied to: encourage and enhance greening in management systems; improve productivity; the development of greener products and services acknowledged by eco-labelling; "build green" in construction projects; and more consistent compliance to intelligent environmental regulations. Quality management systems create the synergy that allows these efforts to flow together to optimize the changes needed for a sustainable future for Indonesia. Connecting green procurement to Green Productivity, environmental improvements are bottom line advantages and become market drivers.

True understanding of what is ecologically sound, and which environmental qualities are beneficial to the purchaser of goods and services is developed by understanding the environmental impact of an activity, product, or service. If a purchaser has an understanding of environmental aspects, impacts, and significance along a supply chain, it lays the groundwork for benefit for all within that system.

Figure 6. The Power in Quality Management



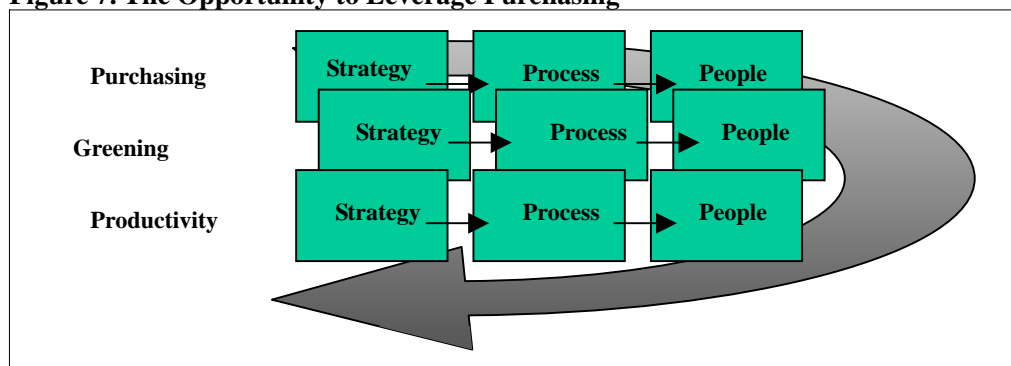
Indonesia has the opportunity to leverage EMS/ISO 14001 as a business tool to further develop this supply chain approach as it builds on the concepts of quality with a focus on the significant environmental impacts that an organization has on its surroundings. From a purchaser's perspective, the key benefits of having a supply chain adopt ISO 14001, include:

- Identification of the physical area and influence of management on significant environmental aspects (the critical success factor in EMS);
- Consistency in the management approach along the supply chain;
- Identification of the key concerns related to goods and services that are being acquired; and
- Opportunity to gain from a systems improvement, achieving higher returns along the whole chain, not just isolated improvements.

In addition, for a purchaser, the benefit of Life Cycle Assessment (LCA) is to enable an understanding of where the greatest risk is along the supply chain as well as understand the inputs, throughput, and output. Risk in this context includes both positive and negative outcomes. The purchaser is not expected to have in-depth knowledge and skill at applying an LCA, nor is the intention to have members along the supply chain produce detailed life cycle assessments. LCA, coupled with other purchasing tools can lead to more opportunity for lowering risk and cost in greening procurement.

Obviously, if Bangtek has the opportunity to use quality management as a connecting link between greening and procurement, the same opportunity exists for others. The philosophy, concept, and tools of quality management can act as a bridge between the two merged systems and Green Productivity.

Figure 7. The Opportunity to Leverage Purchasing



A focus on short-term results is not recommended as Indonesia has other immediate economic and political pressures, including core institutional reforms. Also, pressure to show short-term results most often fail to produce satisfactory results or real value, and efforts are not maintained as a consequence.

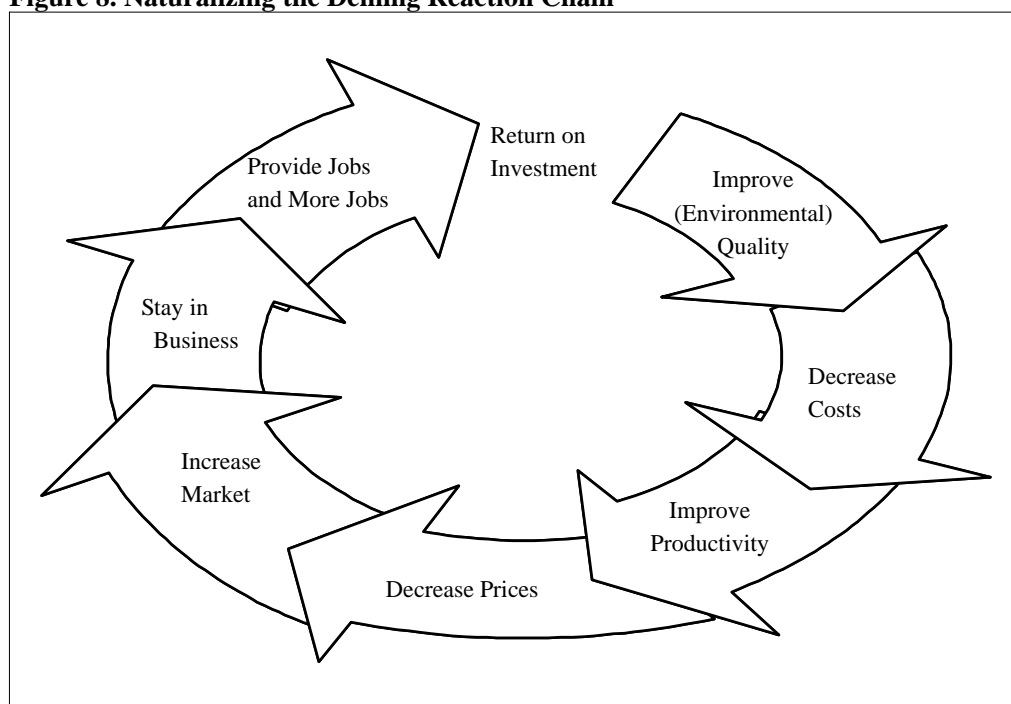
Short-term deadlines will not bring sustainable benefits, in either improved environmental performance or in lower costs. BAPEDAL needs to continue its efforts to improve by greening its internal supply chains to meet its leadership objective. It also has

the challenge of influencing others within Indonesia to do the same, as other countries have a head start.

Environmental management and performance are becoming important criteria in a growing green global marketplace. Indonesia is starting to face competition now from other developing countries in the greening of commodities. This is preceding a defined shift in trade pressure from developed countries where consumer markets are already stating preference for green products and services.

How does the overlap of these three elements bring synergy among the three processes using quality? A slight modification of the Deming Chain Reaction, one that aligns it to the principle of continual improvement and nature can propel this discussion from an academic idea to a commercially valuable application.

Figure 8. Naturalizing the Deming Reaction Chain



If one improves the quality at the point of design (including environmental quality) of an activity, product, or service, it will lead to a reduction in both financial and environmental costs. This in turn will lead to improved productivity with greater efficiencies in resource use. In environmental terms, this means a reduction or elimination of pollution at the source, which has direct and indirect social benefits. A decrease in prices benefits the customer (purchaser), the consumer (a downstream purchaser), and enhances the competitive advantage for that supplier. Status as a preferred supplier increases the chances for a vibrant economy that allows for growth. Growth brings the need for more human resources to fill jobs. There are direct and indirect social benefits derived from this, and certainly improved shareholder returns. This supports the reasoning that the new Dow Jones Sustainability Index represents.

While the traditional role of purchasing was to acquire needed goods or services at the lowest price from competent, reliable sources, purchasing itself is a process undergoing improvements. It is becoming a process of acquiring goods and services where the importance of relationships between fewer entities as part of a streamlined supply chain is increasing. For purchasers, the opportunity exists to play a significant and more strategic role in an organization and its evolution to a sustainable future.

Connecting together members in a supply chain, along with improving productivity, will be accomplished by people learning about the ecology of the supply chain and the economic and social benefits of supply chain synergy. This leads to the “ecology of sourcing,” which connects members along the supply chain in a systematic manner, demonstrating the synergy between members of the chain (i.e., the positive impact that members have upstream and downstream, closing the chain, and forming a cycle or loop.)

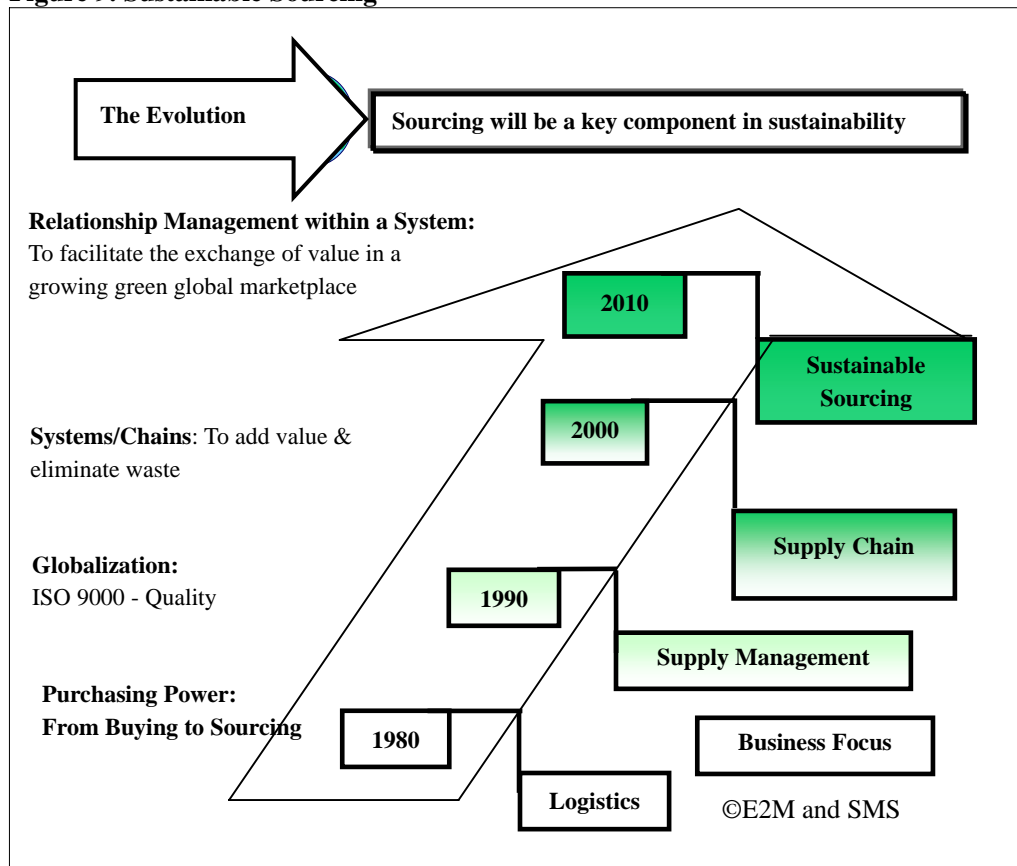
As environmental criteria are moved upstream in the supply chain, the understanding of the benefits in the life cycle of the product or service are growing. What is evolving now is that purchasing is not just about “buying”; it is about sourcing. Hence, a systems approach is invaluable. With the high percentage of cost inherent in product design, managing the supply chain as a cycle becomes crucial. It is vital to move the implementation of greening further upstream to the point of design. Shifting attention to the design phase also raises the potential for a systems improvement, where the whole supply chain benefits. Others can benefit directly or indirectly from these shifts. This sets the stage for the next innovation in purchasing, the introduction of *sustainable sourcing*.

Sustainable sourcing recognizes the trends toward outsourcing and the growth of a global marketplace that require the identification, monitoring, and improvement of the performance of responsible and responsive sources. This is *not* to mean that the purchaser polices the system, acting as an enforcer to supply chain members. Sustainable sourcing will be based on meeting a customer’s requirements and exceeding a customer’s expectations to create value, deliverable in an energy efficient form. Suppliers are sources of ideas, technology, time savings, energy, materials, and money, acting as an external consultant. The purchaser is a strategic facilitator, working with the supply chain to bring bottom-line contributions, which add to the systems’ competitive advantage.

As this evolution requires global sourcing with strategic alliances, entities will enjoy long-term contracts, interacting with the broader issue of trade, including the option for barter and other innovative exchanges of goods and services. Given the trend in purchasing toward streamlining the numbers of suppliers by larger companies, SMEs must address the challenge of providing more product and service to one client with multiple regional or international sites. This can mean loss in business for those who are ill prepared to expand or improve. One approach is to form strategic alliances with similar entities in other regional economies. International standards supporting environmental and quality management systems establish consistency in activities, products, and services delivered. Each SME thrives and the customer, the multi-national firm, has the benefits of a seemingly streamlined number of suppliers.

The system members can learn together how to continuously improve, manage cost along the chain, and share the rewards and benefits of a unique and dynamic system connected through the electronic web. This is the direction that early adopters are taking in the innovative curve towards sustainability; the year 2010 is a reasonable time frame to target reaching a critical mass of acceptance. What will foster the shift from supply chain management to sustainable sourcing?

Figure 9. Sustainable Sourcing



There are a number of critical success factors. Some of them include:

- Empowering the people involved;
- Building their knowledge base;
- Strengthening their skills;
- Helping the people involved build confidence;
- Rewarding their progress;
- Connecting the will to improve to the opportunity;
- Encouraging the link with other like minded organizations; and
- Enhancing the linkage between those organizations that have incorporated green productivity enhancements with the purchasing community that wishes to source from these preferred suppliers.

One such link lies in an on-line market opportunity for organizations to connect to a growing green global marketplace. www.14000registry.com allows organizations to post their adoption of ISO 14001 as well as other standards such as ISO 9001, Responsible Care, eco-labelling, and other environmental process and performance designations.

As valuable as the international standards process has been for developing common frameworks, it has refrained from marketing the benefits of those who have adopted ISO standards. Other sites that exist tend to serve restricted markets, provide limited information, only post statistics related to certified companies, or are run by registrars to serve their own client base.

For companies that have made Green Productivity enhancements using ISO 14001 and ISO 9001, the Registry is a marketing platform. Customers can learn about the range of goods and services offered, contact names and numbers, and be linked directly to the potential suppliers own website at the click of a button. For government bodies or agencies that have adopted ISO 14001, it is an opportunity to show leadership. For organizations trying to source better-managed companies, it can reduce the time and frustration of searching, especially when a supply chain is international. Other stakeholders are showing an interest in the Registry, bankers and insurers looking for confirmation of due diligence find confidence in this kind of public statement. Economic development officers and trade officers seeking new markets and potential partners can search the site for contacts.

The Registry reflects the impartiality of the standards, and is intended to be open to any organization that posts its conformance to ISO 14001 or ISO 9001 whether it is self-declared or third party certified/registered. The Registry does require that the organization provide its environmental policy as part of the posting.

Any company, large or small, in any regional economy can connect with the growing green global marketplace. As an electronic exchange, it operates 24 hours a day, 7 days a week all year round. For example, Palliser Estate Wines of Martinborough Ltd in New Zealand was one of the first companies to take the opportunity to post on the Registry, with the hopes it would bring more business based on their adoption of ISO 14001 and ISO 9002.

Their early adoption of this opportunity reflects their leading-edge thinking as innovators. As the first company to adopt the standard to winemaking, Palliser had to learn how to reduce inputs and better manage outputs, and monitor its progress toward the aim to reduce the amounts of water, electricity, and chemicals used. In the vineyard the use of sprays is minimised, opting for environmentally friendly sprays when possible, and reserving the more toxic ones as a last resort. ISO 14001's requirement for continuous improvement, is an incentive for Palliser to continually review its processes, thereby keeping them on the cutting edge of technology.

Similarly, Prospec Chemicals of Canada, another ISO 14001 certified small business that posted on the Registry, stated that the critical returns in the adoption of the standard included improved environmental performance and emergency response. Of importance to Prospec are the values from improved employee awareness, public image and shareholder confidence, which their posting is intended to reinforce as the knowledge of the Registry in the marketplace increases.

The Registry and its supporters are working to make the website the central place for organizations, of any size, sector, profile, or geographic location/economic region to connect to the global marketplace. As the interest in buying "green" increases, organizations that manage their supply chains in the evolution toward sustainability, will require green productivity as part of their sourcing criteria.

Unquestionably, customers benefit from the GP activities that are underway, especially those that incorporate GP at the design phase. Here is where purchasers can

realize cost savings, as well as environmental benefit. There are short-term gains for suppliers, customers, and downstream consumers as well as the potential for other third parties to benefit directly and indirectly. Green purchasing or procurement opens opportunities that ultimately lead to sustainability.

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5. TOWARDS GREENER GOVERNMENT PROCUREMENT: AN ENVIRONMENT CANADA CASE STUDY

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EXECUTIVE SUMMARY

Greener government purchasing is part of the Government of Canada's larger goal of integrating sustainable development into the day-to-day decision-making of federal managers and employees. To this end, all federal departments and agencies in December 1997 were required to table sustainable development strategies in Parliament which included action plans to address some of the environmental, economic, and social impacts of each department's or agency's policies, programs and operations. Federal departments and agencies are presently preparing their second sustainable development strategies, which are due for submission by December 2000.

The Government of Canada can play an important role in advancing greener procurement by virtue of the degree of public scrutiny paid to federal purchases and the fact that it is the largest single buyer and property manager in Canada. Greener government procurement can result in many benefits to federal departments, which include cost savings, enhanced credibility and improved employee morale. It also supports Environment Canada's broader mandate by strengthening market demand for environmental goods and services, and by promoting greater environmental awareness in Canadian industry.

As part of its sustainable development strategy, Environment Canada, like other federal departments, is demonstrating environmental leadership through the implementation of a comprehensive environmental management system (EMS). An EMS will enable the Department to manage its internal environmental issues (including greener procurement) more strategically. A department-wide working group on greener procurement was recently established to develop a mini-EMS for greener procurement issues which will guide future Environment Canada efforts. To date, Environment Canada has emphasized a pragmatic approach based on taking small steps to achieve concrete results. Leadership from senior management champions has been essential to drive the cultural changes necessary to integrate environmental considerations into day-to-day Environment Canada procurement decisions.

Environment Canada is working in partnership with other departments, non-governmental organizations, and industry to increase greener purchasing for those products and services which have significant economic and environmental impacts. Many important initiatives have been undertaken, including: the purchase of technologies to convert Environment Canada vehicles to alternative fuels; the development and

implementation of environmentally-sensitive accommodation standards; and the development of the *Hotel Eco-efficiency Rating Program*. Environment Canada is also working in partnership with provincial governments and other countries through the Organization of Economic Co-operation and Development (OECD) and the Asia-Pacific Economic Co-operation (APEC) forum to share best practices and tools, and to build our collective capacity.

Through its internal efforts and external partnerships, Environment Canada has learned that an effective greener procurement strategy should incorporate general change-management principles which include: securing commitment from senior managers to champion the change process; clearly defining accountability; and limiting initial efforts to reaching for “low-hanging fruit”. Although many positive steps have been taken, more work is required to make procurement by federal departments greener. For this reason, Environment Canada will continue working internally and with government and industry partners to advance greener procurement as part of its overall environmental mandate.

TOWARDS GREEN GOVERNMENT PROCUREMENT: AN ENVIRONMENT CANADA CASE STUDY

“Greener Government Purchasing” continues to be an important component of the Government of Canada’s larger strategy to advance sound environmental management in its policies and operations. Over the last two years, Environment Canada has continued working to promote greener procurement within its own operations as well as within industry, other federal government departments, and other levels of government.

The Government of Canada’s Purchasing Power

The Government of Canada, through its purchasing practices, can have a significant impact on the national economy, and the goods and services made available in the marketplace. The federal government’s impact is articulated in several different ways. First, spending by the Government of Canada is highly visible and is frequently scrutinized by the media and general public. This public scrutiny provides the federal government with both the opportunity and the obligation to lead by example in demonstrating its environmental commitment through greener purchasing practices. This issue of environmental leadership is particularly relevant for Environment Canada as its policies and actions must be consistent with each other in order for the department to be credible nationally and internationally.

Second, as the largest single buyer and property manager in Canada, the federal government has an opportunity to have a tremendous impact by harnessing its spending power. A 1996 report by Price Waterhouse¹ estimated that the Government of Canada spends \$11.6 billion annually on products and services, and manages approximately 64,000 buildings throughout Canada. In some areas, such as the environmental industry sector, computer purchases, and defense and security products, the federal government is among the largest buyers due to the high dollar value of purchases made and its unique procurement requirements. In these areas, government procurement has the potential to

¹ Price Waterhouse. *Costs and Benefits of Greening Federal Government Operations*. Environment Canada. (May 15, 1996).

be an important driver for the supply of environmentally preferable products and services.

Benefits of Greener Government Procurement

Greener government procurement can result in many environmental, economic and social benefits. Some of the environmental and economic advantages of purchasing environmentally friendly products and services include:²

- Increased savings by buying goods which can be reused or remanufactured;
- Lower costs due to efficient waste and hazardous materials management;
- Cost savings by employing energy, water, and fuel conserving devices;
- Lower health costs related to exposure to toxics; and
- Reduced demand for landfill space.

Greener government procurement also supports Environment Canada's mandate to promote pollution prevention, the use of environmental management systems, and the application of life-cycle management concepts. A Canadian study found that federal government procurement has the potential to broadly stimulate manufacturers, and suppliers to upgrade their processes, implement cleaner production techniques and change the way in which their services are delivered.³ In this way, greener federal procurement is an important complement to a broad mix of policy tools such as voluntary programs, economic instruments, and reporting mechanisms that seek to influence industry through non-legislative means.

Effective use of federal spending power also helps to strengthen market demand for environmental goods, services, and technologies, thus supporting development of and innovation in Canada's environmental industry. The environmental industries sector in Canada is large and growing. It is composed of 5,950 firms employing 159,932 workers and has annual sales of \$11.6 billion.⁴ Canada's environmental industry is largely an enabling sector that provides expertise, technologies, and services to meet the environmental needs of traditional industrial sectors. While strong environmental regulations are one of the most important drivers for the demand of environmental services, federal spending can certainly add to overall market demand for these services.

Finally, the process of implementing a greener government procurement strategy is an effective means to foster positive cultural change and improve employee commitment within individual departments. This is due to the fact that greener government action-plans and training programs engage employees in the change process, increase organizational awareness, and encourage personal responsibility for the environment.

² *National Workshop on Greener Government Purchasing: Workshop Proceedings*. Government of Canada. November, 1996; and *National Round Table on the Environment and the Economy*. Federal Green Procurement Task Force.

³ *Going for Green: Meeting Foreign Demand for Environmentally Preferable Products and Services through Federal Procurement. Backgrounder: National Round Table on the Environment and the Economy*, 1997.

⁴ Statistics Canada. *Environment Industry 1997*.

THE GOVERNMENT OF CANADA'S FRAMEWORK FOR SUSTAINABLE DEVELOPMENT

The goal of greener government procurement fits within the Government of Canada's broader effort to integrate environmental and sustainable development considerations into the day-to-day decision-making of managers and employees at all levels. A broad framework has been established to advance sustainable development in federal departments. In 1995, legislation was passed requiring federal government departments and agencies to table sustainable development strategies in Parliament by December of 1997. Sustainable development strategies include action plans to address some of the economic, environmental, and social impacts of each department's policies, programs, and operations. To ensure momentum is maintained, departments must publicly report their progress in achieving their targets every year and update their strategies every three years. A Commissioner of the Environment and Sustainable Development was also mandated to monitor how departments have implemented their action plans and to determine whether they have met the objectives of their sustainable development strategies.⁵

In an effort to guide departmental work on sustainable development, the Government of Canada endorsed two key policies in 1995. *A Guide to Green Government* outlines the federal government's commitment to integrate sustainable development into the way government defines its operations and makes decisions. The *Directions on Greening Government Operations* policy directs departments to implement environmental management systems (EMS) and identifies greener procurement as a key environmental issue to be addressed each department.

Since the tabling of the first round of Sustainable Development Strategies in 1997, federal departments have been told that they need to establish clear and measurable targets by which the public can judge whether their strategies are being successfully implemented. In addition, they have also been told that while many actions have been taken, it does not appear that appropriate management practices are being applied to ensure successful implementation of Sustainable Development Strategies within departments.

A recently released document outlines the expectations for the second generation of Sustainable Development Strategies, which are due in December 2000. Three points were stressed: departments should undertake an assessment of their first strategy; careful planning is needed to identify priority areas for action that are clearly linked to departmental impacts on Sustainable Development; and adequate management systems are needed to ensure implementation.

As part of an effort to set a common direction for the next round of sustainable development strategies the government recently released *Sustainable Development in Government Operations: A Strategy for Excellence*. The strategy is based on the commitments outlined in *A Guide to Green Government* and recommends best practices in seven priority areas, including greener procurement. The strategy proposes a set of collaboratively developed performance measures and offers a sample set of concrete targets.

⁵ Amendments to the Government of Canada's *Auditor General Act*, 1995.

To create a forum for discussion on the issues, A Leader's Forum on Sustainable Development was recently held. This forum was an opportunity for senior federal government officials to consult with senior representatives of Canadian society on the Government of Canada's approach to sustainable development. This was a first step and federal departments will hold further consultations on their proposed Sustainable Development Strategy.

Many departments in the federal government have taken steps towards examining methods by which they can reduce the environmental impact of the goods and services they acquire; greener government procurement is a part of many departments' sustainable development strategies. However, departments continue to find barriers and challenges to the systematic implementation and tracking of "green" procurement. Some work is required to understand these challenges better and design appropriate solutions.

To provide guidance on the specific issue of greener government procurement, the Government of Canada has included environmental requirements in its *Material Management Policy*. The policy requires managers to "include environmental considerations in all aspects of managing material from the planning phase through acquisition, use, and disposal of material."⁶ In addition, direction is also provided to apply the four R's (reduce, reuse, recycle and recover) throughout management of the material life-cycle: planning, acquisition, maintenance/operations, and disposal.

The *Material Management Policy* is important, as it outlines the broad goal towards which federal departments must strive. However, because each department must establish its own path for implementation, little guidance has been given to assist federal departments in the specifically how to apply this policy to their operations. This absence of procurement targets, monitoring and reporting requirements, and high-level "signaling" regarding the importance of greener procurement pose challenges to the implementation of the policy.

The Treasury Board Advisory Committee on Contracts has been asked to form a working group on Procurement Strategy for Sustainable Development. This was as a result of the federal government's mid-term policy planning process. This working group deals with horizontal issues across the federal government and is exploring ways to advance the cause of sustainable development through sustainable procurement.

Another initiative is the interdepartmental committee on Performance Measurement for Sustainable Government Operations, which was established in 1997. This committee looked at how to establish, define, and promote the use of common measurements as they relate to sustainable government operations. A guidance document on Indicators for Environmental Performance Measurement for Government Operations was developed to assist federal departments as they establish reporting systems to track performance towards greening their operations.

CHALLENGES TO GREENER GOVERNMENT PROCUREMENT

Federal departments still face other challenges in increasing the quantity of greener goods and services purchased. One is the increasingly decentralized manner in which

⁶ Treasury Board Material Management Policy, 1995. Chapter 1-1 of the "Material, Risk and Common Services" volume of the *Treasury Board Manual*.

purchasing is done in federal departments. The procurement process has dramatically changed in recent years due a reduced reliance on central purchasing agents and a corresponding increase in the number of managers and employees who have authority to make purchases through non-electronic instruments such as credit cards. Within Environment Canada, procurement decisions were previously coordinated by a small group of professional procurement officers. Today, however, more than 25 percent of employees have the authority to make purchases of goods and services valued up to \$5,000.⁷ These purchases, in terms of actual transactions, account for the majority of Environment Canada's acquisitions. This trend will only grow in time as purchasing authority is expected to increase to up to \$25,000 Canadian dollars (CDN) in the coming years.

Decentralization and the reliance on non-electronic purchasing instruments make it difficult for departments to accurately measure and monitor the purchasing practices of its employees, particularly for those items under CDN\$5,000. As a result, departments often do not have the necessary information to quantify the percentage of greener purchases made; to develop concrete procurement targets; and to measure the effectiveness of greener procurement action plans.

Limited time and financial resources also pose challenges to increasing greener government procurement. There is a frequently held misconception that environmentally preferable products cost more and perform less well than their alternatives.⁸ As a result, ongoing and punctual educational efforts are needed to change these negative biases.

There are cases where the original acquisition costs of greener goods are indeed higher. However, the economic benefits for these greener goods can often be demonstrated when the costs associated with the full product life-cycle are factored into the buying decision. Unfortunately, managers typically do not have the capacity nor time to calculate the life-cycle costs and benefits of their procurement decisions. This is particularly the case for goods such as computer or laboratory equipment that experience a high rate of technological change. Moreover, most, if not all, of the secondary costs do not represent a charge against managers' budgets. As a result, procurement decisions are all too often based on perceptions of product quality and original acquisition costs.

Limited resources pose a special concern for managers responsible for the environmental management of the internal operations of departments. They typically employ a risk management approach to prioritize the use of funds for internal environmental activities related to health, safety, and legal compliance. As a result, internal greener procurement initiatives often do not receive adequate attention or resources.

Another complicating factor for government departments is the need to reconcile the goal of greener purchasing with other competing priorities. Government procurement is often employed to advance a range of policy objectives. Managers must evaluate other considerations including competitive pricing, job creation, reduction of regional disparities, and the promotion of employment equity. One example is the federal

⁷ *Procurement Profile: National Capital Region*, Stefan Janhager, Administration Directorate, Environment Canada. November 29, 1995.

⁸ *Going for Green: Meeting Foreign Demand for Environmentally Preferable Products and Services through Federal Procurement. National Round Table on the Environment and the Economy*, 1997.

Procurement Strategy for Aboriginal Business (PSAB)).⁹ The purpose of this strategy is to increase representation of Aboriginal business in federal government contract awards and sub-contracts. All federal departments and agencies with contracting budgets in excess of CDN\$1 million must develop and report on multi-year performance objectives, such as the estimated number and dollar value of contracts awarded to Aboriginal businesses. As a result of these different procurement priorities, win-win solutions are not always possible.

International trade agreements also complicate the government procurement process. Departments of the government of Canada are subject to various trade agreements, including the 1996 World Trade Organization Agreement on Government Procurement and the 1992 North American Free Trade Agreement (NAFTA). These agreements have been endorsed to eliminate barriers to trade and to facilitate the cross-boarder movement of goods and services between signatory countries. As a result, enterprises of signatory countries can bid for contracts which exceed the thresholds of the varying agreements. For example, the government of Canada must open contracts for goods CDN\$34,100 or greater to the United States; while the threshold for services for both the United States and Mexico is approximately CDN\$72,000.

In some cases, these trade agreements hinder greener government purchasing as contracts can only specify greener performance criteria, and cannot, for example, specify “national” eco-labels. That said, these agreements recognize the need for the protection of essential security interests and, as a result, some contract categories are excluded. These exceptions enable departments, like Environment Canada, to be more prescriptive for contracts in areas such as research and development, utilities, and weather reporting and observation services.¹⁰

Defining “Greener” Goods and Services

Given these challenges, departments require simple, easy-to-use tools to inform and guide employee procurement decisions. Managers responsible for the development of simple tools face challenges in determining what constitutes a greener product or service. This process can often be both intimidating and value-laden as it is difficult to weigh environmental merits across different product categories and attributes. For example, how does one evaluate the merits of wool versus synthetic carpeting made from recycled pop bottles; or the merits of processes which emphasize toxic reduction versus energy efficiency? In an effort to select greener goods and services, departments are trying to employ a multi-faceted approach which includes the use of national eco-labeling programs, the incorporation of environmental specifications in government tenders, and life-cycle analysis. Greener procurement strategies have relied most heavily on national eco-labeling programs, with the most influential being Canada’s Environmental Choice Program (ECP).

Environment Canada established the ECP in 1988 to guide consumers in making environmentally sound purchasing decisions and to encourage the commercial development of less harmful products. The ECP, currently managed by TerraChoice

⁹ Treasury Board of Canada Secretariat, *Contracting Policy Notice 1996-6: Aboriginal Business Procurement Policy Performance Objectives*.

¹⁰ “Annex 1001.1b-1” of the *North American Free Trade Agreement* between the Government of Canada, the United Mexican States and the United States of America, 1992.

Environmental Services Inc., was the second such program to be developed in the world. The ECP awards the official Environmental Choice logo certification mark to products or services that meet environmental criteria established in cooperation with industry, government, and public interest groups. Certification may be awarded for those products that have been reused, or are made in a way that improves energy efficiency, reduces hazardous by-products, or uses recycled materials. In some ECP guidelines, supplier production processes are considered for goods such as paints, printers, adhesives, and engine coolants. While the ECP currently does not require companies to have an operating EMS or to carry out environmental audits, its certification process recognizes companies that are ISO 14004 certified.

The ECP enjoys international credibility due to a comprehensive third-party certification process that includes a review of product and process information; an examination of quality assurance/control measures; and an audit of the company's facilities and processes relevant to the product being certified. ECP has guidelines for over 50 products and services. In addition, there are currently over 230 companies licensed to use the EcoLogo, and approximately 2,800 household, commercial, and industrial products certified by the ECP.¹¹

Use of eco-labeling programs, such as the ECP, is an effective means to identify greener procurement options. However, these programs alone are not sufficient to inform government decision-makers because only a small portion of products and services required by the federal government have obtained certification. This is due to many factors. First, these programs typically focus on commonly-purchased goods such as office products and household items, and not the unique or highly specific products often required by the federal government. Second, rapid technological change results in the introduction of new products or goods that have not gone through the certification process. Third, low Canadian demand for greener goods results in the fact that the EcoLogo is not broadly promoted or communicated by Canadian companies in their major marketing efforts.¹² Fourth, certification and licensing costs may limit participation by those firms, particularly small and medium-sized enterprises, that do not anticipate sufficient economic benefits through these programs. Industry reluctance to market environmental attributes and the low market demand are mutually reinforcing, with the end result being a limited number of greener goods and services that are advertised and available in the Canadian marketplace.

In an effort to make incremental improvements to procurement practices, federal departments, such as Environment Canada, are broadening their definition of what constitutes a greener product and are starting to include notions such as greener production processes. This provides a larger range of greener goods to choose from and also reinforces industry efforts to apply more comprehensive approaches such as environmental design, environmental management systems, and life-cycle analysis.

A national electronic greener procurement database: *EcoNexusTM – The Green Procurement Directory* is in the testing stage. It was created by the Centre for Indigenous Environmental Resources with funding from Public Works and Government Services

¹¹ *TerraChoice Environmental Services Inc. Corporate Profile*. October 7, 2000.

¹² *Going for Green: Meeting Foreign Demand for Environmentally Preferable Products and Services through Federal Procurement, Background Paper*. National Round Table on the Environment and the Economy. 1997.

Canada (PWGSC), another federal department. This database is based on a more comprehensive definition of greener goods and services. The evaluation and selection criteria include concepts related to the overall environmental management of a firm, including its use of natural resources, new or modified production processes, and the environmental performance of suppliers. Environment Canada is also seeking to improve its procurement practices by buying greener goods and services where certified “green” options are not available. To this end, it exchanges greener procurement tools and criteria, such as greener product lists, with other federal departments, provincial governments, and other countries. While these tools may not represent perfect solutions, they enable Environment Canada to benefit from the work of others and, in turn, make incremental improvements to purchasing practices.

While some progress is being made to better identify greener goods and services, more work is required nationally and internationally so that consumers have the necessary information to confidently evaluate and select greener goods across different product attributes and categories.

ENVIRONMENT CANADA’S APPROACH TO GREENER PROCUREMENT

Environment Canada tabled its first sustainable development strategy in Parliament in April of 1997 in support of the Government of Canada’s commitment to the environment and sustainable development. It is presently drafting its second strategy, which is due in December of 2000. This strategy is an important step to comprehensively assess the economic, environmental, and social impacts of its policies, programs and operations. Environment Canada’s current work to design and implement an environmental management system (EMS) represents the operational component of its sustainable development strategy. An EMS will enable Environment Canada to strategically manage all of its environmental risks and opportunities, including greener procurement.

Environment Canada has employed a pragmatic, results-oriented approach to increase the quantity of greener goods and services it purchased. Ministerial approval of *EC Green Procurement Policy* in 1994 (updated in 1999) was an important first step toward the goal of greener procurement within Environment Canada. The Policy provides direction to guide employee purchasing decisions, while at the same time leaving room for flexibility in decision-making. This policy directs employees to:

- Consider the “cradle-to-grave” impact of goods and services;
- Use EcoLogo certified products wherever feasible;
- Adopt greener criteria in purchasing decisions (i.e., select recycled or energy-efficient products); and
- Include environmental terms and conditions within the selection criteria of Environment Canada contracts.

Effective training programs and information tools are essential to increase employee awareness so that this policy becomes a daily reality for departmental personnel. Environment Canada has developed several useful greener procurement tools to assist employees in making better purchasing decisions. Environment Canada

developed greener procurement databases in most regional Environment Canada offices and at headquarters, identifying greener product options for items such as computers, office furniture, paper products, which are most commonly purchased by the Department.

To promote awareness and use of these tools, Environment Canada developed a “green suite” of computer-based training courses. The Department also designed a half-day Greener Procurement Workshop, which focuses on concrete ways to encourage greener procurement by making small changes to employee purchasing practices and applying practical procurement tools. It also introduces social marketing concepts by eliciting employee commitments to greener procurement.

These efforts have emphasized a pragmatic, small-steps approach that encourages employees to take responsibility for their procurement decisions. However, as the Department implements its EMS, it is beginning to take a more strategic approach to the management of its internal operations and greener procurement efforts. The Department’s Operational Environment Policy, approved in 1997, identifies greener procurement as a key component of Environment Canada’s environmental strategy. This view was reinforced in the findings of a department-wide initial environmental review (IER), which identified greener procurement as a priority environmental aspect for the Department. As a result, Environment Canada’s National EMS Team established a departmental procurement working group in 1997. This group is responsible for conducting a “mini-EMS” for greener procurement issues by systematically applying the following EMS principles:

- Securing departmental commitment;
- Developing concrete action plans;
- Implementing action plans and ensuring departmental capacity to do so;
- Measuring and evaluating progress; and
- Continuously reviewing and improving EC’s performance.

An important next step will be to develop better means to track greener purchasing within Environment Canada and to create progressive greener procurement targets that can be effectively measured and monitored. The establishment of a working group represents a positive step forward toward a more strategic and coordinated approach in managing EC’s greener procurement efforts.

Other initiatives include a “new officing strategy” which promotes the 3 Rs in the area of office renovations projects, as well as the promotion of the Hotel Eco-efficiency rating program. The Department plans to measure its performance in the procurement of greener goods and services by modifying its Departmental Financial/Material Management automated system to record such purchases. This will enable Environment Canada to set measurable targets and monitor its performance progress. Environment Canada also plans to add greener procurement criteria in its selection criteria for awarding contracts for goods and services over CDN\$25,000.

Targeted Greener Procurement Strategies

In order to achieve the greatest results in the most efficient manner, federal government departments, including Environment Canada, are working in partnership with non-governmental organizations and industry to develop practical options. This work has typically focused on those products and services that have significant

environmental and economic impacts, and on those transactions that are carried out by a relatively small number of employees.

Vehicles

Procurement and management of the federal fleet represents an important opportunity area for greener procurement. The passage of *The Alternative Fuels Act* by Parliament in 1995 demonstrates the Government of Canada's commitment to environmental leadership by reducing a broad range of air pollutants through the increased use of alternatively-fueled vehicles. This Act required that 50 percent of Government of Canada's eligible new vehicle purchases in fiscal year 1997/98 operate using alternative fuels where cost-effective and feasible. This requirement rose to 60 percent in 1998/99 and 75 percent in 1999/2000.

In addition to the environmental benefits, it is thought by some that this Act may support an increase in the demand for alternatively-fueled vehicles in Canada. However, it is important to recognize that the Government of Canada's total fleet of 25,000 vehicles represents less than one percent of the on-road vehicles in use in Canada. Federal departments, even as a collective, may not have sufficient buying power to impact on the development of an alternative fuel supply infrastructure given the geographic dispersion of federal operations. *The Alternative Fuels Act* underlines the federal government's commitment to environmental leadership through the implementation of a greener procurement strategy for its fleet to reduce its environmental impact.

All federal departments are working towards compliance with this Act as part of their overall environmental management programs, and are looking toward automobile and alternative fuel suppliers to design creative technologies that will facilitate compliance. As part of its broader fleet strategy, Environment Canada's Minister, in 1995, committed the Department to reduce its fleet size by 30 percent over three years; to increase its use of alternative fuels (such as propane and natural gas); to increase its use of car pooling and leasing; and to use recycled motor oils and coolants. A departmental fleet policy was approved by senior management and a comprehensive training program was implemented to educate drivers on the benefits of environmentally-sound driving, maintenance, and procurement practices. To share best practices and implement regional action plans, a departmental ground transportation working group, composed of fleet managers, was formed in 1997.

Environment Canada has reduced its fleet from 711 to 555 vehicles to date. Furthermore, approximately 60 vehicles have been converted to use alternative fuels. However, these conversions have not yet led to the environmental and economic benefits originally forecast. Major financial, technical, and emission issues have been identified: conversions have resulted in some unanticipated operating problems; have proven to be costly; and have occasionally resulted in increased air emissions. This experience is an important reminder that leading-edge greener technologies may not always live up to supplier claims. Given this reality, it is felt that the long-term success of EC's efforts to comply with the Act will depend, in part, on a reduced reliance on conversion technologies and the development of greener options by original equipment manufacturers.

Building management

Building management represents an important greener procurement opportunity where a coordinated federal program can result in significant environmental and economic savings. The Federal Buildings Initiative (FBI), designed by the federal department of Natural Resources Canada (NRCan) in 1991, helps managers to take advantage of long-term cost savings of greener building operations. The FBI involves an innovative partnership between the public and private sector to improve the energy efficiency in federal-owned facilities without financial investment or risk on the part of the Government of Canada. The FBI program uses private capital, resulting from longer-term cost savings, to finance building energy, water, and air system retrofits.

Environment Canada issued the first energy performance contract awarded under the FBI in 1993 to retrofit the Canada Centre for Inland Waters in Burlington. The FBI retrofit program included upgrades to the building electrical and mechanical systems; targeted reductions in water consumption; and the installation of a new electricity and heating production system.

These initiatives have resulted in an annual reduction of carbon dioxide emissions by 12,700 metric tons and yearly savings of CDN\$ 930,000 after a 7.2 year pay back period. Following the expiration of the contract, these savings will be retained by the Department. Opportunities to implement the FBI program for other Environment Canada sites across the country have also been undertaken.

One such opportunity was Place Vincent Massey. It was selected as the site to launch the FBI model in a leased building, the first project of its kind initiated by the federal government. The project was initially proposed by Environment Canada to NRCan, Public Works and Government Services Canada (PWGSC) and the landlord which resulted in a “buy-in” from all parties involved. The potential for energy savings is estimated at CDN\$ 150,000 annually. The FBI is considered to be one of the most successful environmental programs for federal operations as it has resulted in significant environmental and financial savings, and supports Canada’s environmental industry.

Work is also underway to promote environmental stewardship and greener procurement in the management of office accommodations. In 1995, Environment Canada and PWGSC created *The Environmentally Responsible Construction and Renovation Handbook*. The Handbook is a compilation of practical information to help federal property and facility managers address two common environmental concerns: solid waste reduction and the selection of greener building materials and products.

To build on this work, Environment Canada and PWGSC are now developing a more comprehensive set of environmentally sensitive accommodation standards called *The Green Office Building Plan*. Its objective is to ensure that building selection and design, construction and demolition, electrical and mechanical systems, furnishing materials, and facility management strategies incorporate measures to maximize energy and water conservation, improve indoor environmental quality (i.e. indoor air, lighting), and implement sound waste management principles. Because *The Green Office Building Plan* is intended to be integrated into existing procurement processes on a federal public service-wide basis, it is expected to have many positive environmental impacts and should also help to increase the demand for greener accommodation goods, services, and processes.

To pilot *The Green Office Building Plan*, Environment Canada initiated the *New Officing Strategies Project* for an Environment Canada office floor. This project

incorporates new planning and design concepts such as improved functionality, team work settings, and non-territorial meeting rooms. As an important part of this demonstration project, environmental criteria were specified in all facets of the endeavor ranging from product selection to construction and demolition waste diversion plans. To this end, the project employed life-cycle (cradle to grave) concepts, which included considerations on how to minimize the amount of waste entering landfills. For example, existing components were salvaged, carpet was recycled, and drywall was installed between wall panels to increase sound insulation.

As part of this project, Environment Canada worked in partnership with PWGSC and industry leaders to establish and apply a remanufactured standard for systems-furniture which is the first of its kind within the federal public service. Through remanufacturing, previously used panels and furniture components are refurbished to “as new” quality. The standard specified a minimum 60 percent remanufacturing requirement for panels and systems furniture used in the project. In addition, non-refurbished products featured environmental attributes, such as recycled content in carpet, steel, sound insulating material, and particle board.

In September of 1997, this Environment Canada office floor was the first in Canada to be ECP certified because of the environmental considerations incorporated in its design, construction, and day-to-day operations. Environment Canada will continue to work with PWGSC and industry partners to develop more precise environmental specifications for future projects. For example, minimum quantities of recycled material, such as steel, will be identified for use in furniture components.

In Churchill, Manitoba, the full life cycle of a building was taken into account in designing a building for use in the Aerological network. There are approximately 35–40 Aerological sites located in various locations across the country, most are in remote northern locations. As program requirements change, the sites may be closed and/or relocated. The original building design dates from the early 1950s and was basically a large two story box. It was built to accommodate the program at the time, which was large, bulky, and required 2–4 people to operate. The equipment and human resource requirements have changed considerably over the years, and a prototype operations building was developed and is being tested. It is highly efficient and completely self-contained. It is estimated the energy savings alone will be in the area of 80 percent, which is significant considering these buildings are required in the Arctic where energy is usually provided by diesel generators. They are modularized, which means that should the program require a given station to be closed/moved, it can be relocated with minimal disruption to the surrounding terrain.

Energy

Concrete steps are also being taken to create markets for greener energy through first-purchase strategies. As part of its sustainable development strategy, Environment Canada has committed to purchase 15–20 percent of its building energy from renewable sources by the year 2010, and to commence greener power pilot projects in fiscal year 1998/99.¹³ To realize this commitment, Environment Canada, along with Natural Resources Canada (NRCan), signed a greener energy purchasing agreement with an Alberta energy company. In it, the two federal departments agreed to purchase up to a

¹³ *Environment Canada's Sustainable Development Strategy*, April 1997, p. 16.

total of 13,000 megawatt hours of greener power per year for their Alberta facilities over the next 10 years. This agreement demonstrates true environmental leadership as both Environment Canada and NRCan will be paying a premium for the wind power generated by this energy company. It is thought that this agreement could, in turn, stimulate interest by energy companies of other provinces to develop greener power alternatives. Currently there is an agreement in place to provide 2 million kilowatt-hours of electricity generated from 2 wind turbines for the next 10 years.

Hotels

Environment Canada is also working in cooperation with the Hotel Association of Canada, TerraChoice Environmental services, and other government departments to develop an independent *Hotel Eco-efficiency Rating Program* which will be the first of its kind in the world. This work reinforces and supplements voluntary efforts already undertaken by the lodging industry to adopt best practices in environmental management. In this program, hotels are independently evaluated on their corporate environmental management practices in areas such as guest and food services, meeting facilities, and grounds maintenance. As of April 30, 2000, one hundred and thirty (130) hotels had been Green Leaf certified.

To encourage federal use of the one-to-five *Green Leaf* rating system, the hotel ratings are expected to be incorporated into the 1999 Federal Government Directory for Government Employees. Environment Canada will direct its employees to use this rating system when selecting hotels for accommodation and conference purposes. Work is also underway to complete a pilot with three other countries to extend these efforts internationally.

Telephones

In a direct effort to foster life-cycle management and demonstrate that eco-efficiency can improve competitiveness over the complete product life cycle, Environment Canada entered into a partnership with Nortel, a Canadian telecommunications company. In 1997, Nortel and Environment Canada announced a CDN\$ 1.2 million research project to explore environmentally preferable design technologies. The project explored sustainable telephone design and production practices that decrease environmental impacts and provide a competitive edge in the global economy. Environment Canada contributed CDN\$ 250,000 to sponsor a life cycle assessment to identify and verify potential environmental improvements. In this project, Nortel used environmental design standards and practices to explore "concept" telephones with leading environmental features such as lead-free interconnection technology, fewer parts, and a reduction in the number of materials for ease of recycling. This initiative represents the first time that the Government of Canada and private industry worked together to examine an entire product life-cycle. The final report detailing the work is expected shortly and will be used to promote to industry the business and environmental value of this approach to product design.

Photocopiers and paper products

Environment Canada initiated the creation of an inter-departmental working group composed of departments operating within a federal building complex of 6,000 employees to leverage the building's total spending power in photocopier purchases. A

contract was issued for the approximately 200 photocopiers required in the complex. This coordinated approach significantly improved the price and service levels received. In addition, it enabled departments to insist on certain environmental criteria, such as default double-sided copying, machine components that are recycled and recyclable, and packaging, such as toner bottles, which are taken back by the supplier.

To increase the use of greener paper procurement, this same interdepartmental working group issued a second contract to ensure these photocopiers would be supplied with EcoLogo certified paper (50% recycled, 10% post consumer fibres) and not virgin copy paper. Environment Canada is also working with a stationary supplier located in the complex to increase the number and visibility of greener products it offers. These efforts should help to increase the amount of greener stationary products federal employees purchase within the complex.

Government Partnerships

Climate Change is another important procurement issue. Canada has committed to reducing its greenhouse gas emissions by six percent below 1990 levels by the year 2010. A National Implementation Strategy has been launched to ensure that all sectors of the economy, including the federal government, contribute to achieving the targets. Following planning and consultations, a House in Order Strategy, to reduce GHG emissions from federal government operations is being finalized. As part of this strategy, a House in Order Greenhouse Gas Responsible Procurement Task Group has been formed and is identifying opportunities to not only reduce carbon dioxide emissions, but to show leadership by the federal government in purchasing products that are energy efficient.

As part of its broader policy agenda, Environment Canada is also developing effective partnerships with different orders of government to advance greener procurement thinking and practices both nationally and internationally. Within Canada, Environment Canada has worked through different venues to encourage an effective dialogue. In November of 1996, Environment Canada and PWGSC sponsored a two-day *National Procurement Workshop*. Federal, provincial, and municipal representatives, as well as participants from private sector organizations and suppliers, came together to better understand different perspectives in accelerating progress in greener government purchasing.

In addition, a Federal Green Procurement Task Force was created by the National Round Table for the Environment and the Economy (NRTEE) in 1994 to assist federal departments and agencies in greening their procurement practices. This group of industry, not-for-profit, and governmental participants, including Environment Canada, has been actively working to advance its mandate. In 1996, the Task Force commissioned a report, entitled *Development of Criteria for Green Procurement: Summary Report*, which outlined the state of green procurement for private and public sectors in Canada and identified possible criteria that could be used to increase greener procurement. One of the study's key findings was that gains in green procurement can only be made when an organization has a clear, public commitment from senior managers supported by adequate resources and implementation strategies.

Environment Canada chairs the green procurement Committee of the Material Management Institute, a national, non-profit organization open to everyone with an interest in the areas of public sector purchasing, contracting, inventory and asset management, warehousing, supply management or any other aspect of the life-cycle

management of publicly owned material. This new committee is an ideal vehicle for sharing best practices, exchanging and disseminating information regarding greener procurement. Environment Canada is also hosting a Greener Procurement Conference to further federal, provincial and municipal governments and private sector initiatives in the greener procurement area. The Material Management Institute and the federal government are working together to develop a greener procurement component for the certification program for procurement agents.

Environment Canada supported Public Works and Government Services Canada on the development of a national electronic greener procurement database EcoNexusTM and an environmentally responsible Construction and Renovation Handbook, a compilation of practical information to help government departments in the selection of greener building products and activities.

Environment Canada continues to be an active member of the Federal Committee on Environmental Management Systems. A subgroup of this committee developed an Environmental Awareness and Training Program for federal managers and employees. This program includes awareness presentations on environmental management targeted at senior managers, a Web-based learning tool to increase employee awareness and motivate action, and support tools for training staff.

A second study, *Going For Green: Meeting Foreign Demand for Environmentally Preferable Products and Services through Federal Procurement*, was completed in 1997 and was followed by an expert stakeholder workshop to discuss its findings. The study identified trends for greener products in some of Canada's major trading markets, and the role of the Government of Canada as a public purchaser. Most recently, in January of 1998, the NRTEE published a *Statement on Federal Green Procurement* which included a series of conclusions and recommendations to inform and guide the procurement efforts of federal government decision-makers.

Environment Canada is also building closer working relationships with Member countries of the Organization for Economic Co-operation and Development (OECD), the Asia Pacific Economic Co-operation (APEC) forum, and the United Nations Environment Programme (UNEP).

Environment Canada chaired the working group which led to the 1996 passage by OECD Ministers of a Council Recommendation on *Improving the Environmental Performance of Government*. This document was intended to encourage member country governments to reduce the environmental impacts of their own operations and decision-making processes. As a follow-up to this resolution, several OECD meetings have been held to encourage member-country governments to share practical information and best practices. To facilitate the exchange of information, Environment Canada also initiated the creation of a Greening Government web site for the OECD. The department has also been an active participant in the OECD Green Goods conferences on greener public purchasing and its associated working group. Environment Canada is also interested in the development of common performance indicators and issues of improving environmental performance of governments.

Work is also underway, through workshops and meetings, to collaborate with Asia-Pacific countries on greening government, greener procurement practices, and sustainable cities. Examples include the "Canada-China Workshop on Greening Government and Environmental Management Systems" which is tentatively scheduled for September of 2000 and an Environment Canada sponsored International Workshop on

“Creating Sustainable Cities through Urban Environmental Management” held in Bangkok, Thailand in March of 2000. At that workshop, the department field-tested the pilot “City Solutions Network”, a web based knowledge management tool for urban decision makers. The City Solutions Network will contain information on the topics of green procurement and e-commerce.

Environment Canada also co-developed and co-facilitated a United Nations Environmental Program sponsored pilot workshop on the “Application of Environmental Management Systems to Urban Management” which was held in Hungary in July of 1999. The successful Hungary pilot has led to the organization of workshops scheduled for Brazil in June of 2000 and South East Asia in November of 2000 with an additional workshop planned for the Caribbean and Central America. This training will become part of United Nations Environment Program’s core courses.

These partnerships and meetings are beneficial because government at different levels learn from the experiences of others. By exchanging valuable tools and best practices, governments can save time and money by minimizing the duplication of effort. Moreover, such exchanges can also help to gradually raise the overall bar of performance across governments.

LESSONS LEARNED – KEY COMPONENTS OF EFFECTIVE GREENER PROCUREMENT STRATEGIES

Over the years, Environment Canada has learned many important lessons through partnerships with other governments and through its own experience in implementing a greener procurement strategy. In order to effectively advance greener procurement within government organizations, it is useful to apply the following change management principles:

- *Secure a champion from senior levels* to establish organizational commitment, drive the change process, and achieve real success. Leadership from senior managers is essential to send the necessary signal that greener procurement is a real priority;
- *Encourage a culture of environmental awareness* by emphasizing incremental, pragmatic changes to the day-to-day decision-making and responsibilities of all managers and employees;
- *Involve key employees* in the design and implementation of the greener procurement strategy. Employee participation will increase buy-in and help to ensure the strategy is designed to meet the organization’s unique characteristics and needs;
- *Simplify the environmental decision-making process* by integrating tools that are easy to understand and use into the organization’s procurement processes. Employees are less likely to use complicated tools when dealing with time pressures, competing purchasing priorities, and the intimidation factor of selecting greener goods and services;
- *Define clear environmental accountabilities* throughout all managerial and employee levels to strengthen commitment, stimulate action, and facilitate the examination of past greener procurement efforts;

- *Limit the scope* of initial efforts by reaching for “low-hanging fruit”: those areas which have the greatest opportunity for positive environmental change in the short-term. For example, organizations could develop specific strategies for high-volume goods or could focus training efforts on those employees who make the largest proportion of procurement decisions;
- *Establish realistic, but challenging environmental targets* to focus efforts, maintain momentum, and encourage a culture of continuous improvement;
- *Recognize innovative initiatives and reward successes* to foster creativity and risk-taking within the organization; and
- *Foster partnerships* with other governments, non-governmental organizations, and industry leaders to increase practical knowledge, share best practices, minimize duplication of effort, and initiate joint greener purchasing initiatives.

Additional Opportunities to Advance Greener Government Purchasing

Although some positive steps have been taken, there is a great deal of additional work that is required to leverage the Government of Canada’s purchasing power and increase the quantity of greener goods and services that departments buy. Some important steps that should be taken over the next years include:

- Creating a Greener Purchasing Forum of Canadian governments with appropriate private sector involvement to share information, leverage collective purchasing power and, ultimately, develop common procurement standards based on best practices.¹⁴ These standards could then be used by all levels of government to provide suppliers with greater certainty and consistency in developing greener products and services;
- Instituting, as part of federal government procurement processes, the requirement that potential suppliers fully describe the positive environmental attributes of their products, processes, services, and environmental management systems;¹⁵
- Fostering greater collaboration and exchange of greener procurement tools across governments, both nationally and internationally. In Canada, this could be encouraged through the creation of a national web site;
- Fostering greater collaboration with other federal departments to better leverage federal government purchasing power and to develop shared performance indicators in assessing the efficacy of governmental procurement strategies;
- Developing additional partnerships with industry and non-governmental organizations to design and develop greener goods and services; and
- Capitalizing on future technological advances in electronic commerce over the longer-term. Greener criteria could then be seamlessly embedded into procurement software to make greener purchasing a default option and to facilitate the tracking of greener purchases for government departments.

¹⁴ *National Workshop on Greener Government Purchasing. Workshop Proceedings.* Government of Canada. November 1996

¹⁵ *National Round Table on the Environment and the Economy: Statement on Federal Green Procurement.* January 1998.

CONCLUSION

The government of Canada's departments and agencies are striving to better incorporate the environment into the management of its policies, programs, and operations. As part of this larger effort, progress has been achieved in promoting and implementing greener government purchasing strategies within federal departments. Environment Canada has been able to realize many important successes by fostering effective partnerships and emphasizing a pragmatic, small-steps approach to achieve concrete results. However, more work can and should be done. As a result, Environment Canada remains committed to continue working both internally and with external partners to advance greener procurement as part of its overall environmental mandate.

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LIST OF ACRONYMS

APEC	Asia-Pacific Economic Cooperation Forum
Environment Canada	Environment Canada
EMS	environmental management system
ECP	Environmental Choice Program
FBI	Federal Buildings Initiative
IER	initial environmental review
ISO	International Organisation for Standardisation
NAFTA	North American Free Trade Agreement
NRCan	Natural Resources Canada
NRTEE	National Round Table on the Environment and the Economy
OECD	Organization for Economic Co-operation and Development
PSAB	Procurement Strategy for Aboriginal Business
PWGSC	Public Works and Government Services Canada

6. ECO-EFFICIENCY AND AN OVERVIEW OF GREEN PURCHASING

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ABSTRACT

Eco-efficiency –a management concept designed to encourage businesses to become more competitive, more innovative, and more environmentally responsible– was first coined by the World Business Council for Sustainable Development (WBCSD) and then endorsed by the 1992 ‘Earth Summit’ as the means for companies, individually and collectively, to contribute to the far-reaching Agenda 21 action program developed by the milestone conference. Today, the validity of eco-efficiency is being clearly demonstrated by its success in the growing number of companies which have adopted it as their business norm and translated it into action. Eco-efficiency is a key component on the road to sustainability –a powerful driver for widespread, root-and-branch change, if properly implemented on a large scale. It impacts the entire product chain– by addressing the whole life cycle, promoting a shift from products to services, encouraging green purchasing, and enabling the development of sustainable consumption patterns.

This paper presents the development of the eco-efficiency concept, including the application, measurement, and reporting of eco-efficiency as well as the case studies which show the benefits of eco-efficiency. An overview on green purchasing is also provided to demonstrate a powerful drive for companies to achieve eco-efficiency in the next century.

THE ECO-EFFICIENCY CONCEPT

Eco-efficiency has certainly come a long way since the phrase was first coined in 1991 in the book “Changing Course” produced by the WBCSD as an input to the Earth Summit in Rio. Stephan Schmidheiny was looking for a term that could express the combination of environmental and financial performance, so he organized a competition to find the right term. The winner was a colleague of his who suggested the word “eco-efficiency.” Today, 8 years later, the ever-growing number of discussions and applications of the concept is a sign of its power.

The brief definition of eco-efficiency is the combination of economic and ecological efficiency to add more value with less environmental impact. The more formal definition is as follows:

“Eco-Efficiency is reached by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing the ecological impact and resource intensity throughout the life cycle to a level at least in line with the Earth’s carrying capacity”.

A company wanting to become eco-efficient should strive to improve in the following 7 aspects of eco-efficiency as defined by the WBCSD:

1. Reduce the material intensity of its goods and services;
2. Reduce the energy intensity of its goods and services;
3. Reduce the dispersion of any toxic materials;
4. Enhance the recyclability of its materials;
5. Maximize the sustainable use of renewable resources;
6. Extend the durability of its products; and
7. Increase the service intensity of its goods and services.

Eco-efficiency combines environmental and economic performance. It enhances the efficiency of production processes and creates new and better products and services using fewer resources and generating less pollution along with the entire value chain. Eco-efficiency complements many other environmental management approaches by drawing a positive link between environmental improvement and bottom line benefits. Yet, eco-efficiency includes a feature that sets it apart from other concepts. It focuses as much on value creation as on resource use or pollution reduction. Eco-efficiency can help to create value for a company and society as a whole by explicitly promoting change toward sustainable growth. This emphasis on creating and adding value is clearly to society’s benefit.

How Has the WBCSD Developed the Concept of Eco-Efficiency?

Since the emergence of the Eco-Efficiency concept, the WBCSD has developed it further through a number of reports and books. For example, *Eco-Efficient Leadership for Improved Economic and Environmental Performance* (1996) outlined the concept in broad terms and defined it as a management philosophy for business.

Eco-Efficiency: The Business Link to Sustainable Development (1997), was co-authored by Livio DeSimone, Chairman and CEO, 3M, and Frank Popoff, Chairman, Dow Chemical. The book presented numerous studies of the application of eco-efficiency within leading international companies. It explained how businesses were encouraging eco-efficient practices in their operations, but argued that further development required enabling frameworks from governments.

In the study *Environmental Performance and Shareholder Value* (1997), DuPont, Storebrand, and the Swiss Bank Corporation together with some 40 WBCSD members drew attention to the positive link between environmental and financial performance. However, unless financial markets can evaluate and reward eco-efficiency in business, they concluded that companies will still not advance quickly enough toward more sustainability. The lack of an agreed eco-efficiency metrics and reporting format was also apparent.

In cooperation with the United Nations Environment Program (UNEP), the WBCSD launched *Cleaner Production and Eco-Efficiency - Complementary Approaches*

to *Sustainable Development* (1998), in which we pointed out the mutual strength of both concepts in driving progress toward sustainable development.

Two “*Eco-Efficiency Bulletins*” were also produced in 1999 to give status reports on the further development of the concept.

MAKING THE CHALLENGE OF SUSTAINABILITY A BUSINESS OPPORTUNITY

Eco-efficiency benefits both the environment and the corporate bottom line. By integrating environmental aspects throughout the life cycle of their products and services, companies reduce consumption of resources, lessen environmental burdens, and limit risks and liabilities. Applying eco-efficiency in product design and procurement processes also leads to economic benefits by cutting a company’s total cost of ownership and shortening pay-back periods on necessary capital investments.

Companies that implement eco-efficient practices are better equipped to: meet new demands from stakeholders; respond more aggressively to competitive pressures; anticipate customer needs more successfully; ensure employees’ health and safety; and protect the environment more effectively.

The eco-efficiency concept is driven by the vision of “creating value by making the challenge of sustainability a business opportunity”. Business is implementing this vision as a holistic approach on four levels:

Innovation

Companies are manufacturing products with new and enhanced functionalities –and selling services to enhance the products’ functional value. This “eco-innovative” approach, supported by Dow Chemical, generates business opportunities and economic growth as well as environmental improvements.

Eco-efficient Processes

Worldwide and across all sectors, large and small companies have benefited from 3M’s concept, “Pollution Prevention Pays,” and other approaches, as companies are moving from costly end-of-pipe solutions to managing environmental issues on an integrated basis. Eco-efficiency indeed offers benefits at every stage of a product’s supply chain and can help improve overall supply-chain management, including the elimination of harmful substances and the formulation of an end-of-life strategy for products.

By-Product Synergy

Another value-creating aspect of eco-efficiency is by-product synergy, which entails using the by-products and wastes of one industry as the raw materials and resources for another –thus creating zero waste. In the Gulf of Mexico, for example, the TXI corporation is leading a by-product synergy project and found that companies which adopt this strategy increase their profitability, reduce pollution and natural resource use, and alleviate the adverse environmental impact of industrial development.

Shifting Market Mechanisms

Companies, such as Interface, have started leasing equipment as well as selling it, and now provide functional offerings for to meet their customers' needs. The introduction of these new services underlines a shift to improved product durability, designing to facilitate upgrading, and enforced recycling –changes that ultimately mean closing material loops and increasing service intensity of products.

There are a number of management tools to help identify and select opportunities to make these changes, including:

- Formal risk and environmental assessments;
- LCA;
- EMAS and ISO 14000;
- Environmental accounts/audits;
- Financial accounting methods that reflect “hidden” costs and potential benefits;
- Formal eco-efficiency assessments; and
- Environmental reporting and benchmarking to provide feedback to management.

We believe that the potential for eco-efficiency is huge and the examples of the benefits are many. The following few examples illustrate some of the results that can be achieved:

- *3M*
3P: Pollution Prevention Pays program has yielded:
 - Economic benefits: savings of US\$750 million since 1975; and
 - Ecological benefits: releases to air, water and land reduced by 1.4 billion pounds since 1975.
- *Procter & Gamble*
Eco-efficiency through LCA.
P&G uses life cycle inventory to make eco-efficient detergents: the Ultra formulation (1989).
Results:
 - 50 percent less volume than traditional detergents;
 - 30 percent less raw materials;
 - 30 percent less packaging (cartons); and
 - 40 percent less transportation needs.
- *Xerox*
Savings of 100 MUSD/year.
Xerox is now embarking on a program to become a truly Eco-Efficient corporation.
- *Dow Chemical*
Annual savings from reduction of wastes and emissions are almost twice the investment.
- *Gerling, Germany*
Gerling applies “risk-adjusted pricing” to the companies it insures. It has shown that the more eco-efficient a customer, the lower the risk factor which is then translated into lower premiums.

- *UBS/Swiss Bank*
UBS/Swiss Bank Corporation takes environmental risks into account in parallel with traditional types of risks. The bank will lend at a better rate to “environmentally-safe” clients.

There are also examples from developing countries:

- *Acegrasas, Colombia*
A food producer of oil and butter. Investment to reduce water use was paid back in less than half a year.
- *SME's (small and medium sized enterprises) in Brazil*
Adoption of eco-efficient practices enhanced environmental and social performances, and increased profits. Investments were paid back on average in less than 6 months.

There are many internal barriers to eco-efficiency in a company so if you want to reap the benefits of this concept you need a dedicated approach. The single most important requirement is senior management commitment. If that is lacking and if the company lacks a vision of how to become more sustainable, the likelihood of success is limited.

On the other hand, for companies that have tried eco-efficiency, the benefits in the form of financial performance, stronger employee commitment, and reduced environmental impact have turned out to be substantial.

THE FINANCIAL MARKETS

Business also needs recognition from the financial markets for its achievements. One recent development that is worthy of notice is the release of the Dow Jones Sustainability Index, listing 200 companies judged to be leaders in sustainability. Through a so-called “back-test” of how the Sustainability Index would have performed over the last five years, Dow Jones concluded that the Sustainability would have outperformed the General Index with four percentage points, i.e. 17 percent versus 13 percent. This has raised the level of interest from fund managers in environmentally related matters.

Eco-funds are also becoming popular in Japan with total sales of 133.2 billion yen (as of November 1999). So far, four investment trust companies have launched Eco-funds.

Net assets of the Eco-funds in Japan

Nikko Securities Asset Management Co., Ltd.	71.8 billion yen
Yasuda Kasai Global Asset Management Co., Ltd. (YKAM)	22.0 billion yen
DLIBJ Asset Management Co., Ltd.	35.0 billion yen
UBS Fund Management Co., Ltd.	9.1 billion yen
Total	137.9 billion yen

In order to screen portfolios, the analyst team in the eco-funds carefully reviews the environmental management practices and performance of selected companies, based on information available to general public, the results of its questionnaire, and interviews. For example, the following three aspects are taken under consideration in the eco-fund jointly developed by Yasuda Kasai Global Asset Management Co., Ltd. (YKAM) and Yasuda Fire and Marine Insurance Co., Ltd.:

- Development of environmental management;
- Publication of environment-related information; and
- Reduction of environmental impact and promotion of eco-efficiency.

In USA, a total of US\$2 trillion is now invested in a socially responsible manner, including the investment in proactive environmental companies, representing about 13 percent of the US\$16 trillion total of funds under professional management. The fastest growing component of socially responsible investing is the growth of portfolios that employ both screening and shareholder advocacy, in which shareholders use their ownership positions to influence corporate actions.

TURNING BUSINESS CONCEPTS INTO POLICY CONCEPTS

“Achieving more value with less impact” –today’s definition of eco-efficiency– is not just a corporate aim, but also very much a goal for all parts of society. Extended to the economy at large, eco-efficiency can create value on an additional level, i.e. eco-efficiency in economies. At the macro level, eco-efficiency has been defined as “de-linking growth of welfare from use of nature”, (i.e. more value with less impact for the entire economy.)

Since its inception, the business concept of eco-efficiency has gained credibility among governments and inter-governmental organizations. The OECD has developed its own program on eco-efficiency and published a report on the topic in 1998. Several UN organizations, including the UNEP and UN Commission on Sustainable Development, are also exploring policies and measures necessary to implement eco-efficiency.

In addition, the European Union heads of states and governments have started pushing to integrate sustainable development, including eco-efficiency, into their policies to stimulate progress toward sustainable industrial development. As evidence of this, the WBCSD is engaged in the first Europe-wide initiative on eco-efficiency, the European Eco-Efficiency Initiative, aimed at establishing eco-efficiency as a leading business concept throughout Europe.

In the process of turning eco-efficiency, a business concept, into a policy concept, it shares similarities with complementary management tools such as Cleaner Production toward the common objective of sustainable development. Figure 1 shows how eco-efficiency concept relates to others for sustainable development.

As well as business, governments should also integrate these management concepts into their economic and industrial policies and action plans to move the sustainable development agenda forward. This will help business progress faster toward responsible entrepreneurship, or striking the right balance between profitable operation, environmental

protection and social progress. Figure 2 shows the roadmap and agenda for both public and private sector to sustainability.

Figure 1. Relationship Between Concepts

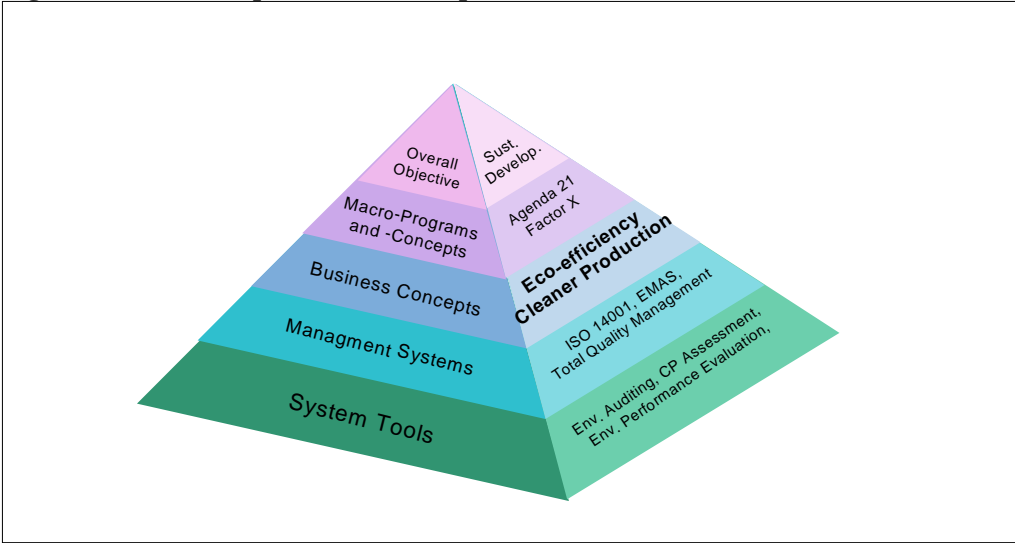
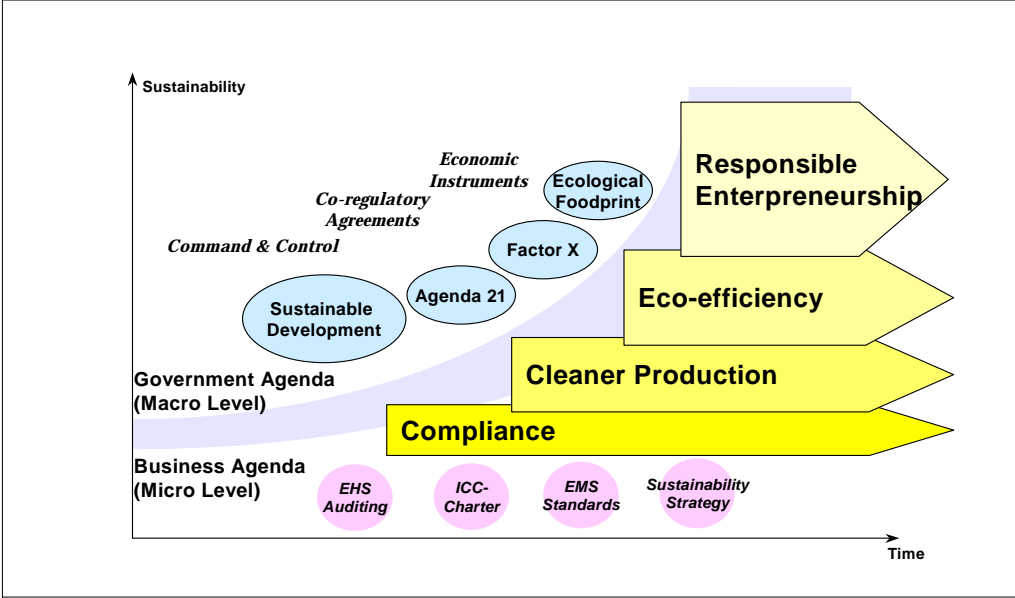


Figure 2. Roadmap to Sustainability



ECO-EFFICIENCY INDICATORS: A TOOL FOR BETTER DECISION-MAKING

The WBCSD has developed a set of eco-efficiency indicators to help measure progress toward economic and environmental sustainability in business. Eco-efficiency indicators primarily serve as a decision-making tool for internal management to evaluate performance, set targets, and initiate improvement measures. They also are important tools for communicating with internal and external stakeholders.

The basic objective of eco-efficiency is to maximize value while minimizing resource use and adverse environmental impacts. In order to calculate eco-efficiency, the WBCSD has developed the following equation, which merges value and ecological aspects into an efficiency ratio:

Eco-efficiency =	<div style="display: inline-block; text-align: center;"><div style="margin-bottom: 5px;">Product or service value</div><div style="border-top: 1px solid black; width: 100%;"></div><div style="margin-top: 5px;">Environmental influence</div></div>
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This basic equation can be used to calculate several different eco-efficiency ratios. Specific calculations will depend upon the needs of individual business managers and on the values and impacts specific to their business sector. It is necessary to maintain “numerator” and “denominator” data separately in order to clearly identify the origin of the data and the basis for the calculations.

Eco-efficiency does not address all three pillars of sustainable development. While it strives to improve economic and environmental efficiency, the concept does not pertain to social issues. Yet, eco-efficiency is a key development driver for business and governments.

There are many reasons why companies should measure and report their eco-efficiency performance:

- To improve efficiency by tracking and documenting progress as well as limitations;
- To identify cost savings in operations;
- To generate a positive response from investors and rating agencies as environmental performance and eco-efficient operations emerge as important criteria for investors; and
- To communicate the corporate message positively and clearly.

Monitoring and reporting are key elements of a management system. Accurate measurements can help managers make sound decisions and assess whether their objectives can be met or not. Reporting to all those who can influence decisions the status of ongoing efforts and discussing with them ways to further improve can make a management process more effective and ensure solid progress. The information provided with the concept should be especially useful for managers as they devise ways to improve the eco-efficiency of their businesses. Also, stakeholders such as employees, neighbors,

and business partners such as investors and insurers may want to use dedicated information relevant for their own decision-making.

The eco-efficiency indicators and efforts by other initiatives on corporate reporting, such as the Global Reporting Initiative (GRI), share the goal of identifying common elements for measurement and communication, and harmonizing indicators to the extent that is practical and scientifically possible. The objective of the WBCSD's work is not to develop one single approach to measuring and reporting eco-efficiency. Rather, it seeks to establish a general, voluntary framework that is flexible enough to be widely used, broadly accepted, and easily interpreted by a large spectrum of sectors. The specifics of defining, measuring, and communicating eco-efficiency will necessarily vary from one business to another, and comparisons between different businesses must be approached with great caution.

To keep the framework flexible and applicable to diverse sectors, but still allow harmonization of indicators, the concept recommends a two-level approach of:

1. Generally applicable indicators; and
2. Business specific indicators.

While “generally applicable” indicators should be internationally agreed upon and valid for virtually all businesses, they may not be of equal value or importance for a given company; nor are the necessarily comparable between different businesses. All other indicators have been called “business-specific indicators” as their relevance and pertinence vary from one business to another.

Generally Applicable Eco-Efficiency Indicators

Product/Service Value

- Mass or number of products or services produced or sold; and
- Net sales.

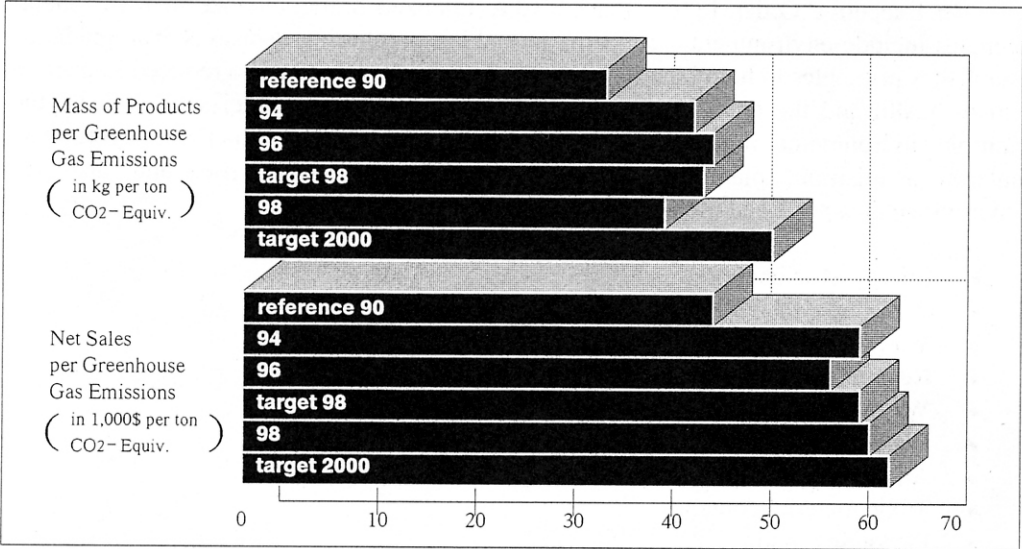
Product/Service Creation Environment Influence

- Energy consumption;
- Material consumption;
- Net water consumption;
- Greenhouse gas emissions; and
- Ozone depleting substance emissions.

The WBCSD has recently launched a pilot program (including one of the BCSD-Taiwan's member companies within the pilot group) to test the validity of its eco-efficiency indicators concept. The BCSD-Taiwan has also launched a pilot test for three industry sectors in Taiwan, including: pulp and paper, cement, and semiconductor industries. The aim is to gain practical experience and to adapt the framework as necessary. The framework does not recommend that companies issue a separate or stand-alone eco-efficiency report –but rather that companies integrate eco-efficiency information into their overall decision-making and communication processes. Eco-efficiency information can be communicated on the basis of a facility, a region, a

division or an entire corporation, although there is a risk in aggregating data across different products and/or operations.

Figure 3. Presenting Improvements Over Time Compared to a Reference Point and to Targets



To enable transparency and facilitate understanding, it is necessary to maintain “value” and “impact” data separately when calculating the eco-efficiency ratios, as well as when reporting organizational information. Companies may further choose to report eco-efficiency as trends over time or as a comparison to a reference point or target, as shown in the Figure 3. Performance can also be benchmarked relative to an industry average.

GREEN PURCHASING

Incorporating environmental considerations into procurement and purchasing policies can force suppliers to apply sustainable development practices to their products and services. Green purchasing policies from public and private sectors are probably going to have the greatest impact on business in the 21 century. It has been recognized as a very powerful measure to combine eco-efficiency with supply chain management.

Public Sector

The federal government of the USA purchases more than US\$ 200 billion worth of goods and services each year. Recognizing that purchasing decisions can have environmental consequences, the federal government is incorporating environmental considerations into its purchasing practices. In early 1993, President Clinton began issuing a series of Executive Orders mandating that executive agencies take actions to improve their environmental performance. The Executive Orders promote energy efficiency, water conservation, reduced toxic emissions, waste prevention and recycling, and environmentally preferable purchasing. On September 14, 1998, President Clinton

issued Executive Order 13101, Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition. Accordingly, environmentally preferable purchasing means selecting “products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose.”

In Executive Order 13101, the US-EPA finalized draft guidance to help federal agencies include environmental concerns in making purchasing decisions. The guidance establishes principles to help identify products and services that have a reduced impact on human health and the environment. The US-EPA encourages agencies to evaluate the multiple environmental impacts of every product throughout the product’s life cycle –raw material acquisition, manufacture, packaging and distribution, use, and disposal. Environmental aspects can include:

- Energy-efficiency;
- Recycled content;
- Water-efficiency;
- Resource conservation;
- Waste prevention;
- Renewable material percentages;
- Adverse effects to workers, animals, plants, air, water, and soil;
- Toxic material content;
- Packaging; and
- Transportation.

The era of green purchasing in the Republic of China formally began in 1999. The ROC’s Government Procurement Act (hereinafter referred to as the “Act”) came into effect on May 25, 1999. In accordance with Article 96 of the Act, the EPA and the Public Construction Commission (PCC) promulgated regulations concerning priority purchasing for environmentally-friendly products. Environmentally friendly products can enjoy a 10 percent price advantage when participating in government bids.

Private Sector

The growing interest in environmentally preferable purchasing, however, is not limited to the public sector. Private-sector companies are also investigating and purchasing environmentally preferable products and services. Through a variety of environmental and cost-saving initiatives –design for the environment, greening the supply chain, full-cost accounting, zero-waste initiatives, ISO 14000 certification, environmental accounting, and others– private sector companies are identifying, manufacturing, and purchasing green or eco-efficient products and services.

The business reasons for which companies adopt environmentally preferable purchasing practices to help improve the environment include:

- Responding to customer interest in “environmentally friendly” products and practices
 - Public Service Electric and Gas Company’s “buy recycled” program in 1997.

- Distinguishing a company and its products from competitors
 - Sony’s “Greenplus” program in Netherlands; and
 - Volvo provided information on the environmental impacts of products in Japan, Europe, Australia, and the United States.
- Pursuing cost savings
 - Purchasing lighter weight or reduced packaging to contain their products by Anheuser-Busch, The Body Shop, Herman Miller, IBM, and McDonald’s.

Many companies have incorporated environmentally preferable purchasing principles into their routine operations. Some companies have issued official principles to their suppliers, such as Toyota’s Environmental Purchasing Guidelines, and Nokia’s Supplier Requirements. Some are developing and refining critical components of what could become formal environmentally preferable purchasing programs. The components include the following:

- Developing lists of chemicals to avoid;
- Creating lists of approved products;
- Establishing single environmental attribute purchasing programs;
- Considering multiple environmental attributes when making purchasing decisions; and
- Working closely with suppliers to enhance environmental performance.

In the United Kingdom, the business association, Business in the Environment, as published guidelines on best practices and has a task force of leading companies who are introducing it. The guidelines were influenced by two pioneers in the field, the telecommunications company BT, and B&Q, Europe’s biggest do-it-yourself supplier. BT has an environment section in its procurement department and screens all major purchases. It also confers an Environmental Suppliers Award to recognize good practice among suppliers. B&Q conducts an annual questionnaire survey of its suppliers, which it uses to grade their production methods and source of material. B&Q prefers to work with its suppliers to achieve improvement but at the end of the day will stop buying if poor performers do not mend their ways.

Procurement policies are probably having the greatest impact on the forest product industry. Tracking whether products are produced using sustainable forestry practices has become much easier with the evolution of independent certification. Certification is provided by the Forest Stewardship Council, a body created by the Worldwide Fund for Nature (WWF) and proactive timber users such as B&Q.

More and more companies agree that supplying environmentally preferable products will be an important industry objective in the next century. Supplying “environmentally friendly” products requires companies to purchase and use environmentally preferable components in manufactured products and to identify vendors to stock environmentally preferable products. In an attempt to identify such products, more than 1,800 Japanese companies and other organizations have joined the Japanese government’s Green Purchasing Network (GPN) to learn more about environmentally preferable purchasing and to share product information. More information about GPN can be found at <http://www.wnn.or.jp/wnn-eco/phne>.

CONCLUSIONS

By 2002, when Earth Summit III reviews general progress toward sustainability, more and more developed countries and multinational companies plan to present and discuss specific concrete results –demonstrating that product innovation and eco-efficiently operating companies have had an effect on the performance of the economy on the macro level. To confirm this, the issues monitored and reported on the micro- and macro- levels must fit together, and such information must be available from major parts of the economy, both the private sector and communities. The eco-efficiency indicators, as proposed by the WBCSD, are the best tool for meeting the requirement.

Governments have a role to play in helping to spread the application of eco-efficiency globally. They have the means to promote and accelerate the process of change by and within business. The responsibility is on them to provide free and open markets which enhance the willingness of companies to increase their eco-efficiency. Restrictions and barriers, however well-intentioned, will be counter-productive from both environmental and economic points of view.

Companies have found out that the more they work on resource productivity, the greater the potential and the bigger the gains that can be achieved. As is often the case, the limitations are very much in our own minds, and whether or not we make a real dedicated effort to reach the potential that the eco-efficiency concept promises. Long-term objectives like factor 4 and factor 10 that have been proposed by some have, so far, limited analytical underpinnings and should be seen more as expressions of ambitions. The future prospects of eco-efficiency are substantial, but it is difficult to judge its ultimate potential. However, eco-efficiency firmly places us on the journey toward sustainability.

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7. ECO-DESIGN TOWARDS GREEN PRODUCTIVITY

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ABSTRACT

Hitachi is dedicated to emphasizing environmental considerations in all aspects of its products' lifecycles from design to disposal after use. Our goal is eco-design towards Green Productivity. We have thus incorporated life cycle assessment (LCA), disassembly evaluation (DEM) and recyclability evaluation (REM) methodologies into our product design process to achieve this goal. This paper outlines Hitachi's approach to eco-design and the application of the aforementioned methodologies to product design. Hitachi is actively promoting the transfer of these eco-methods (so-called "green-technology transfer") to the Asia-Pacific region.

INTRODUCTION

In order to achieve a sustainable economic system, industries must improve their Green Productivity (GP). Industries that can realize GP, which is defined as "a strategy for enhancing productivity and environmental performance for overall socio-economic development," will enhance their international competitiveness. Many Japanese industries are now incorporating GP concepts into their products by applying eco-design concepts to upgrade eco-efficiency. In line with the establishment of a corporate environmental management system, Hitachi has developed methodologies for life cycle assessment (LCA), disassembly evaluation (DEM) and recyclability evaluation (REM) to support its eco-design initiatives. This paper describes some examples of Hitachi's eco-design work and explains how these technologies are being transferred to the Asia-Pacific region.

THE RELATIONSHIP BETWEEN PRODUCTS AND THE ENVIRONMENT

Our economic system has been created by mass production and mass consumption. Therefore, to establish a sustainable economic system, we must consider product manufacturing from the viewpoint of the relationship between products and the environment. For example, manufacturers must use recycled materials to reduce the amount of unnecessary material consumption and must also manufacture products using fewer parts. It is also necessary to reduce the amount of waste by extending the life of products. Discarded products should be carefully sorted into their constituent materials at the point of recycling with the goal of returning materials to the manufacturing plant as

recycled materials. In addition, the parts of the discarded products should also be reused. Establishing a sound product circulation loop integrating concepts of reduction, reuse, and recycling can solve many global environmental problems, such as global warming, ozone-layer destruction, water and air pollution, excess waste, and depletion of resources.

In Japan, the principles of reduce, reuse, and recycle are now called the 3Rs and are the basis for creating a sustainable economic society. Note that the manufacturing plant is the starting point of the recycling loop that integrates the 3Rs into the economic system, and also note the overall importance of eco-design to achieving sustainability.

There are also many laws and standards which are relevant to eco-design. A product must be designed to meet domestic and international regulations which incorporate both safety and environmental protection. Landfills are now full, especially in metropolitan areas in Japan, and decreasing the amount of waste generated is an urgent national priority. To control the generation of waste and promote the creation of a recycling-oriented society, extended producer responsibility (EPR) was introduced into the “Basic Law for Promotion of a Recycling-Oriented Society” (enacted in May, 2000). This law stipulates that companies are responsible for the total life cycle of their products, which makes the eco-design of the products the most important stage in the production chain. In addition to domestic pressures, ISO/TC207, which is examining international standards of environmental management, is planning to publish a technical report on Design-for-the-Environment (DFE) by December 2001 to serve as a guideline for integrating environmental aspects into product development.

In considering the relationship between companies and society, there are two important activities for a “green” company. The first is to establish an environmental management system in compliance with the laws and use eco-design methods like life cycle assessment (LCA) and green product assessment to produce eco-friendly products. The other is to communicate with society in developing a green business by providing stakeholders with environmental information such as eco-labels or environmental reports. Such activities can be improved by cooperation with Asian Productivity Organization (APO) and Green Productivity Association activities. Enterprises that become involved in these activities will become “green” companies and will survive in the global market.

ENVIRONMENTAL ACTIVITIES AT HITACHI

There are three core areas of environmental activities. The first one is the “creation of green products”, also described as designing products to solve environmental problems. The second is “environmentally friendly production” which means taking environmental considerations into account during manufacturing. In establishing the corporate environmental management system, all of the Hitachi group received ISO 14001 certification. The third is the “development of environmental technologies to contribute to the world’s socio-economic well-being.”

To integrate all these environmental activities, Hitachi has written an environmental charter covering all members of the Hitachi group. Its basic principles are: “contribute to society, conduct corporate activities in a fair and open manner, and promote harmony with the natural environment.”

Hitachi’s organizational structure reflects the importance of environmental activities in Hitachi’s business. The senior executive committee for environmental policy

is comprised of board directors, the group presidents, and CEOs. This committee reports to president and director Etsuo Shoyama and is responsible for top-down implementation of policies affecting both production facilities and affiliated companies through the environmental management operational committee. The environmental management policy office, corporate manufacturing engineering, and environmental policy department serve as the coordinating body to promote the three core areas of Hitachi's environmental activities.

ECO-DESIGN METHODS

The basic principle of eco-design consists of three elements based on the lifecycle of a product (Yamamoto, 1999). The first element is the cost of the product, which represents economic value. The second element is impact, which represents environmental value and the influence on the global environment through global warming, ozone layer destruction, and depletion of resources. The third is performance, which represents consumer satisfaction and is related to safety, benefits, and convenience. The integrated value of an eco-design product is the total of cost, impact, and performance. A product's eco-efficiency is measured by dividing the value of performance by impact. Until recently, products have only been evaluated against the ratio of their performance divided by cost, which fails to recognize the impact of the product. However, it is a basic principle of eco-design that we must maximize the value of the ratio of performance divided by the multiple of cost and impact.

In applying eco-design to the design process, the product is assessed twice in terms of its environmental aspects. The first assessment follows completion of the initial product design. Environmental aspects are assessed a second time after confirmation of product quality and performance through tests of prototypes. If there is a problem at either assessment stage, the design process stops and repeats the previous stage. Furthermore, market information on products already sold in the market is utilized to improve the design of the product.

There are currently six evaluation methods and five tools in the current eco-design process (Yamamoto, 1999 – see Table 1). Generally speaking, the most popular methods in Japan are the checklist method for qualitative evaluation and life cycle assessment (LCA) for quantitative analysis. Both are practiced at Hitachi. These methods use the following tools: guidelines for eco-materials selection; chemical management for pollutant release and transfer registration (PRTR); disassemblability evaluations (DEM); recyclability evaluation (REM); packaging guidelines; and the ISO14000 series. “Eco-assist”, a software sold by Hitachi, is used in eco-design and incorporates EMS, LCA, and DEM/REM.

PRODUCT ASSESSMENT CHECKLIST

An example of a Product Assessment Checklist is shown in Figure 1. The checklist helps designers evaluate a product according to various assessment categories. As part of the process, the designer evaluates whether the new product is superior to the previous model in terms of environmental considerations. There are eight assessment categories,

and a maximum of five points are given for each category. A score of two points indicates that the environmental impact is the same as that of the previous product. The eight categories are: product weight, length of product life, recyclability, disassemblability, ease of treatment, environmental conservation, energy efficiency, and internal/external communication. A standard personal computer is used to carry out the assessment and the results are shown as a radar chart.

Table 1. Eco-Design Methodologies and Tools

Methodologies	Tools
Checklist for product assessment - Qualitative assessment	Guideline for eco-material selection
DfX-CAD - Combining CAD and individual modules	Management for pollutant release and transfer registries (PRTR)
LCA - Quantitative assessment of environmental impact through the life-cycle of products	DEM/REM
MIPS	Packaging guidelines
Back casting	ISO 14000 series (ECO-ASSIST)
Macro-approach - On-site environmental management system	

Three additional components are used to support a checklist assessment. The first is an eco-material selection guideline to reduce the environmental impact of product disposal and make it easier to recycle products. The second is chemical substance management guidelines and activities. The third is the use of DEM/ REM to evaluate product disassemblability and recyclability. These components are discussed further in the following sections.

ECO-MATERIAL SELECTION GUIDELINES

Hitachi uses eco-material selection guidelines for key raw materials such as plastics. The plastics presently used by Hitachi are graded A through D based on the following factors: energy consumption, cleanliness, recyclability (e.g., appearance, molding, and regenerative properties), material properties (non-halogen, flame retardant, high-temperature use, etc.), and cost. Materials are evaluated with respect to future environmental impact. A and B grade plastics are deemed as usable, while C and D grade plastics are considered problematic regarding environmental factors. For example, the best studied plastic in the eco-material guidelines is PVC. Although PVC is valuable as a by-product of caustic soda preparation, it causes problems when burned. It is thus rated as a D-grade molding material until cleaner incineration technologies can be developed.

Figure 1. Sample Checklist

			Evaluation							Remarks	
Items		performance	Old	New	1	2	3	4	5		
			1st	2nd							
Smaller products											
?	Smaller ? Less area ?	m3 m2				up	same	<10%	<20%	≥20%	Evaluated by reduction %
?	Less weight ?	kg		3	3	up	same	<10%	<20%	≥20%	Evaluated by reduction %
Higher reliability											
?	Parts reliability	Successful %		2	3	down	same			up	
?	Materials reliability	Successful %		2	2	down	same			up	
Reduction of packaging compared with old product											
?	Smaller, lighter carton ?	m3		3	3	up	same	<10%	<20%	≥20%	
		kg	2	2	3	up	same	<10%	<20%	≥20%	
?	Less styrene foam?	m3		2	2	up	same	<10%	<20%	≥20%	
		kg	2	2	2	up	same	<10%	<20%	≥20%	
?	Smaller, less wooden flame ?	m3		2	2	up	same	<10%	<20%	≥20%	
		kg	2	3	3	up	same	<10%	<20%	≥20%	
?	Less polyethylene coverage ?	kg		2	2	up	same	<5%	<10%	≥10%	
Less production waste											
?	Wastes from production stage	kg		3	2	up	same			down	
Total average			2.0	2.3	2.4						

ACTIVITIES TO CONTROL CHEMICAL SUBSTANCES

Hitachi classifies potentially environmentally hazardous chemical substances into three classes for voluntary control. Class 1 and 2 chemical substances are covered by voluntary action plans to either reduce or eliminate use. Class 3 substances are controlled by laws on pollutant release and transfer registries as well as publication of material safety data sheets (MSDS).

An internal network for chemical management based on these classes has been developed to assist Hitachi staff in eco-design (Figure 2).

EVALUATION OF EASE OF PRODUCT DISASSEMBLY AND RECYCLING

For a product to be environmentally friendly and easy to recycle, it is important to not only develop recycling techniques, but also to design the product in such a way that it is easy to recycle. Accordingly, recycling-compatible design means selecting materials and designing structures that facilitate the collection, disassembly, sorting, and recovery of product components.

Hitachi has developed DEM and REM to quantitatively evaluate the ease of disassembly and recyclability of new products. An example of DEM is shown in Figure 3. After the basic product design is completed, the disassemblability is evaluated using Hitachi's DEM. If the evaluation is satisfactory at the first stage, detailed design work is started. Once the more detailed design is completed, DEM is repeated. If the detailed design is judged as satisfactory, the first sample is made and mass production is started. However, if the design is determined unsatisfactory, it must be improved before production can begin. In the example in Figure 3, the calculated disassemblability time of an automatic washing machine shows that the disassembly time is reduced by more than half by adopting the "front-opening" design. Therefore, DEM/REM can also be used to improve design.

LIFE CYCLE ASSESSMENT (LCA)

LCA is a means of deriving a quantitative evaluation of product design and thereby refining product quality and characteristics. In addition to its use in new product design, LCA is increasingly regarded as a useful technique for evaluating products already in use. LCA analyzes the total impact of a product on the environment from extraction of the raw materials that go into the product through manufacture, usage, and final disposal.

The steps in conducting an LCA are: definition of goal and scope; inventory analysis; impact assessment; and interpretation of results. Inventory analysis of LCA involves data collection and calculation procedures to quantify relevant inputs and outputs of a product system. The impact assessment phase of LCA is aimed at evaluating the significance of potential environmental impacts by using the results of the life cycle inventory analysis.

Figure 4 depicts the LCA system implemented at Hitachi. The system uses a standard personal computer to quantitatively calculate resource consumption and environmental discharges. Using a refrigerator as an example, the results of an LCA on

Figure 2. Network System for Chemical Management

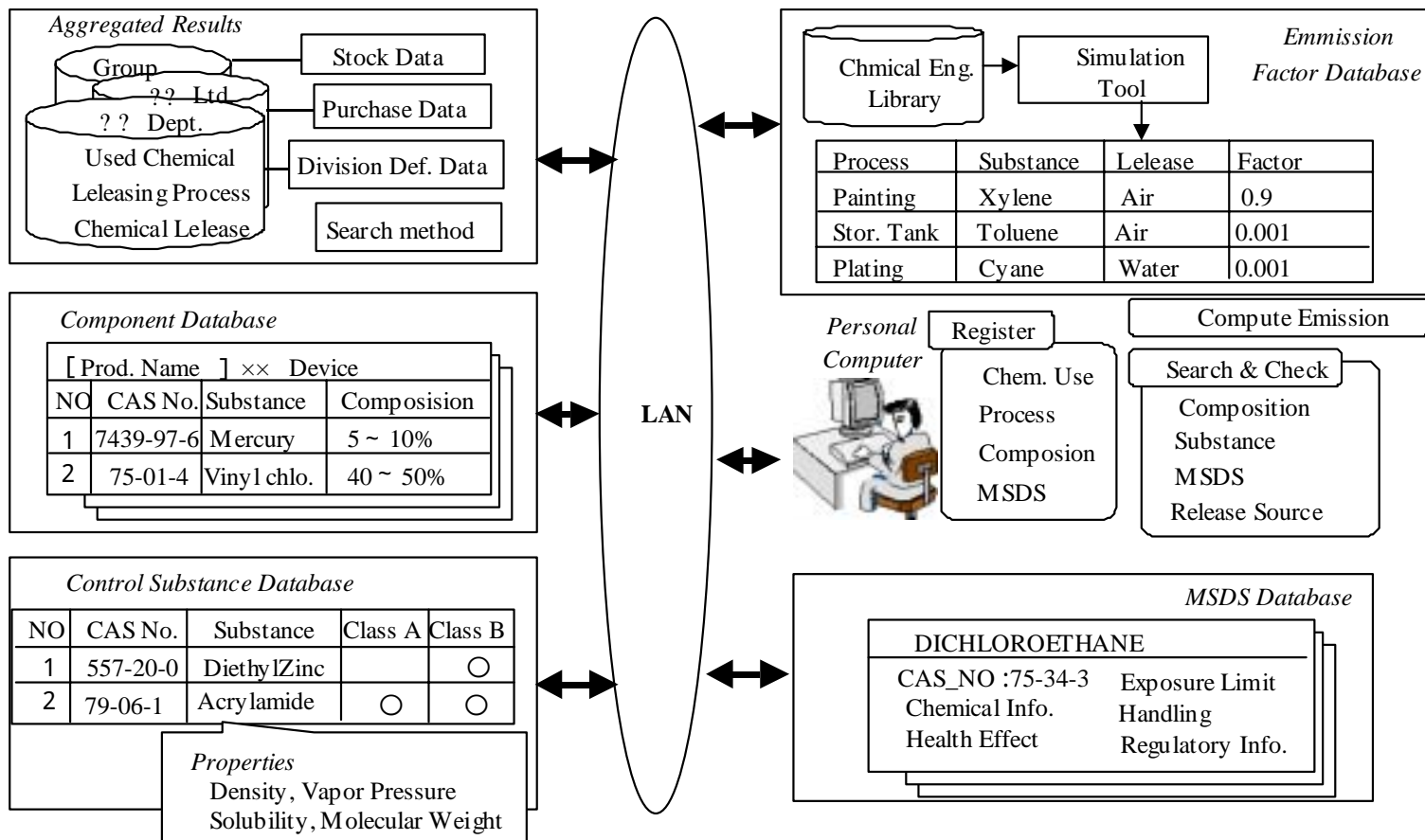


Figure 3. DEM Assessment of Washing Machine

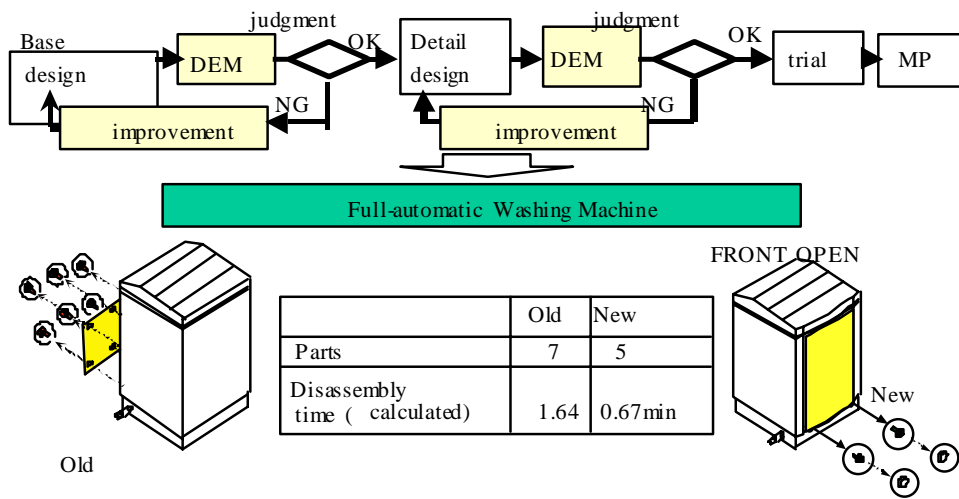
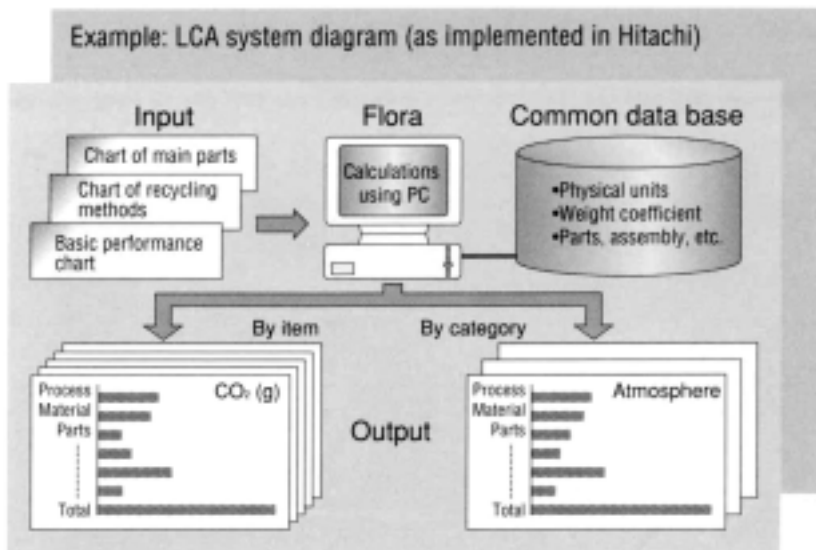


Figure 4. Hitachi LCA System Diagram

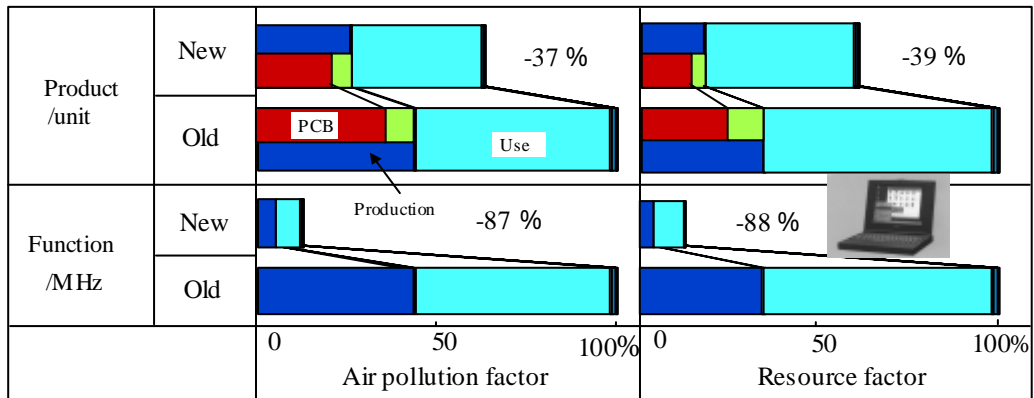


CO₂ discharge showed that most of the energy consumption during the life cycle of a refrigerator occurs during usage. As a result, energy-saving features have to be incorporated at the design stage.

Hitachi is doing this and is also making products that weigh less and last longer. The LCA results have been used in the development of a new type of eco-design refrigerator that reduces electricity consumption.

Figure 5 shows the LCA of a personal computer. It shows the air pollution factor and impact on resource depletion. It is clear that PCs have a significant environmental impact during both the production and usage stages. This LCA helped Hitachi design a new type of PC with lower environmental impact (37-39 percent per unit product and 87-88 percent per unit function) in both production and usage.

Figure 5. LCA of a Personal Computer



ECO-DESIGN PRODUCT EXAMPLES

Hitachi has already registered a number of eco-design products, and Figure 6 shows an example of Hitachi's eco-design refrigerator. As shown in the figure, by using a spiral fin condenser instead of a pulse fin condenser, the freezing cycle is simplified which reduces the disassembly time. In addition, the new model uses pulse-amplitude modulation control to save energy, minimize noise, and decrease freezing time. The use of PVC plastic is also reduced. The refrigerator's environmentally friendly design reduces disassembly time by 56 percent, increases recyclability by 48 percent, decreases amount of styrene foam packaging by 56 percent, and improves energy savings by 30 percent. The design received an Energy Conservation Program award from Japan's Ministry of International Trade and Industry (MITI).

Figure 7 shows another example of an eco-design product: a laptop computer. In the eco-design of this PC, the number of circuit boards was reduced, energy consumption was reduced by 34 percent, weight was reduced by 47 percent, and 90 percent of the metal parts are recycled.

VOLUNTARY ACTIONS IN THE JAPANESE COMPUTER INDUSTRY

In addition to actions by individual companies such as Hitachi, the Japanese computer industry as a whole is becoming more involved in eco-design. 40 kilotons of old personal computers (PCs) were discarded in Japan in 1999. Of these, 75 percent came from businesses and 25 percent from private users. It is estimated that the amount of waste PCs will increase to 100 kilotons in 2005 with business PCs accounting for 70

percent of this amount. It is thus clear from this trend that the industry should be more proactive in addressing the disposal of old PCs.

Figure 6. Hitachi Eco-Design Refrigerator

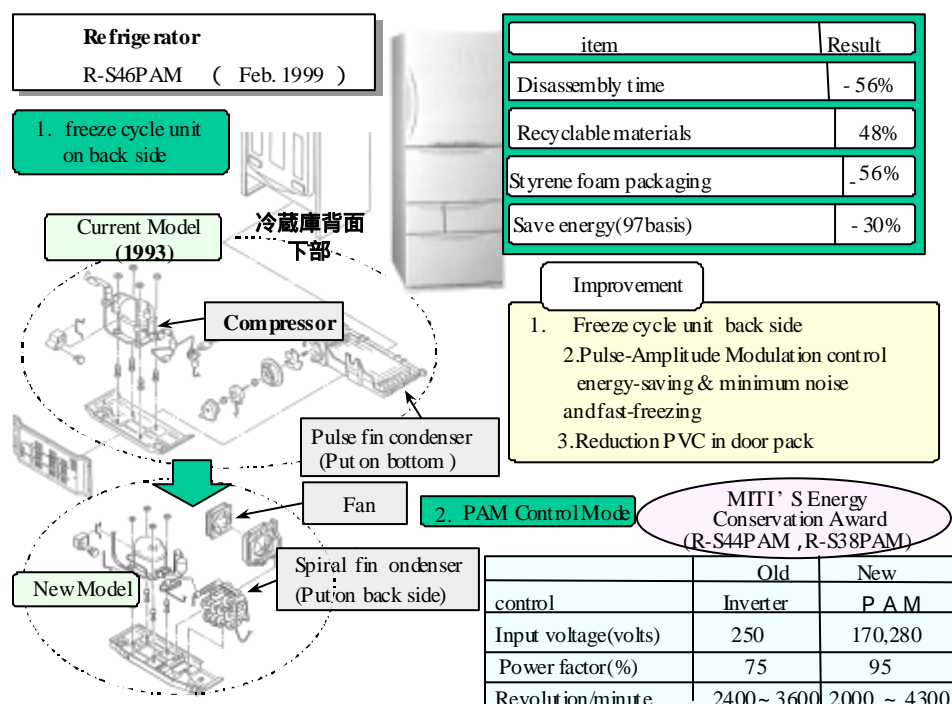
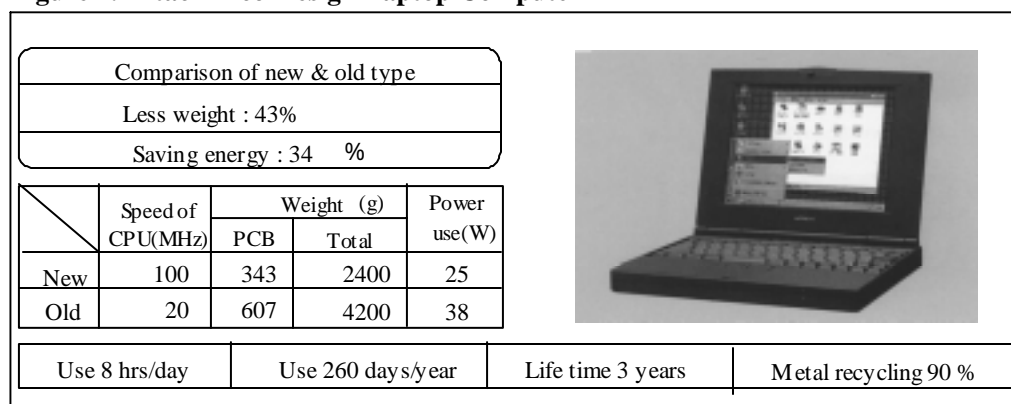


Figure 7. Hitachi Eco-Design Laptop Computer



The Japanese Electric Industry Development Association (JEIDA) has been promoting the 3Rs concept as a voluntary action plan. They are encouraging companies to reduce by-products (including packaging), reuse parts, and improve recycling of materials and thermal recovery. To promote the 3Rs concept, resolving the logistics of the

“take-back” of used products is important, and industry needs to establish goals and targets for the 3Rs. This voluntary action plan has been approved by 22 Japanese PC makers and related companies.

GREEN TECHNOLOGY TRANSFERS FROM JAPAN TO ASIA

One of the roles of Japanese companies is to promote Green Productivity in the Asia-Pacific region. Therefore, transforming eco-design towards Green Productivity is important. Hitachi is actively promoting GP technology transfer by inviting designers to come to Japan. Hitachi holds seminars and training programs on eco-design covering EMS, LCA, DEM/REM, chemical substance management, lead-free soldering, and PC weight reduction design. It is hoped that when these designers return to their countries with a better knowledge of eco-design technologies, they will promote these technologies throughout the Asia-Pacific region and help establish a sustainable economic society. To achieve this technology transfer, the support of Asian Productivity Organization is essential.

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8. ENHANCING THE COMPETITIVE EDGE THROUGH COOPERATION BETWEEN LARGE FIRMS AND SMEs: THE CENTER SATELLITE FACTORY SYSTEM IN THE REPUBLIC OF CHINA

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ABSTRACT

The Center-Satellite (C-S) System has successfully developed strategic alliances between large firms and small and medium-sized enterprises (SMEs) in the Republic of China (ROC) over the past fifteen years. The majority of SMEs in the ROC face significant constraints in terms of their research and development (R&D) capacity, management capability, and the availability of human and financial resources. Therefore, stimulating inter-firm cooperation to achieve the necessary economies of scale to overcome these challenges, especially in the face of strong global competition, is a key to maintaining overall national competitiveness. The effective implementation of the C-S system has been an integral part of the ROC's economic miracle. The C-S system is an industrial management program through which the government provides technical and managerial assistance to support the development of participating companies. Topics discussed in detail in this paper include: (1) the definition of the C-S system; (2) the strategic thinking behind the development of the system; (3) the C-S strategic plan; and (4) the mechanism and measures for implementing the C-S system. A case study from Royal Information Electronics Co. is used to further illustrate the implementation processes and resulting benefits. Due to the broad success of the C-S system, the Corporate Synergy Development Center has been commissioned to develop and execute the ROC's new Manufacturing Cooperative Competitiveness Plan. The new plan will involve extending the strategic vision and objectives of the C-S system from cooperative factory networks to cooperative supply chain networks.

INTRODUCTION

The Republic of China's (ROC) economic miracle is the story of how a small country became an economic power. This transformation was achieved through: 1) the cooperation between small and medium enterprises in capitalizing their strengths and exploiting their export potential; 2) the consistent and persistent measures taken by the government to build a strong industrial base for advanced economic development.

Analyzing the ROC's development trajectory, there are six phases which can be identified. The first phase in the ROC's economic evolution was during the 1940's. It was

the period of reconstruction where infrastructure was rebuilt and land reform and numerous industrial projects were implemented. The second phase began in the 1950's and was the decade of developing the ROC's consumer commodity industries. The deficit was reduced by import substitution, and foreign exchange was generated through various exports. The period of rapid growth occurred happened during the 1960's when the triple strategies of import substitution, export expansion, and encouragement of upstream manufacturing industries were brought together. The strong performance of the ROC's export processing zones is one of the noted examples of this phase.

The decade of the 1970's saw the development of supporting infrastructure and capital intensive industries. Policies were used to reinforce the ROC's infrastructure, market base, and manpower pool. Ten major national construction projects were launched and completed. The phase of the development of technology intensive and high-tech industries followed in the 1980's. To speed up industrial changes, industrial parks were established, and R&D activities and strategic industries were encouraged through generous incentives. During this time, the Center-Satellite System was established.

Finally, the decade of the 1990's saw the continuation of the evolution of the ROC's industrial structure. The government sought to add value the industrial structure to help improve the quality of living in the ROC through combining upgraded industries with national development plans. Companies were motivated to upgrade quality, competitiveness, and environmental performance.

The ROC's economy is dominated by SMEs, which account to almost 98 percent of the total number of manufacturing enterprises in the country. They also contribute 50-55 percent of the ROC's exports and employ 70-80 percent of the labor force. They are relatively weak in terms of management, research and development, marketing, and financial capacity due to their small size, and are unable to achieve the scale required to compete globally. Chinese culture tends to motivate individuals to establish their own companies and become their own boss rather than work for large enterprises. Therefore, it is unlikely that the dominance of SMEs in the industrial structure will change in the short term. As a result, a system to forge alliances among SMEs to enable them to compete with global enterprises is needed to support the SME sector. As businesses are increasingly crossing national, and even regional, boundaries in their pursuit of markets, cooperative alliances may become the only way for SMEs to survive. The Center-Satellite System implemented by the Corporate Synergy Development Center (CSD) is a mechanism to address this need and has already demonstrated significant results.

STRATEGIC THINKING

In developing a program, three aspects must be considered:

Network size vs. Firm size:

Networks are the most logical way to attain economies of scale for competitive purposes. In a network, cooperative enterprises can spread expenses among more products and services. Otherwise, individual exporters have to bear higher overhead expenses for things such as marketing that must then be added on to the final prices.

Inter-firm vs. Intra-firm Assistance:

The C-S System is the most efficient way to upgrade enterprises to retain a comparative edge. Assistance packages must be provided to the C-S network to upgrade both the individuals and the whole. Thus, the center and the satellites are motivated to cooperate. From the government's viewpoint, providing inter-firm assistance is more practical, manageable, and less expensive than offering intra-firm assistance.

Cooperation vs. Competition

The C-S System fosters teamwork and cooperation to avoid destructive competition and maintain long-term competitiveness for the companies. The goal is to let satellite firms see themselves as allies with shared visions and goals. Once established, this interdependence allows the whole system to be simultaneously upgraded.

WHAT IS THE C-S SYSTEM?**Definition**

The definition of the C-S System is “an industrial management program that strengthens the SME dominated industrial structure and renders it internationally competitive via the formation of cooperative networks, through the development of comprehensive assistance packages supported by the government.”

There are several factors that are key to creating a successful C-S program. Since it is an industrial management program, it must be tailored to fit the specific industry background of the participants as well as the local culture. The C-S program in the ROC has been adapted to fit Chinese culture, and is consistent with local values and beliefs. A C-S system seeks to stimulate symbiotic and cooperative alliances among the center firms and their satellites. Overall success is tied to the sharing of responsibilities and benefits, as well as cooperation toward reaching the common goal. The government provides comprehensive technology management (also called techno-managerial) assistance packages, and provides a mechanism for upgrading all aspects of the businesses. In the initial stage of program development, the government appoints a competent organization to oversee implementation. The people who handle this process must be experts in the fields of science and industrial management. It should have a staff of production engineers and experts in quality control, financial management, and environmental experts, etc. Since business and management are dynamic fields, there should be a research and development unit managed by experienced professionals. Finally, the program must be linked to appropriate financial and fiscal incentive measures to attract participants. Program growth will depend heavily on these incentives, and industrial policy makers should seek full support from all government agencies.

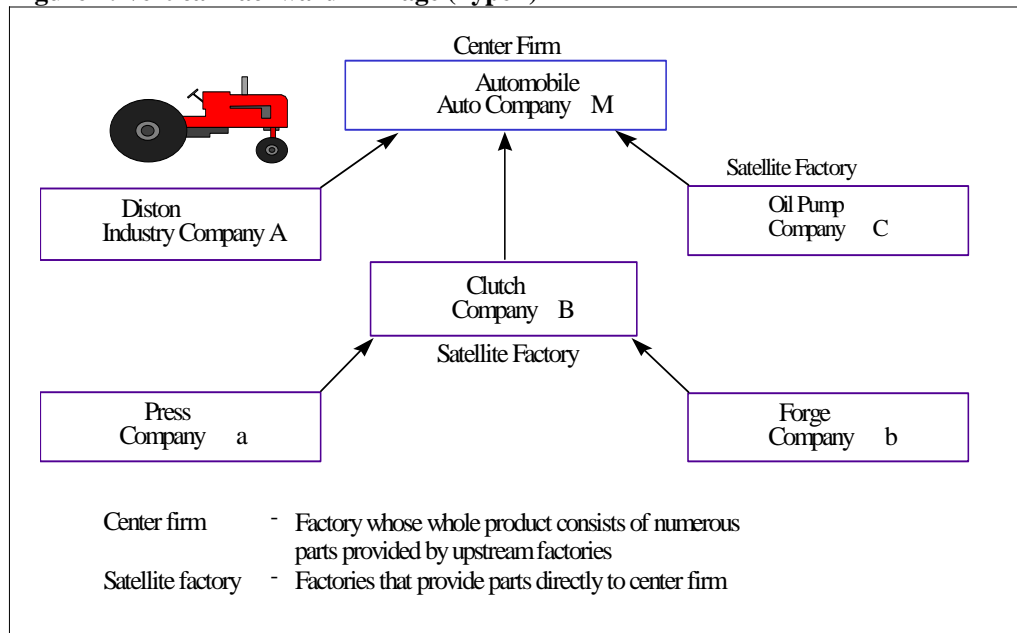
Types of C-S Systems

Assistance packages are tailored to fit the unique needs of each C-S network. Since industrial chains are highly complex, they are usually broken down to upstream, midstream, and downstream industries. In the ROC, three types of C-S System frameworks have been developed.

Type I: Vertical Backward Linkage

Type I is a system where the central firm is the down-stream assembler who produces the final product, whose components are supplied by midstream satellites. The Center Factory is influenced by the quality, cost, and delivery time of the satellites' products (Figure 1).

Figure 1. Vertical Backward Linkage (Type I)



Type II: Vertical Forward Linkage

In Type II systems, the upstream or midstream material producer or supplier is the center, and the satellites are midstream or downstream users who are customers of the center firm (Figure 2). In this case, quality and price of the raw materials have a strong impact on competitiveness.

Type III: the Horizontal Linkage

In Type III systems, the center firm is a trader or exporter, and the satellites are the SMEs that manufacture the materials sold (Figure 3).

Figure 2. Vertical Forward Linkage (Type II)

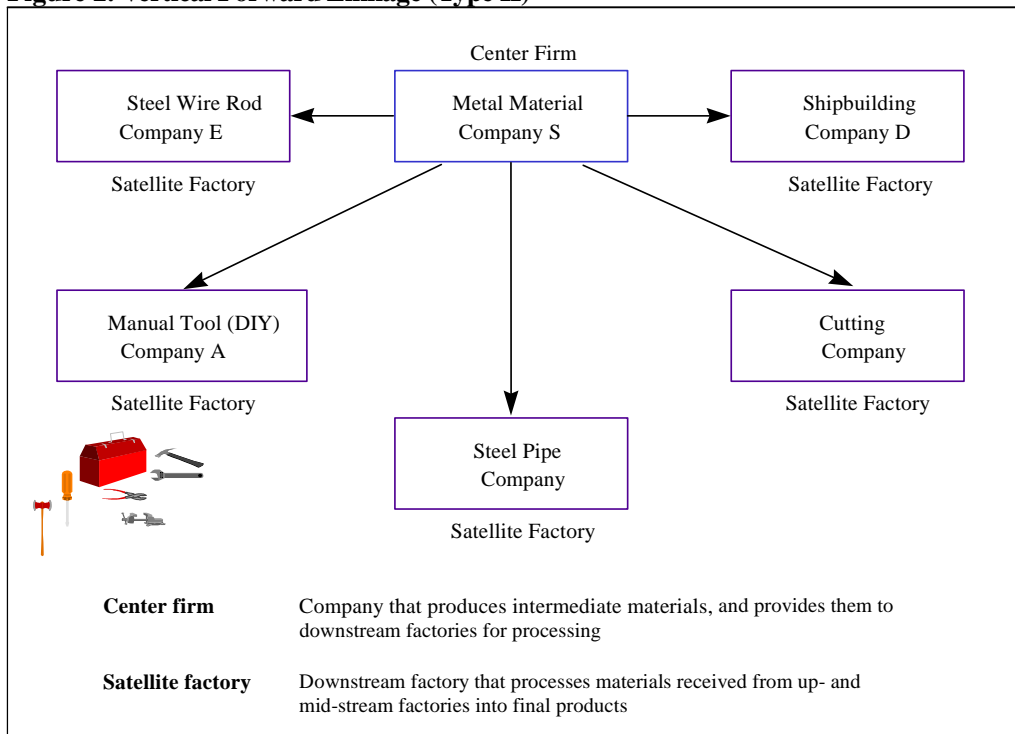
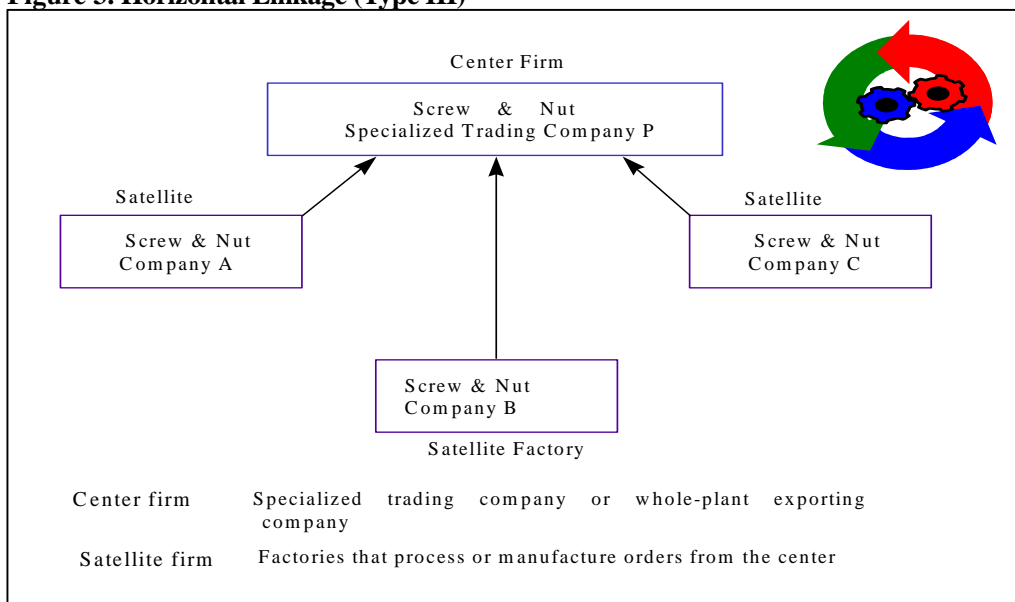


Figure 3. Horizontal Linkage (Type III)



THE C-S SYSTEM STRATEGIC PLAN

C-S Vision

The C-S System is an assistance program that to maintain the ROC's status as a world class producer and is key to *"building a complete and vibrant industrial infrastructure."*

C-S Mission

The C-S System is being used to improve the ROC's industrial infrastructure by several methods. First, the system enhances cooperation within industry and also between government and industry. Second, use of the system rationalizes the production and marketing activities of local industry and adds professional guidance and assistance. Other goals of the system include the upgrading of quality management, maintenance of industry networks, and promoting teamwork.

Objectives

The primary objectives of the strategic plan can be described as follows:

- Upgrade the level of product and service quality to improve ROC industry's international image;
- Enhance business productivity and profitability;
- Cultivate long term, mutually trusting relationships within the cooperative network; and
- Accelerate awareness about industrial policies through efficient channels.

Management Philosophy

The spirit of C-S can be summed up in the following slogan: "United we stand, divided we fall. Together, we shall be the leader." Introduction of the C-S System encourages cooperation among firms to attain common objectives. However, while each member is expected to work in a symbiotic manner, the failure of one member will not ruin the rest of the network.

Operational Strategies

Establishing a responsible organization

The ROC government strengthened the C-S System implementation structure by establishing the Corporate Synergy Development Center in partnership with the private sector. The involvement of the private sector has made the system more bottom-line oriented, and capable of quickly responding to industry needs.

Developing a functioning system

The implementation consists of three areas outlined below:

1. Developing program content and structure

An inter-agency committee of related organizations' representatives helps guide the IDB (Industrial Development Bureau) Executive Secretary in implementing the program. Involvement of organizations representing multiple stakeholders helps ensure

widespread dissemination of information regarding the program. Figure 4 depicts the implementation process.

Within this process, there are a number of tasks to be undertaken, including:

- Developing promotional strategies and policies for the C-S System;
- Forming expert groups;
- Undertaking actions to maintain the long-term sustainability of system operation;
- Presenting awards and organizing quality management competitions; and
- Initiating technology exchanges and study visits.

Tasks are undertaken with to accomplish the following objectives:

- Attracting businesses to participate in the C-S program;
- Developing a C-S program appropriate for local manufacturers;
- Accelerating the use of the C-S System through efficient distribution of resources;
- Strengthening cooperation among satellites and upper, middle, and downstream industries; and
- Upgrading the image of ROC products and generate quality awareness within business.

By the end of 1999, 190 companies from 24 different industry sectors had served as center firms and 3,105 factories in total had registered as part of a C-S system.

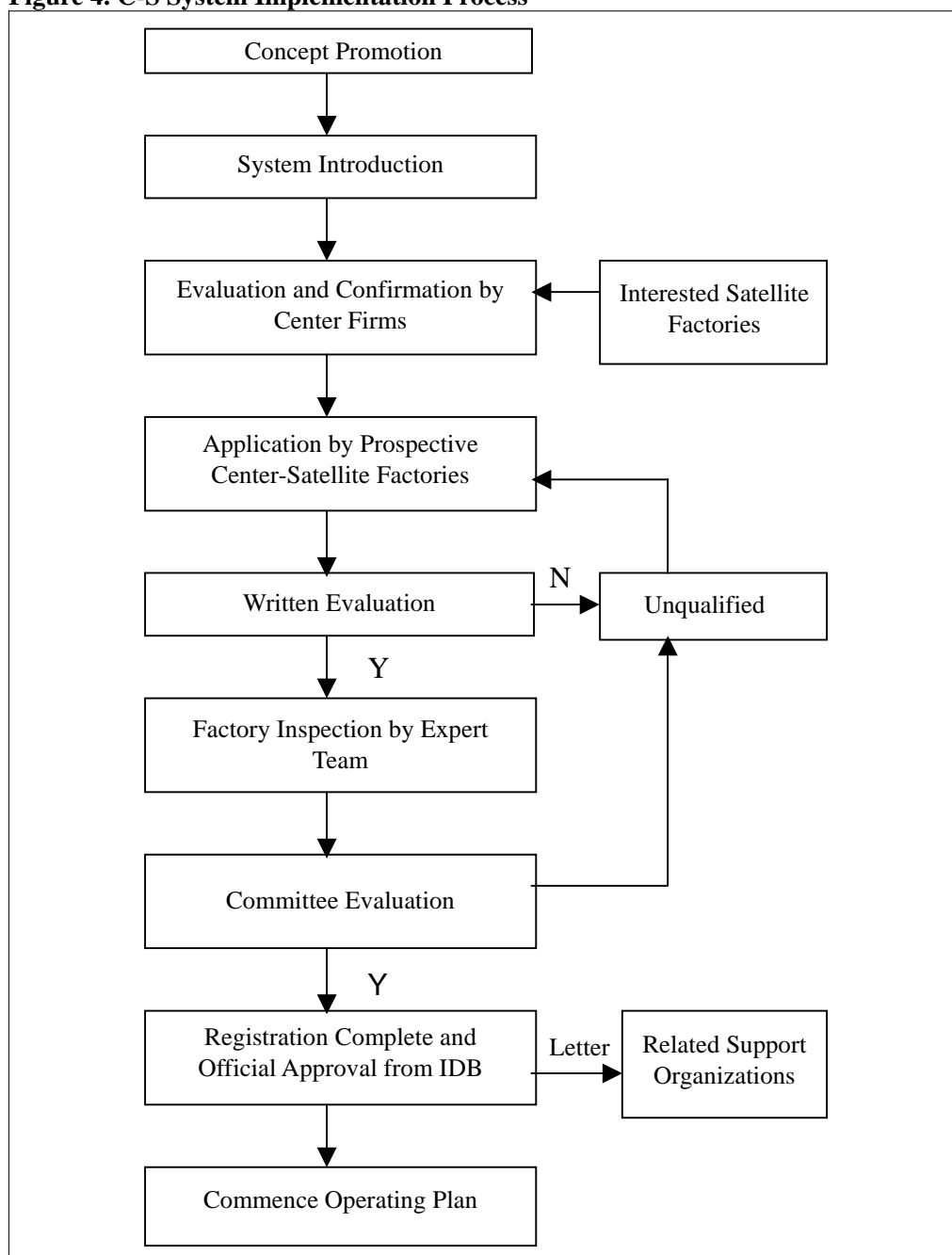
2. Establishing system parameters

There are three key issues in establishing a system model. The first issue is to establish the criteria to qualify potential center and satellite factories. Important criteria include: availability of sufficient capital, high annual turnover, production and marketing economies of scale, a healthy financial position, use of management, accounting, and a quality control system. The center factory will enter into long-term purchasing contracts and provide guidance to the satellites. Secondly, the obligations of the center and satellite factories are to ensure a stable supply and demand situation, engage the services of experts to assist satellites, and jointly develop international markets. Satellite factories must have consent before disclosing or selling any technologies provided by center firms and have a general responsibility not to disclose any confidential information related to the center firm. Third, the C-S System goals are to establish strong internal management systems, improve the financial position of the satellites, obtain ISO or other certifications such as the CNS mark for quality, and accelerate business growth for all participants. Many of these mutual dependencies will be incorporated into contracts between the firms.

3. Building model C-S systems

It is impossible to cover all industrial sectors and enterprises. Therefore, the government seeks to develop several model C-S Factory Systems in different industry sectors in each of the three types of C-S arrangements. Significant achievements are publicized and outstanding C-S Factory Systems receive awards for their achievements. Exchange or study visits to model systems are encouraged to share experiences.

Figure 4. C-S System Implementation Process



Integrating resource and assistance packages

Business success depends on numerous factors. To successfully upgrade industries to a world-class caliber, it is imperative to provide comprehensive and integrated programs on all the aspects related to business success. If these services are already

available or readily developed, then the next step is to integrate services and assistance into a single package.

Measures

Implementation

1. Application procedure to join the C-S program

Firms must undergo a screening process including a review of a written application as well as an on-site evaluation by experts. The review process provides the implementation teams with a thorough analysis of the firm's likelihood of success as well as remedial measures likely to be needed if a team is not fully rejected. If companies are not accepted, they can re-apply after instituting improvements on their own which provides an incentive for companies to upgrade their internal operations. Firms can obtain evaluation reports to help develop their own improvement plans and better prepare themselves for competition in and from the international market.

2. Procedures for designing the C-S improvement plan (see Figure 5)

The next step is to develop the C-S Improvement Plan. This is a strategic plan designed to upgrade the entire network as well as the individual firms. From the macro-analysis of the external and internal conditions affecting the industry using the Strength-Weakness-Opportunities-Threats model, the position for domestic industry as a whole and the specific network are determined. The vision and long-range goals of the center factory are distilled to drive the medium and long term plan. This becomes the basis for the preparation of the annual operation plan for the center and satellite factories.

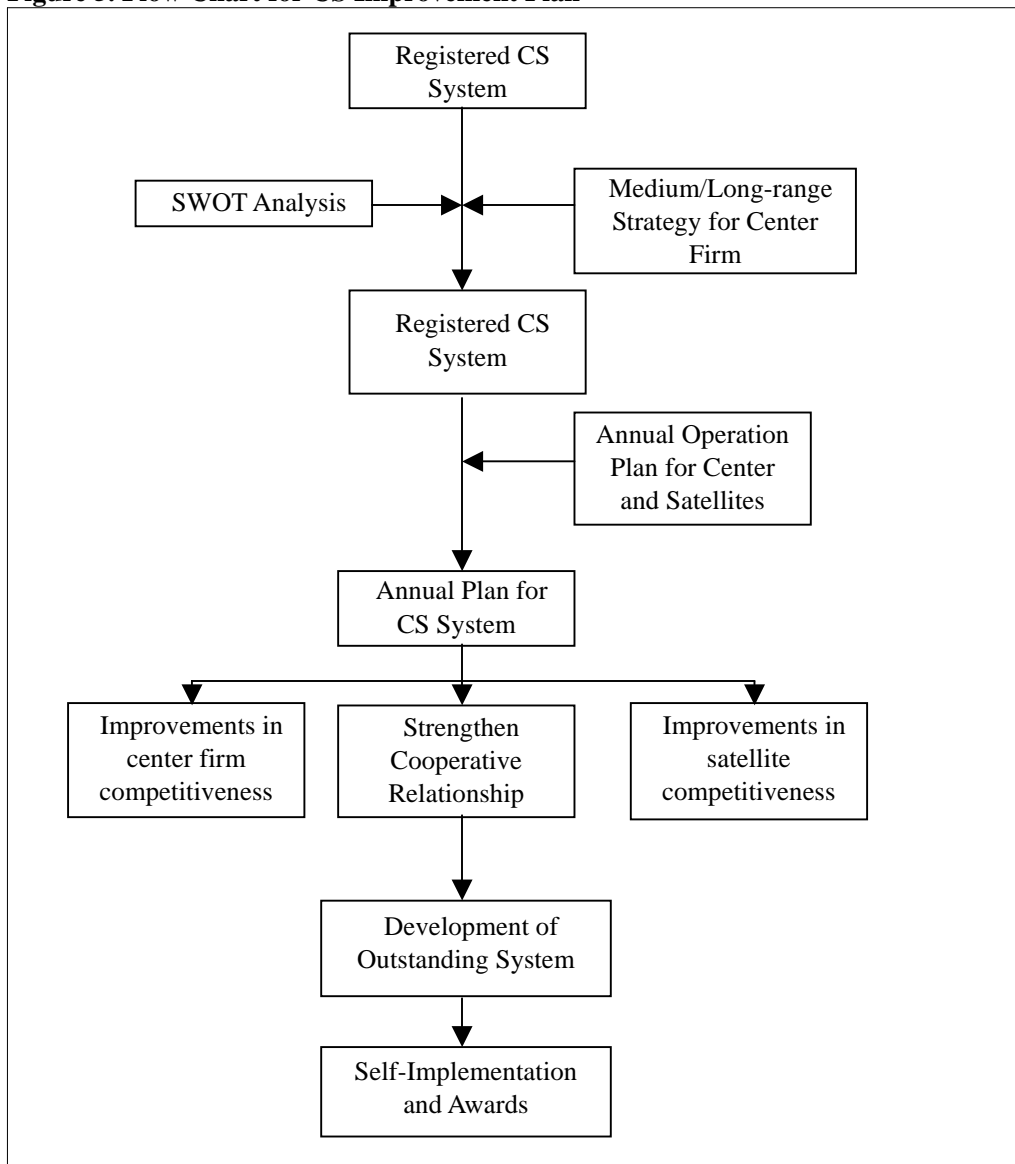
Conducting continuous training and education

Timely and accurate information will help industries coordinate with the ROC's economic agenda, which forms the underpinning of the CSD's planning. The CSD provides the following services:

- Conducting company training sessions;
- Assisting individual firms to develop their own training programs;
- Organizing study visits;
- Introducing foreign training programs to local companies; and
- Training personnel from foreign countries.

CSD provides training on a wide range of subjects including macro-economic policies and trends and market updates. Our programs on international developments cover areas such as R&D, technology developments and trends, management tools, and new production techniques for industrial growth.

Figure 5. Flow Chart for CS Improvement Plan



Establishing an association

Once the government support is withdrawn, the internalization of the program within the network itself is crucial. This is achieved through the formation of a Systematic Association that closes the gap between the center and satellite firms. The following addresses the functions and activities of the C-S Systematic Association:

1. Functions

- Coordinate production and sales within the C-S Factory System;
- Implement a single management policy for the whole system;
- Facilitate the exchange of opinions and communication on problems;

- Upgrade the management skills of the members; and
- Serve as a channel for input into government policies for industry.

2. Activities

- Improve business management which is categorized into: guidance activities, presentations of achievements, exchange visits;
- Offer classes and symposiums on the macro-economic environment, establishment of management research committees, exchanges of personnel, and other assistance;
- Improve the C-S network by promoting self-improvements such as upgrading quality control, improving distribution systems, as well as accident prevention;
- Exchange information on trends in competitors' strategies, new product development, and changes in both domestic and international markets;
- Promote cooperation among top management, personnel, and staff in the network to improve production operations;
- Combine purchasing to reduce production costs, formulation of quality controls, and mutual provision of inspection equipment and manpower;
- Encourage mutual investment;
- Promote product development and technology exchanges through seminars, discussions, joint project studies, and holding internal competitions to encourage continuous technical innovations; and
- Participate in domestic marketing exhibits and establishment of export sales and distribution center for common product components.

Financial and fiscal incentives

- Firms establishing a C-S system pay the lowest tax grade assessed on land-value increment tax;
- Income tax deductions apply to training programs for employees;
- No import tariffs on certain types of capital equipment as well as accelerated depreciation allowed;
- Grants can cover up to fifty percent of company expenses for developing new products or technologies to transfer to other factories;
- Grants can allow study of financial and accounting systems of firms applying for loans;
- Low interest loans cover anti-pollution, automation, and energy saving projects or equipment;
- Re-discount of up to ninety percent of the face value of post-dated checks from trade transactions between the center and satellite;
- Equity infusion into investment projects by the Bank of Communication or the government when necessary for maintaining financial stability; and
- Low, mid, and long term loans available for investment in expansion of production capacity.

Provisions of advisory assistance

1. Human resource training and technology assistance

Government agencies provide key subsidies for group training session as well as assistance rendered by professional associations with foreign experts.

2. Marketing and improvement of standards

- Participation in sponsored trade exhibitions for products made by C-S factories;
- MOEA assistance in obtaining information on domestic and foreign markets;
- Stimulation of product standardization through the enactment of national standards; and
- Assistance in improving market image inspections subsidized by IDB.

3. Management and mutual cooperation

- Assistance in establishing systems for: organization and personnel management; production; material selection; product design; quality management; and financial systems; and
- Support for cooperation between the center firms and their satellites.

4. Pollution control, industrial safety, and energy conservation

- Establishing information management systems and screening appropriate technologies through training sessions and on-site consultations to establish cutting edge management systems; and
- Providing consulting services regarding pollution control, safety, and energy conservation.

Providing a pull through rewards

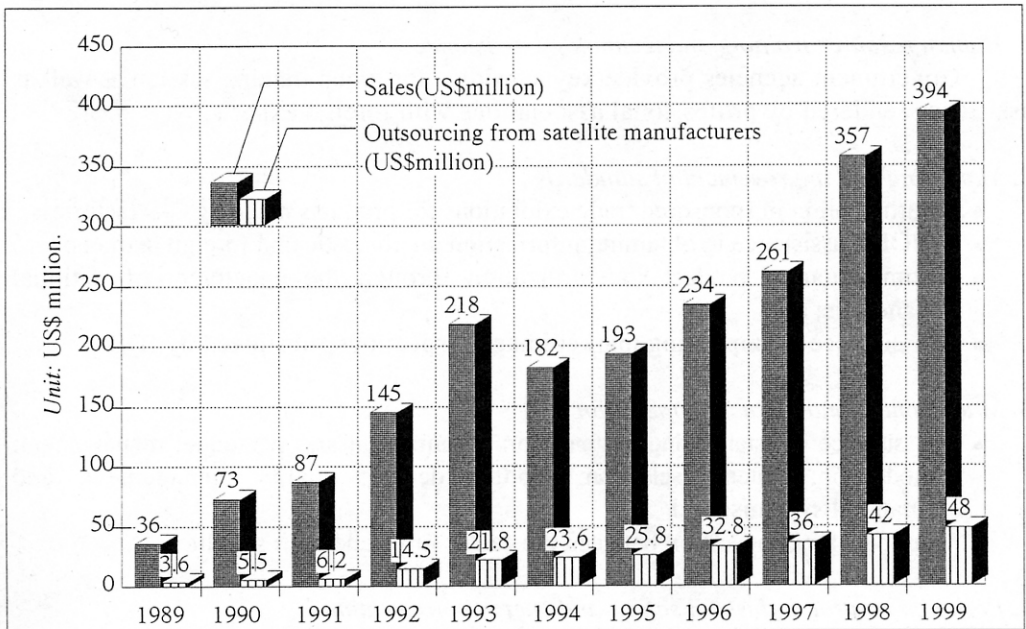
Major awards such as the National Quality Award provide one of the key motivations for companies to put significant effort into their C-S systems. The awards are generally organized by the MOEA and the Executive Yuan (the Cabinet).

CASE STUDY: ROYAL INFORMATION ELECTRONICS CO.

Company Background

Royal Information Electronic Co. Ltd. (RIE), established in 1986, was an example of a SME firm that became a large sized enterprise through the help of the C-S System. Royal Information Electronic's revenues grew from US\$ 36 million in 1989 to US\$ 394 million in 1999 (Figure 6). The company manufactures a number of products including: computer monitors, facsimile machines, and mobile phones. Royal Information has a number of suppliers who manufacture plastic injections, die and molds, capacitors, coil and wires, PCB insertions, and transformers. In April of 1990, RIE decided that development of a C-S System was the best way to grow their company.

Figure 6. RIE Sales and Outsourcing, 1989-1999



Phases of the C-S system implementation with TRL (Figure 7)

Phase 1: Introduction

From April to December of 1990, RIE underwent training to improve its in-house skills in areas such as: purchasing, quality control, and production and operational improvements.

Phase 2: Enhancing cooperation

From January of 1991 to June of 1993, efforts were taken to synchronize the operations of the satellites with the center firm (RIE). Management policies were established and RIE's productivity improved by 50 percent while the productivity of the various satellite participants grew by 3 percent to 22 percent. In addition, the defect rate was decreased by 6.5 percent. Even more important, sales increased to US\$ 218 million, and purchasing from subcontractors increased to US\$ 21.8 million.

Phase 3: Improvement of the management system

From June of 1993 to June of 1994, the management systems were improved for both the whole network and the individual satellites. During phase three, daily production of facsimile machines increased from 400 to 700 sets, and one satellite's productivity increased by 28 percent. The other satellites were also able to introduce new products without having to increase production space and personnel.

Phase 4: Self-implementation

Since June of 1994, RIE has run the C-S system independently, and taken responsibility for providing improvement and consulting services for the whole

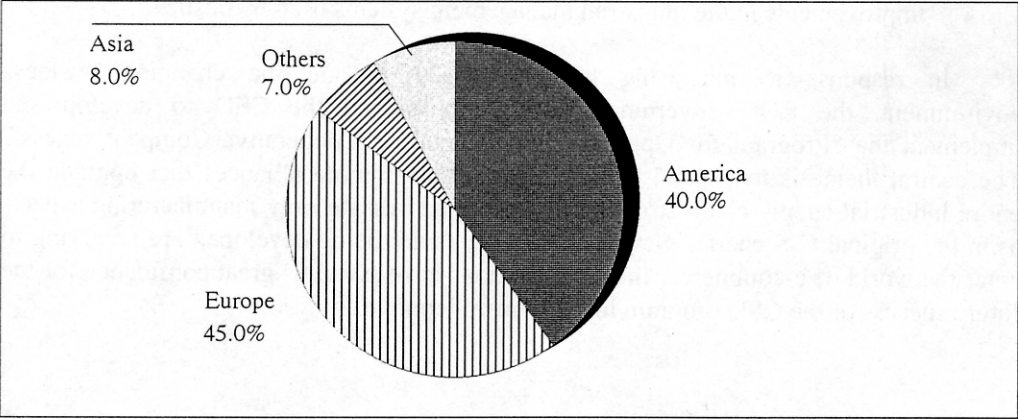
network. Sales increased from US\$ 182 million in 1994 to US\$ 394 million in 1999, a growth of 116 percent.

Figure 7.RIE’s C-S System Implementation

Phase	Introduction	Enhancement	Improvement	Self-implementation
Period	Apr.1990 – Dec. 1990	Jan. 1991 – June 1993	June 1993 – June 1995	July 1995~
Strategy	<ul style="list-style-type: none"> Improvement of the center firm 	<ul style="list-style-type: none"> C-S system management Improvement by individual satellites 	<ul style="list-style-type: none"> System model for cooperative improvement 	<ul style="list-style-type: none"> Self-motivation to enhance competitiveness
Methods	<ul style="list-style-type: none"> Gaining commitment of employees Training 	<ul style="list-style-type: none"> Establishment of network management system Consulting on functional improvements 	<ul style="list-style-type: none"> RIE transfers experiences to the satellites Concurrent improvement 	<ul style="list-style-type: none"> Institutionalization National awards

The internalization of the C-S System is evident through activities such as increased R&D spending and the emergence of new products. The company is also now exporting to 41 countries and has 128 different distribution channels including companies such as: Vobis, Ashima, Dell, Sony, Nec, Alcatel, Benatone, Sharp, Computer City, and other international firms. Figure 8 shows the company’s exports by region.

Figure 8. Exports by Region



Summary of Benefits Under the C-S System to RIE and Satellites

Benefits to the center firm (RIE) consisted of the following:

- Increased revenues, profitability, and competitiveness;
- Lowered costs in obtaining inputs, communication, and transportation;

- Shortened the time frame for developing new products; and
- Developed a stable network of suppliers and a just-in-time (JIT) system.

Benefits to the satellite factories consisted of the following:

- Increased sales, profitability, intangible assets, and competitiveness;
- Lowered manufacturing and marketing costs and lower business risks;
- Improved business operations in areas targeted by the C-S System; and
- Facilitated entry into targeted markets.

FUTURE PROSPECTS: THE NEED TO EXPAND THE CONCEPT

For over fifteen years, the ROC's industry has rapidly grown due to the joint efforts of business, government, academia, international agencies, and the CSD. The CSD has successfully directed these resources towards the shared vision of industrial prosperity. According to a recent evaluation study, the C-S System program provides valuable assistance that enhances productivity of ROC businesses and promotes improved quality management, and global awareness at the firm level.

In addition, it brings desired benefits congruent with the overarching vision of economic development in the ROC and has been responsible for transforming the ROC's industrial infrastructure. The transformation is demonstrated through:

- Increased consciousness of the importance of cooperation and achieving consensus;
- Stabilization of product quality to improve the international image of made-in-Taiwan;
- Enhanced cooperative relationships among firms and stronger competitiveness of industrial clusters in the ROC; and
- Improvements in the industrial management systems used by business.

In response to increasing global competition and the changing business environment, the ROC government has commissioned the CSD to develop and implement the "Program for Upgrading Manufacturing Cooperative Competitiveness." The central theme is to expand the C-S concept to promote alliances that upgrade the entire industrial supply chain structure instead of addressing only manufacturing aspects as in the original C-S charter. Several C-S systems are being developed are preparing to enter the world of e-commerce. Initial indications have given us great confidence for the future success of the CSD program in the new millennium.

9. THE USE OF CORPORATE SYNERGY SYSTEMS IN PROMOTING INDUSTRIAL WASTE MINIMIZATION IN SMALL AND MEDIUM ENTERPRISES IN TAIWAN

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ABSTRACT

A Corporate Synergy System (CSS) is a mechanism through which a group of manufacturing companies works together to achieve certain production or management goals. Established among firms linked by supply chains, a CSS usually consists of a central firm and its manufacturing suppliers or “satellites.” The system is being adopted in Taiwan as the key mechanism for promoting Industrial Waste Minimization (IWM) in small and medium enterprises. In this paper, the background and concept of CSS-IWM are presented, followed by a brief description of Taiwan’s CSS-IWM program. Finally, observations and suggestions are provided to conclude the paper.

BACKGROUND

As with many developing Asian economies, a large proportion of Taiwan’s industrial production comes from small- and medium-sized enterprises (SMEs). Among approximately 95,000 firms in Taiwan, more than 96 percent are SMEs – firms with a capital investment of less than US\$ 1.5 million, total assets less than US\$ 4.5 million, or fewer than 200 employees. Together, these firms generate approximately 50 percent of the gross production of businesses in Taiwan. Not surprisingly, while small on a per-facility basis, the gross volume of wastes generated by SMEs is substantial. Moreover, as many of the SMEs are scattered in commercial and residential areas, the environmental and health impact of these firms on the public at large is particularly severe.

Small and medium-sized enterprises are limited in their capabilities to excel in environmental performance. In general, these firms have little financial, technical, and manpower capability to implement environmental measures. Furthermore, the public at large exerts substantially less pressure on SMEs than on large firms in the environmental, health and safety management. As a consequence, SMEs are comparatively less active in environmental programs. Corporate Synergy Systems have now been used in Taiwan for several years to motivate SMEs to implement IWM programs to improve their environmental performance.

What Is a Corporate Synergy System (CSS)?

A Corporate Synergy System is a mechanism based on created by forming partnerships among business organizations to achieve common goals. Usually established within supply chains, Corporate Synergy Systems are initiated under the leadership of large companies. The upstream suppliers and downstream buyers in the chains are organized to work together to achieve common goals related to improving productivity or environmental performance. The CSS approach has been actively promoted by the government in Taiwan for many years to enhance cooperation among businesses to meet the needs of the country's economic development. In 1984, the Corporate Synergy Development (CSD) Center was established with funding from the Industrial Development Bureau (IDB) of the Ministry of Economic Affairs (MOEA) to coordinate CSS promotion efforts as a non-profit organization. Thus far, more than 100 CSSs have been organized, covering companies that account for one-third of Taiwan's total industrial output. The main objective of these CSSs has been to assist each participating firm to enhance productivity, technological capabilities, and management efficiency.

In any CSS, central firms play a key role in initiation, organization and maintenance of the system. Many large companies take up the role of central firms in a CSS due to a desire to improve their position in competitive markets. The globalization of economic activities and increasingly fierce international competition mean that companies must improve the quality of their products and public image while simultaneously containing their costs of production. To accomplish this, they must take great care in selecting their suppliers. Thus, under the leadership of large companies, supply chains are becoming more integrated in terms of decision making and planning with greater exchange of information among chain members. In addition to cost containment and quality assurance, many large firms have begun to work with upstream suppliers and downstream buyers to reduce their environmental liabilities.

To understand why satellite firms would join a CSS, one must first understand the basic characteristics of these firms. Generally speaking, satellite firms are SMEs with a relatively small staff and low capitalization. They are engaged in manufacturing activities involving relatively simple technologies. Their profit margins are generally small due to fierce market competition, reliance on easily acquired technologies, and relatively transparent cost accounting. SMEs rely heavily on their existing business networks and references from current buyers to generate new sales. In order to make a profit or even simply to survive, SMEs firms must be extremely flexible in meeting the demands of their buyers. Thus, when a large company wants its suppliers to participate in a CSS, suppliers will generally accommodate the request. In return, the central firm(s) of a CSS may reward the suppliers by providing special credit treatment, free staff training, and/or relaxed performance audit requirements. Eventually, through the operation of a CSS, large companies can use a variety of parameters such as product quality, financial strength, and environmental performance to rank their suppliers. The "good" suppliers can be given preference over others while pressure is applied to poorly operating and unranked suppliers to improve their performance. More detailed information on the characteristics of SMEs in Taiwan can be found in a recent paper by Sytyu.¹

¹ Sytyu, D.S., 1995, "The Unique Business Characteristics of Taiwan's Small and Medium Enterprises: Their Business Environment, Sizes and Strategy," (in Chinese) a paper presented in *Journal of CSD Center*, Taipei, Taiwan, Vol. 115, March.

Benefits of and Obstacles to Implementation of Industrial Waste Minimization

Industrial Waste Minimization (IWM) is defined as those technical and management activities that are capable of reducing or preventing generation of pollutants at the source. These activities include in-process recycling and conservation initiatives that reduce the use of materials and energy, substitution of environmentally benign materials for hazardous materials, improving process design and operation to prevent pollutants from leaving the process systems, and implementation of life cycle design to reduce wastage and improve material utilization. IWM is considered to be a win-win situation because it leads to improved production efficiency and better environmental performance. As IWM generally involves process and product changes, regulatory agencies rarely establish rules to require industry to implement IWM. Rather, regulators have hoped that firms would adopt IWM measures voluntarily once they realize the potential benefits of implementation.

Although IWM has many benefits, a number of factors can prevent SMEs from implementing a program. The two primary barriers are technical and financial. Technical barriers impede the ability of a company to develop, evaluate, and implement IWM programs. These barriers include: limited awareness of pollution management issues at a company's decision-making level; lack of in-house expertise on IWM; and the absence of readily available IWM technologies that can be easily adopted. In addition, attitudes toward changing established industrial processes or practices are often negative, which tends to impede implementation of new approaches to preventing pollution. Pollutant generators may be reluctant to take risks with new, unproved technologies or to compromise other business goals and practices; they may also distrust alternative processes or simply be uninterested in changing their habitual ways of doing business. The unavailability of capital for plant modernization often becomes a significant obstacle to implementing IWM even though the measures may lead to cost savings. Major companies may have capital to upgrade inefficient processes, but SMEs often do not. Other obstacles for SMEs in Taiwan to implementing IWM include:

- Lack of a cost-accounting system to identify costs of environmental control and potential benefits of source reduction;
- Lack of proper registration and licensing. A substantial portion of SMEs are currently operating without having registered with the appropriate government agencies resulting in a lack of authority on the part of the government to deal with the environmental issues associated with these firms;
- Lack of aggressive enforcement of pollution control regulations in the country; industries are thus less likely to invest in IWM if they are allowed to illegally dispose of wastes; and
- Lack of manpower, since SME's usually employ only a small staff, and can't easily acquire the new technical and management skills required for IWM implementation.

IWM Promotion in Taiwan

Industrial waste minimization is hardly a new concept in Taiwan. In fact, information on technical aspects of IWM technologies is abundant and can be easily obtained. The most difficult problem, however, is to design promotion programs to

effectively encourage large numbers of industrial firms, especially SMEs, to start implementing, and to commit to continually improving their IWM programs.

As in many developed and developing economies, both government and industry in Taiwan are actively involved in promoting IWM. The role of government agencies in promoting IWM is to provide incentives that help overcome technical and financial barriers to IWM. These incentives can be divided into two categories: technical and financial assistance mechanisms, and regulatory enforcement mechanisms. Government agencies that provide technical and financial incentives for industrial development are contributing to the promotion of IWM by supporting the development of new technologies, providing technical assistance, and disseminating relevant information. Regulatory enforcement agencies are promoting IWM by imposing stringent but flexible technical and environmental regulations to encourage businesses to operate responsibly by developing products and manufacturing methods that reduce or eliminate pollutants at their source.

In Taiwan, the official program to provide technical assistance and financial incentives to promote industrial waste minimization started in 1989 with an executive order by the Premier of the Executive Yuan to adopt IWM as a the cornerstone of Taiwan's strategy for solving environmental problems. Following this executive order, the MOEA and the Environmental Protection Administration (EPA) together established the Joint Waste Reduction Task Force (JWRTF) which was delegated with overall responsibility for promoting IWM in the country. The first task accomplished by the JWRTF was to formulate and implement a 5-year plan from 1991 to 1995 to promote IWM in Taiwan. A second 5-year plan to promote IWM is now being implemented in Taiwan. Specific elements in IWM program include the following:

- *Public awareness promotion:* JWRTF produced booklets, posters, newsletters, technical manuals and videos to educate industry and the general public about IWM. The most positively received form of awareness promotion was the presentation of awards to organizations with outstanding achievements in IWM. As of 1995, a total of 50 firms, 47 individuals, and 17 organizations had received such awards.²
- *Training and education:* To help industry implement IWM, sector-specific training courses were provided for technical staff and decision-makers in industry. Between 1990 and 1995, 256 IWM training courses were offered in the country, benefiting more than 22,000 participants.³
- *Information exchange:* General information on the nature and benefits of IWM technologies, and case studies that illustrate technical feasibility are necessary for user communities. Two computer data systems have been established. One of these systems contains technical information and case studies on IWM techniques. The other data system is designed for use by companies to locate individuals capable of providing specific expertise; it collects human resource information pertinent to individuals' expertise, capabilities, and experience. In addition to these two data systems, an industrial waste exchange information has

² China Technical Consultants, Inc. (CTCI), *Waste Minimization White Paper*, ROC, (in Chinese) prepared for Industrial Development Bureau, Ministry of Economic Affairs, ROC, July 1996.

³ Ibid.

been in operation since 1987. This system has facilitated nearly 200 exchanges between the waste generators and users.

- *Technical assistance:* Contracted by JWRTF, China Technical Consultants, Inc. (CTCI) and Foundation of Taiwan Industrial Services (FTIS) provide technical assistance at no cost to industry. Each year, a number of firms are selected by these nonprofit organizations for in-depth technical assistance. Over the last four years, 89 firms in 30 industrial sectors received assistance; hundreds of additional firms received general consultation.⁴
- *Technology research, development, and demonstration:* Under this program element, special attention has been given to developing technologies and detailed case studies of IWM technologies suitable to domestic conditions. From 1989 to 1995, Ministry of Economic Affairs sponsored nearly 80 research and development projects related to IWM technologies.⁵ Industrial Technology Research Institute (ITRI) performs a majority of these projects. The annual budget allocated by MOEA for R&D of IWM technologies is approximately US\$10 million.
- *Financial incentives:* Under the sponsorship of IDB, several commercial banks are helping firms implement IWM projects by providing low-interest loans. Additional financial incentives that are being provided by government include investment tax credit, import tariff exemption, and accelerated depreciation for IWM equipment. In 1994 and 1995, more than 1,200 applications were approved of tariff exemption for imported IWM and pollution control equipment.⁶

It has been more than eight years since the initiation of the IWM program in the country. During this period, the program's focus has switched from public awareness promotion, training and technology demonstration to providing assistance to industries in the implementation of IWM options. Furthermore, since 1995, new program elements have been added to promote ISO 14000 and life cycle design. Although no quantitative information is available on the extent of IWM application in the country, it is clear, that the IWM program has succeeded in raising awareness of cleaner production concepts in the country. Instead of solely depending on end-of-pipe (EOP) treatment, thousands of firms in the country now consider source reduction a viable option for solving their environmental problems.

In spite of these impressive results, the impact of IWM program on SMEs has been far from satisfactory. Thus far, for example, though more than 200 firms have received in-depth technical assistance to implement IWM measures, less than 20 percent of these firms are SMEs. In an attempt to rectify the situation, the Industrial Development Bureau took the initiative in 1995 to adopt the CSS mechanism to promote IWM in SMEs. The results, as described in the balance of this paper, have been quite impressive.

Steps to Implementing CSS-IWM programs

The first step in establishing a CSS-IWM program involves a commitment from a large company to become a central firm. At the beginning of each fiscal year, the IDB

⁴ Ibid.

⁵ Ibid.

⁶ Ibid.

publishes bulletins soliciting companies to serve as central firms in new CSSs in the country. Large companies who have had experience in implementing IWM programs are naturally good candidates to become central firms of CSSs. To qualify as a central firm, a company must demonstrate commitment from its top management to provide necessary resources to run the CSS-IWM program, and a sufficient number of suppliers who could potentially join the program. Once selected, the central firm(s) would go through the list of its suppliers and make a preliminary selection of firms who could benefit from IWM measures. A seminar then would be organized to explain the basics of a CSS such as: the concept of IWM; the process of implementing a CSS-IWM; the roles and responsibilities of participating firms; and the program schedule. Following the seminar, satellite firms would be asked to register to provide pertinent firm information and indications of top management commitment. These firms would then go through a final qualification procedure before formally being accepted into the system.

A successful CSS-IWM program relies on securing the commitment and general consensus of top decision makers of each satellite firm to follow the methodology and schedule set by the group. During the course of program implementation, specific roles properly are assigned to the central firms, satellite firms, consultants, and government agency. The entire framework requires government agencies to provide: encouragement and support to the program; funding and supervision to consultants who assist central firms in promoting IWM concepts and coordinating CSS implementation; and technical assistance in planning and implementing the IWM program. The central firms must promise adequate incentives to participating satellite firms. Assisted by consultants, they would also organize a team to take overall responsibility for: conducting plant inspections; process audits, program reviews; and perform technology demonstrations for participating firms when necessary.

CSS-IWM programs are generally carried out in the seven steps briefly described below. More detailed descriptions of the IWM implementation approach can be found elsewhere.⁷

- Step 1:* Start by providing training to the staff of each participating firm. Two training courses are designed for different groups. Awareness classes are basically for management personnel and include an introduction to the concept of IWM, benefits and barriers, general approaches, and industrial environmental, health and safety. The technical classes, designed for process and operation staff, include plant audit procedures, IWM opportunity assessment methodology, and available IWM measures and practices;
- Step 2:* Establish an IWM team in each participating firm to take charge of the program and to coordinate the efforts of the plant. Management leads the team and the employees are expected to participate by proposing and implementing IWM measures;
- Step 3:* Conduct plant audits for each participating firm to examine plant operations in detail to determine the sources of waste generation and to prioritize waste streams;

⁷ Chiu, S, and B. Peters, "Industrial Pollution Prevention," a *Technical Memorandum* published by Asian Development Bank, Metro Manila, The Philippines, November 1994.

- Step 4:* Identify potential IWM options for the facilities, through numerous sources, such as secondary literature, personal contacts, and, most importantly, brainstorming employees;
- Step 5:* Identify high priority waste streams and select the best IWM options for the company; then and implement these options;
- Step 6:* Evaluate the progress of the IWM program on a company- and CSS-wide basis following the implementation of selected IWM options; and
- Step 7:* Take actions to sustain the IWM program of each firm and the entire CSS for continued growth and increased benefits.

CSS-IWM programs in Taiwan follow a yearly cycle. Meetings are held periodically in each participating firm to provide staff training, to assess plant operations, to solicit participation and ideas from employees, to review the progress, and to identify and overcome obstacles to IWM implementation. In addition to separate meetings at individual firms, group meetings are organized where consultants and representatives from participating firms gather to exchange ideas and assess the progress of the CSS-IWM program. At the end of fiscal year, actions are taken to assess the results of the program, and to identify additional IWM measures for implementation in next fiscal year.

The success of any CSS-IWM program depends on close collaboration among four major parties: government, consultants, central firms, and participating satellite firms. The specific roles performed by these organizations are listed in Table 1. The roles of government agencies and central and satellite firms have been described earlier; the consulting firms are responsible for bringing all parties together and for providing the expertise needed to make the program operate smoothly. Under a contract with the Industrial Development Bureau, the Foundation of Taiwan Industry Service (FTIS) presently serves as the primary consultant for CSS-IWM program implementation. FTIS's expertise on IWM has been developed through years of serving as one of the government contractors providing technical assistance to industry to practice IWM and implement environmental management systems under ISO 14000.

Results of CSS-IWM Programs in Taiwan

Since 1995, two corporate synergy systems have been established in Taiwan to promote IWM in supply chains. TECO Electric and Machinery Co., Ltd., one of the largest electrical equipment manufacturers in the country, initiated the first system. Prior to initiation of CSS-IWM, several of TECO's plants had implemented IWM programs and therefore had a good understanding of the financial and environmental benefits of the concept. TECO's top management was convinced that further substantial gains could only be realized if its suppliers also adopted IWM measures through CSS-IWM effort. During the first stage of CSS-IWM organization, however, many of TECO's suppliers were either not interested or only passively participating in the program. It was only after TECO's general manager openly threatened to discontinue purchasing relationships that the suppliers began to seriously participate in the CSS-IWM program.

The TECO CSS-IWM system consisted of four of TECO's electric equipment assembly plants serving as the central firms, and 12 suppliers serving as satellite firms.⁸

⁸ TECO Electric and Machinery Co., LTD, and Foundation of Taiwan Industrial Service, *TECO's Corporate Synergy System for Promotion of Industrial Waste Minimization- A Special Report*, (in

Table 1. Roles of Organizations Involved in CSS-IWM Program

Organization	Roles
Government agencies	<ul style="list-style-type: none"> • Provide encouragement and support
Consulting firms	<ul style="list-style-type: none"> • Provide staff training programs • Assist in establishing IWM teams • Assist in plant audits • Assist in identification and feasibility analysis of IWM options • Assist firms to compile pertinent data • Call regular meeting to track progress • Supply pertinent information
Central firms	<ul style="list-style-type: none"> • Get top management commitment and support • Serve as a role model • CSS system audit and reviews • Provide assistance and incentives to participating satellite firms
Satellite firms	<ul style="list-style-type: none"> • Get top management commitment • Establish IWM teams • Carry out IWM implementation

An Environmental Safety Promotion Team (ESPT) was organized among all these firms to run the CSS-IWM program with technical assistance provided by FTIS. Table 2 lists the participating firms in TECO's CSS-IWM, including four central firms (A through D) and 12 satellite firms (E through R). The satellite firms represent suppliers of data processing equipment, printed circuit boards, parts molding, etc. More than 60 percent of the participating firms were SMEs. During FY 1995, the participating firms in the system implemented a total of 2,119 IWM options. Based on available data, these options required a capital investment of US\$ 453,000, and resulted in a savings of US\$ 5 million in FY 1995. The TECO CSS-IWM system has since been expanded to include 32 firms, and many of them have reported reductions in production costs of greater than 20 percent as a result of practicing IWM measures.

A second CSS-IWM program was organized by the Cheng-Loong Paper Manufacturing Company in July of 1996.⁹ Established with Cheng-Loong's Tayuan Paper Mill and Hsinchu Paper Mill as central firms, the CSS consists of 10 up-stream suppliers that provide waste paper, machinery, chemicals, energy, and transportation services, and 3 downstream buyers who are paper container manufacturers (see Table 3). With over 90 percent of participating firms being SMEs, the Cheng-Loong system implemented 868 IWM options in a one-year period from July 1996 to June 1997. These participating firms invested a sum of US\$ 991,000 in IWM measures, resulting in a total benefit of US\$ 3.5 million in FY 1996.

During FY 1997, two additional CSS-IWM systems were organized by SAMPO Corporation and Macronix International with technical assistance of FTIS and CTCI,

Chinese) Taipei, Taiwan, December 1996.

⁹ Industrial Development Bureau (IDB), and Foundation of Taiwan Industrial Service, *Cheng-Loong Tayuan Plant's Corporate Synergy System to Promote Industrial Waste Minimization (Final Report Draft)*, (in Chinese), Taipei, Taiwan, June 1997.

Table 2. Results of TECO's CSS-IWM Program in FY 1995

Firm code	Business /Product	Number of employees	IWM options proposed	IWM options implemented	Investment US\$ (1,000)	Benefit** US\$ (1,000)
A	Appliances	102	40	28	3.6	54.6
B	Appliances	350	1,805	1,612	1,392.9	1,788.2
C	Electric motors	380	565	306	13.6	322.5
D	Electric motors	340	62	53	255.0	2,239.6
E	Electric equipment	850	14	1	*	
F	Printed circuit boards	280	12	8	3.6	26.9
G	Electronics	50	6	6	*	20.0
H	Electronics	54	4	4	*	4.1
I	Packaging	44	13	13	5.4	19.8
J	Packaging	260	71	18	3.9	100.2
K	Plastic	95	8	8	*	26.1
L	Plastic	37	2	1	*	*
M	Metal processing	280	34	28	168.9	336.8
N	Metal processing	47	6	3	*	
O	Parts fabrication	22	4	4	*	2.1
P	Brass tube processing	33	3	3	*	5.4
Q	Brass tube processing	36	17	17	2.57	42.5
R	Molding	50	7	6	*	7.1
Sum		3,310	2,673	2,119	1,849.5	4,993.6

Notes: * Indicate investment data not available.

** Benefits realized in FY1995.

Source: Adapted from Reference no. 4.

respectively. SAMPO is one of the largest electrical appliance and equipment manufacturers in the country. The SAMPO CSS-IWM system consists of 14 firms, 97 percent of which are SMEs that supply metal parts, plastic parts, PB boards, printing products, and packaging materials. The system implemented a total of 789 IWM options that cost US\$ 825,530, and resulted in an annual benefit of US\$ 4,680,425.¹⁰

Macronix is a manufacturer that primarily produces non-volatile memory and logic memory integrated circuits. The CSS-IWM system organized by the company attract 18 firms that produced a host of goods and services including IC fabrication, chemicals, waste treatment, construction, and IC packaging. These firms implemented a sum of 156

¹⁰ Industrial Development Bureau (IDB), and Foundation of Taiwan Industrial Service, 1998, *SAMPO's Corporate Synergy System to Promote Industrial Waste Minimization (Final Report Draft)*, (in Chinese), Taipei, Taiwan, June 1998.

Table 3. Results of Cheng-Loong CSS-IWM Program in FY 1996

Firm code	Business /Product	Number of employees	IWM options proposed	IWM options implemented	Investment US\$ (1,000)	Benefit* US\$ (1,000)
PM-1	Paper	288	210	173	397.8	1,194.5
PM-2	Paper	100	98	92	22.3	521.5
CE-1	Chemicals	15	21	9	24.3	89.3
CE-2	Chemicals	50	66	51	130.7	414.3
CE-3	Chemicals	19	22	21	30.6	85.8
PC-1	Paper containers	155	45	42	10.8	151.0
PC-2	Paper containers	141	455	335	60.0	291.8
PC-3	Paper containers	140	44	28	32.1	134.2
CG-1	Energy	37	56	37	4.3	45.6
TR-1	Transportation	13	10	10	62.9	27.2
WP-1	Waste paper collection	6	13	13	14.6	60.7
WP-2	Waste paper collection	5	8	8	2.2	30.9
WP-3	Waste paper collection	58	26	22	169.3	357.1
WP-4	Waste paper collection	5	14	14	14.6	65.5
ME-1	Machinery	6	13	13	14.6	98.0
Sum		1,040	1,101	868	991.1	3,567.4

Note: *Benefits realized in FY 1996.

Source: Adapted from reference no. 5.

IWM options in FY 1997 at a cost of US\$537,000, and garnering US\$4.5 million in benefits in FY 1997.¹¹

The positive results in previous years provide a strong incentive for expansion of CSS-IWM program in Taiwan. In FY 1998, three new CSS-IWM systems were organized with the assistance from FTIS; these systems were created by central firms including Acer Peripherals, Inc (an electronic manufacturer), Sanyang Industry (a motor cycle and automobile assembler), and Super Textile Corporation. Assisted by CTCI, two additional CSS-IWM system have been organized under United Microelectronics Corporation (an IC fabricator), and Acer Incorp. (a computer manufacturer). A total of 74 satellite firms join these five CSS-IWM systems, of which more than 70 percent are SMEs.

¹¹ Industrial Development Bureau (IDB), and China Technical Consultants, Inc., *MACRONIX's Corporate Synergy System to Promote Industrial Waste Minimization (Final Report Draft)*, (in Chinese), Taipei, Taiwan, June 1998.

SUMMARY AND CONCLUSION

As in many other countries, small and medium enterprises in Taiwan are slow in implementing Industrial Waste Management. These firms are in general less capable financially and technically to acquire more advanced technologies to improve their environmental performance. In an attempt to induce a change, the Corporate Synergy System approach was adopted by the Government in Taiwan in 1995 to attract more SMEs to practice IWM. The results thus far clearly indicate that the CSS approach is effective in promoting IWM in SMEs. Facing the fierce competition in global markets and newly developed international environmental requirements, many large companies are willing to take the initiatives to form CSSs to promote IWM in their supply chains. Driven by the incentives from its buyers (or, in some cases, suppliers), many SMEs would join CSSs and learn how to practice, and realize the benefits of, IWM.

CSS-IWM is still in its first stage of application, however. Since program inception in 1995, four systems have been established under firms that represent manufacturers of electrical equipment, paper products, electrical appliances, and integrated circuits. At the beginning stage, relatively simple IWM-measures (the “low-hanging fruits”) are implemented. The results of a cost and benefits analysis of implemented options are quite positive, with average investment pay off in less than four months. The evidence that CSSs could effectively attract SMEs who would be otherwise left out of the IWM promotion program is most encouraging. Under the influence of IDB, five more CSS-IWM programs are currently being implemented involving many large companies in electronics, computer, textile, IC fabrication and motor vehicle assembly. Furthermore, IDB has recently decided that priority of technical assistance under the IWM promotion program should be given to CSSs. In other words, those firms forming CSSs would receive preference treatment, and those applying technical assistance individually would most likely face rejection. This decision would substantially expand the application of CSS-IWM in the country. Additionally, the government is planning to promote EMS under ISO 14001 and health and safety under BS 8800 through CSSs. This initiative would undoubtedly improve the depth of IWM implementation in the industry.

10. THE MANAGEMENT AND ENVIRONMENT PROTECTION OF THE PAPER INDUSTRY IN TAIWAN, REPUBLIC OF CHINA

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ABSTRACT

Paper manufacturing emerged as a significant industry in the Republic of China following Taiwan's retrocession from Japan in 1945. Over the last fifty years, the industry has undergone a number of transitions as it has grown and matured. In recent years, the domestic industry has entered into a phase of consolidation. The industry has also come under increased competitive pressure as liberalization of trade policy has led to a lowering of import tariffs on paper products. In addition, the industry has become burdened with the image of being a "high polluting" and "energy intensive" industry.

Despite challenging market conditions, the paper industry in the Republic of China is prospering. The paper industry has been pushed to adopt advanced business management techniques and upgrade its technology to raise productivity and quality. At the same time, the industry has also aggressively improved pollution-control technologies and has applied industrial waste minimization techniques, pollution-prevention strategies, and ISO 14000 environmental management systems. As a result, the overall health of the industry has improved, green competitiveness has been increased, and the industry has taken concrete steps to place itself on the path of sustainable development.

The paper presents Cheng Loong's experience as a concrete example of sustainable industrial strategy and demonstrates how our achievements in quality and environmental management have increased the company's green competitiveness. In addition, the paper reviews the social and environmental contributions of the paper industry to the Republic of China as it strives to meet the challenge of sustainability.

PREFACE

Paper manufacturing is one of the Republic of China's traditional industry sectors which has prospered with the economic development of the Republic of China. Paper production in 1947 was a mere 12,000 metric tons, but grew rapidly to a peak of 4.5 million tons in 1997. During this period, manufacturing processes underwent significant changes due to the need to improve environmental performance. In the 1970s, industry technology was based on the conventional paper-mill model in which raw materials such as straw,

bagasse, bamboo, and wood were converted for processing in a separate paper-making facility. With the closure of the last bagasse pulping mill in 1994, the industry has undergone a dramatic restructuring. There are now only two pulp mills still manufacturing bleached kraft from imported wood materials. The remaining 122 paper mills in the Republic of China manufacture their products using distinctive kraft pulp and waste paper. The change in the industry was in part driven by the work of a task force established by the Industrial Development Bureau of the Ministry of Economic Affairs in 1998 to address pollution control in the paper industry. As a direct result of their work, a large variety of paper products are still manufactured in the Republic of China, but with significantly less environmental impact from pulping operations.

According to the Taiwan Paper Industry Association, a total of 1,198,000 tons of kraft pulp (379,000 tons of which were produced domestically) and 3,924,000 tons of waste paper were used in paper-making in 1999. Production of paper and board reached 4,349,000 tons of which 671,000 tons were exported. With 1,419,000 tons of paper products imported, paper consumption within the Republic of China reached 5,130,000 tons, which equals an annual per capita consumption of 232.2 kilograms. Of the waste paper consumed, 2,814,000 tons were recovered domestically and 1,110,000 tons were imported from abroad. The Republic of China's waste paper recovery and waste paper utilization rate were 54.9 percent and 72.7 percent respectively. Figure 1 shows the paper cycle in the Republic of China.

Cheng Loong has striven to become an example of sustainable development in the paper industry through its managerial initiatives and its efforts to improve its overall green competitiveness. Paper companies are frequently assessed by external stakeholders in terms of their ability to use water efficiently and minimize amount of wastewater effluent generated per ton of paper manufactured. In addition, the government of the Republic of China has instituted incentives to encourage more efficient behavior. Cheng Loong believes that improved water efficiency leads to dual benefits in terms of both cost effectiveness and improved environmental protection. This pattern is an excellent reference for promoting sustainable development within industry.

INTRODUCTION TO CHENG LOONG'S APPROACH TO ENVIRONMENTAL MANAGEMENT

Cheng Loong Corporate Structure

Net sales: NT\$13.83 billion (in 1999)

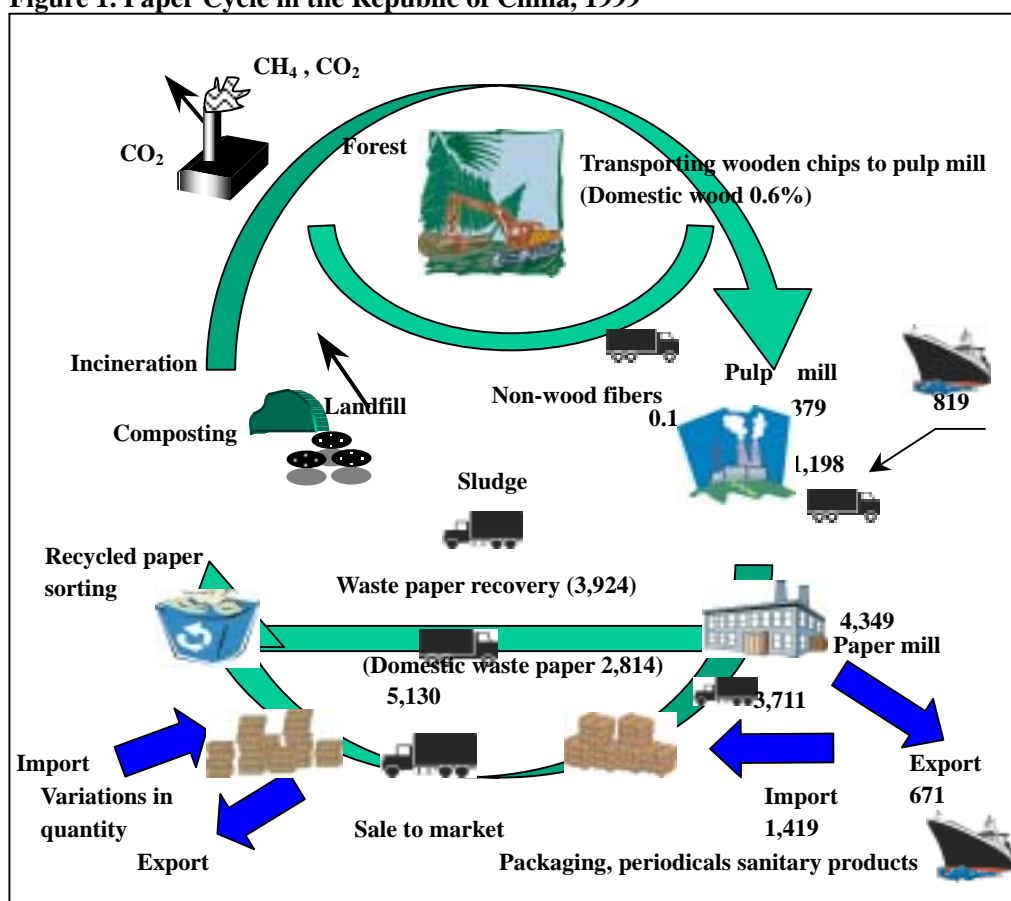
Organizational structure: The company is organized under four divisions: Corporate Headquarters, Paper Products, Container boxes, and Tissue Paper.

Number of factories: 10

Number of employees: 2,670

Subsidiaries/Affiliates: Cheng Loong has 16 affiliated companies in domestic and international markets. Each affiliate operates an independent production and marketing system. Long-term research and development (R&D) and group business operations are supervised by corporate headquarters.

Figure 1. Paper Cycle in the Republic of China, 1999



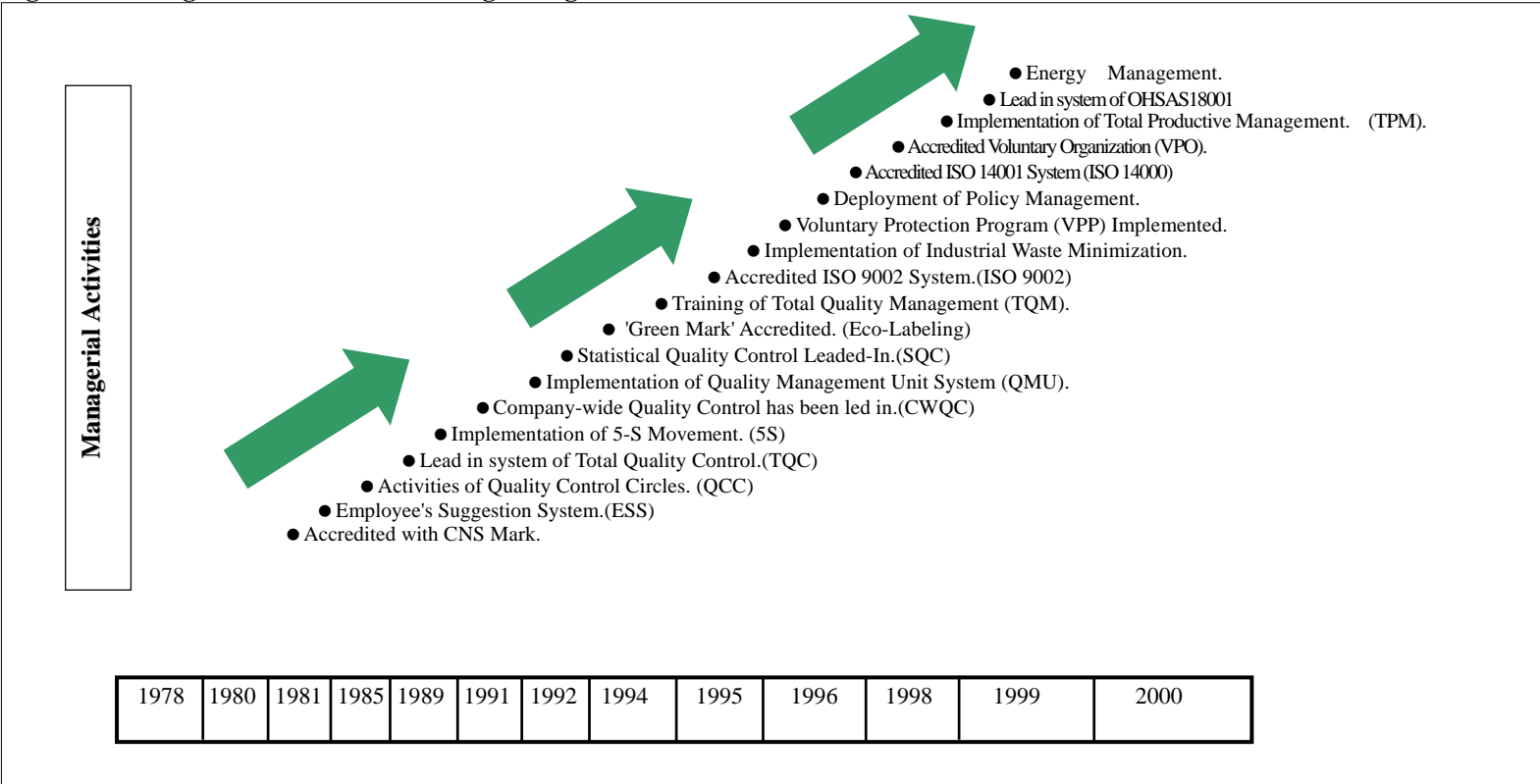
Management Activities:

The corporate headquarters of Cheng Loong coordinates development of general administrative and management systems. Figure 2 shows management achievements since 1978. Cheng Loong's management vision is supported by our company values of "sincerity and trustworthiness", "concern for quality of life," "efficient utilization of resources," and "dedication to society." Cheng Loong's goal is to become the leading company in the paper industry through diversified domestic and international development

Main Products

- *Paper Division:* Cheng Loong's three mills produce: corrugated medium, kraft liner, duplex board, coated white board, art paper, wood free writing and printing paper, simili paper, and kraft paper;
- *Container Boxes Division:* Cheng Loong's seven corrugated container plants produce: corrugated paperboard, corrugated carton, display packaging containers, water-repellent containers, and corrugated-board pallet; and
- *Tissue Paper Division:* Markets household papers manufactured by affiliates under the brand name of "Andante."

Figure 2. Managerial Milestones of Cheng Loong



STRATEGIES FOR SUSTAINABLE DEVELOPMENT

One of the key goals at Cheng Loong is to help conserve natural resources. As part of its commitment, Cheng Loong has developed a number of policies related to product quality, environment, safety and health. The primary emphasis of each the policies are outlined below:

- *Quality Policy:* Total staff participation, quality management, and customer satisfaction;
- *Environmental Policy:* Total staff participation, treasuring natural resources, protect the environment; and
- *Health and Safety Policies:* Total staff participation, safety as the top priority, zero accidents.

Within Cheng Loong, policies are backed up by the development of management systems for tracking quality, health, safety, and environmental performance. Each factory has ISO 9000 and ISO 14000 committees which are chaired by the factory managers. At the corporate level, the President of Cheng Loong also chairs an ISO Practice Committee comprised of Division Directors and factory managers. Cheng Loong seeks to encourage and reward implementation of practices such as waste minimization that lead to more efficient performance. Through these systems, the company seeks to: enhance the overall quality of management; reduce costs; strengthen the financial health of the business; and meet the company's social responsibilities.

Within this broad framework, the company has a number of detailed policies that relate to the overall business, including commitments to:

- Enhance the development of new products and marketing channels in mainland China and other international markets;
- Further integrate production and sales process by: simplifying operational procedures to improve efficiency; reallocation of manpower; and achieving Quick Response (QR) to our customers;
- Upgrade technologies and research capabilities to improve Cheng Loong's manufacturing process and overall productivity;
- Improve environmental performance by: enhancing the effectiveness of our pollution control systems; increasing plant energy efficiency; and increasing re-utilization of resources;
- Upgrade the skills, professionalism, and internationalization of Cheng Loong employees through a practical training program; and
- Become involved in activities that are of benefit to society, the environment, and industry.

ACHIEVING GREEN COMPETITIVENESS

In order to keep pace with the rapidly growing expectations of the market and Cheng Loong's growth as a business, the company constantly invests new resources in strengthening its environmental, health, and safety (EHS) management.

To coordinate EHS efforts throughout the company, an Environmental, Health, and Safety Department was established in Corporate Headquarters. The EHS Department is responsible for integrating new concepts and methods in environmental management into the company's existing system. The department promotes activities such as the establishment of a Voluntary Protection Program for Health and Safety (VPP), industrial waste minimization, and other such systems. In addition, the department plays an important role in providing guidance to Cheng Loong subsidiaries on achieving compliance with government regulations. Part of this guidance involves facilitating the application of technologies relevant to resource recovery/reuse, energy conservation, and end-of-pipe pollution control.

The EHS Department also coordinates the involvement of Cheng Loong's upstream and downstream suppliers in its Corporate Synergy System. The program has achieved significant synergies in promoting industrial waste minimization within the supply chain.

As a result of its successful EHS programs, Cheng Loong has been selected as a demonstration factory for ISO 14001 implementation. In addition, the company has also been recognized by the Taiwan's Council of Labor Affairs for its work in health and safety. Cheng Loong is pleased to have the opportunity to share its experience in order to help improve the overall competitiveness of The Republic of China's paper industry. The next major goal facing the industry will be to integrate ISO 14000 management systems with OHSAS 18001 (Occupational Health and Safety Assessment Series). In addition, the industry will have to continue seeking regular improvements in its routine EHS management and will also need to increase its efforts to help address global environmental issues.

The following sections provide a more detailed discussion of some of Cheng Loong's specific achievements.

Implementation of the ISO 9000

Cheng Loong places a high priority on maintaining a strong quality assurance system and is the largest industrial paper and container box manufacturer to obtain the Chinese National Standard (CNS) mark for quality management. Cheng Loong's products have consistently maintained a reputation for quality and all of Cheng Loong's factories have been received ISO 9002 certification.

Cheng Loong's emphasis on quality has led to significant advances in product design. The company provides a variety of packaging designs to its customers and has won more 25 design awards over the last decade, including the "Star of the World" awarded by the World Packaging Organization. The strong design skills of the company have also been applied to developing environmentally friendly products. Cheng Loong has several products that have received the Republic of China's Green Mark (eco-label) which has helped maintain the company's "green" market position.

The company has achieved significant gains over the last several years due to implementation of ISO 9002. Through extensive internal quality auditing, we have been able to identify and resolve problems in our process that led to quality failures. The system has led to a deeply ingrained commitment to quality on the part of our employees. In addition, a detailed Standard Operating Procedure (SOP) was developed to minimize operational mistakes which has further helped stabilize the quality of our products. We have seen the success of our efforts through a dramatic decrease in the number of customer complaints about our products.

Increased Utilization of Waste Paper

Cheng Loong has been in the paper industry for four decades, originally starting as a manufacturer of corrugated containers before expanding to become a producer of industrial paper products. Our company has long nurtured a culture that treasures our natural resources, which had led us to use waste paper as part of our raw material stream. By applying breakthrough techniques in the utilization of waste paper in the paper making process, we have taken the initiative to eliminate key polluting steps in the pulping process. Cheng Loong modified its production process to use waste paper co-mingled with kraft pulp and has become the largest corporate consumer of waste paper in the Republic of China.

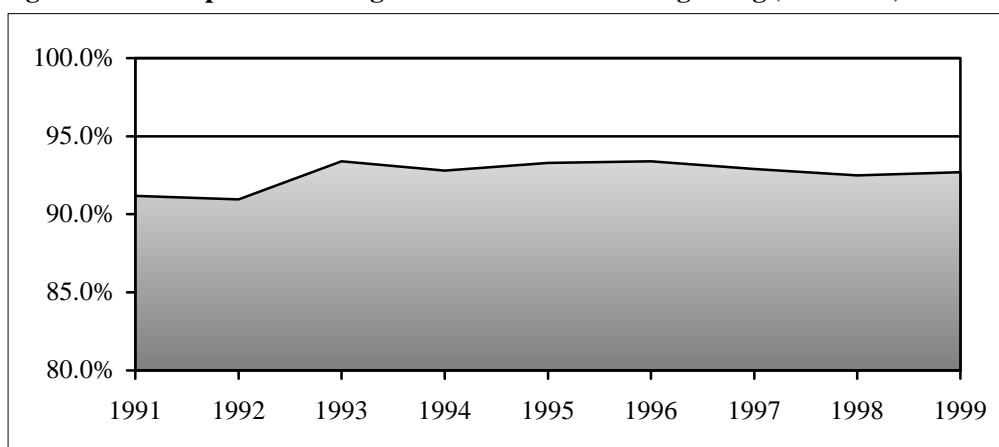
As has been frequently noted, an effective resource recovery and reuse program can dramatically improve a company's eco-efficiency. In the case of waste paper reuse, several goals are achieved. Use of waste paper substitutes for use of wood, thereby saving forest resources. From an ecological perspective, increasing reuse of "wastes" is the first step towards sustainable utilization of our natural resources. At the same time, reuse also reduces the amount of waste requiring disposal and also reduces the volume of greenhouse gases generated through incineration of waste paper.

Currently waste paper accounts for approximately 90 percent of the raw materials used in manufacturing industrial paper at Cheng Loong (see Table 1 and Figure 3). From the data, it can be seen that Cheng Loong has continued to invest in effective reuse of waste paper. As part of the company's goal to move upwards along the "clean production continuum," we have eliminated several highly polluting processes such as de-inking and bleaching. The company has invested NT\$8.5 billion in its facilities and now consumes close to one million tons of waste paper per year. Through its inherent resource recovery function, the paper industry contributes significantly to environmental protection.

Table 1. Raw Material Consumption in Cheng Loong

Raw material consumption (1,000 Tons)									
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999
Kraft pulp	69	73	93	102	123	124	134	151	161
Imported waste paper	269	288	249	227	271	335	328	262	321
Domestic waste paper	444	446	487	530	519	569	616	664	650
Subtotal	782	807	829	859	913	1,028	1,078	1,077	1,132
Productions (1,000 Tons)									
Fine paper	46	70	80	89	92	94	103	87	91
Industrial paper	604	636	649	684	684	795	836	866	923
Subtotal	650	706	729	773	776	889	939	953	1,014

Figure 3. Waste Paper as Percentage of Raw Materials in Cheng Loong (1991~1999)



Adoption of Advanced Technologies

Over the last ten years, Cheng Loong has made a concerted effort to develop world-class manufacturing facilities. Table 2 lists the significant capital purchases since 1991 which have helped Cheng Loong achieve significant improvements in resource utilization, overall productivity, and pollution prevention and control. Coupled with improved management strategies, Cheng Loong has improved its position on the clean production continuum and has simultaneously continued to produce fine paper products for a diversified market.

Improved Energy Efficiency

Electricity and steam are two resources key to effective management of a paper mill. In order to reduce energy costs and lower carbon dioxide emissions (CO₂), Cheng Loong has invested in a co-generation facility (see Table 3.) Figures 4 and 5 show Cheng Loong's energy consumption and CO₂ emissions per ton of paper manufactured. Figure 6 shows oil consumption per 10,000 m² of corrugated containers. As a result of several years of hard work, all of our paper mills received recognition from the Ministry of Economic Affairs for "excellent achievements in energy conservation."

Efficient Use of Water

Paper mills incorporate a variety of production processes starting with pulping and ending with rolls of paper. Water is essential for production and the paper industry uses large volumes. Increasing water efficiency through improved process design is one of the major challenges facing the industry. Water recycling can be a successful approach, however, it can also create problems in product quality which need further study in order to be resolved. Figure 7 shows the average volume of water consumed per ton of paper manufactured at Cheng Loong. All of our paper mills have been recognized by the Water Resources Bureau for "excellent achievements in water conservation." Although water use is more limited in our corrugated container factories, it is still a key aspect for our environmental management system. Process wastewater is fully recycled for use in making starch glue.

Table 2. Major Equipment Investments, 1991-1998

Year	Paper mill		Corrugated container plant		Environmental protection	
	Items	Description	Items	Description	Items	Description
1990	No.9 paper machine	Finland	Printing folding gluer machine	Japan	Waste water treatment Paper dust collector	35,000 m ³ /day secondary treatment
	Coater	Japan				
			Printing folding gluer machine	Japan	Paper dust collector	
			Printing folding gluer machine	Japan	Paper dust collector	
1991					Waste water treatment	4,800 m ³ /day
1992			Printing die-cut machine	Japan	Waste water treatment Waste water treatment (each container plant) Paper dust collector	UASB secondary treatment 12,000 m ³ /day 100~200 m ³ /day
1993			Printing folding gluer	Japan	Paper dust collector	

Table 2 (*continued*)

Year	Paper mill		Corrugated container plant		Environmental protection	
	Items	Description	Items	Description	Items	Description
1994			Printing die-cut machine	Republic of China	Paper dust collector	
1995			Printing folding gluer machine	France	Flue gas desulphurization device	Removing rate 95% Japan
			Printing folding gluer machine	France	Paper dust collector	
			Corrugator	U.S. Republic of China	Noise protection hood	
1996	No.7 Paper Machine	Finland	Printing die-cut machine	France	Paper dust collector	
			Corrugator	Germany	Noise protection hood	
1997			Printing folding gluer machine	France	Flue gas desulphurization device	Removing rate 95% Japan
			Corrugator	Germany	Noise-protection hood	
			Printing die-cut machine	Republic of China	Flue gas desulphurization device	Removing rate 95% Japan
1998			Printing folding gluer machine	Japan	Paper dust collector	
			Printing die-cut machine	Japan	Paper dust collector	
			Printing die-cut machine	Japan	Paper dust collector	
					Recovery boiler (under construction)	Capacity: 160T/day Japan

Table 3. Co-generation Capacity at Cheng Loong

Plant	No.	Boiler		Power capacity (Kw)	Installed year
		Steam (T/Hr)	Pressure (ATG kg/cm ²)		
Hou-Li	G1	65	82	9,600	1984
	G2	230	130	48,000	1996
Ta-Yuan	—	70	85	10,800	1987

Figure 4. Energy Consumption per Ton of Industrial Paper Manufactured at Cheng Loong

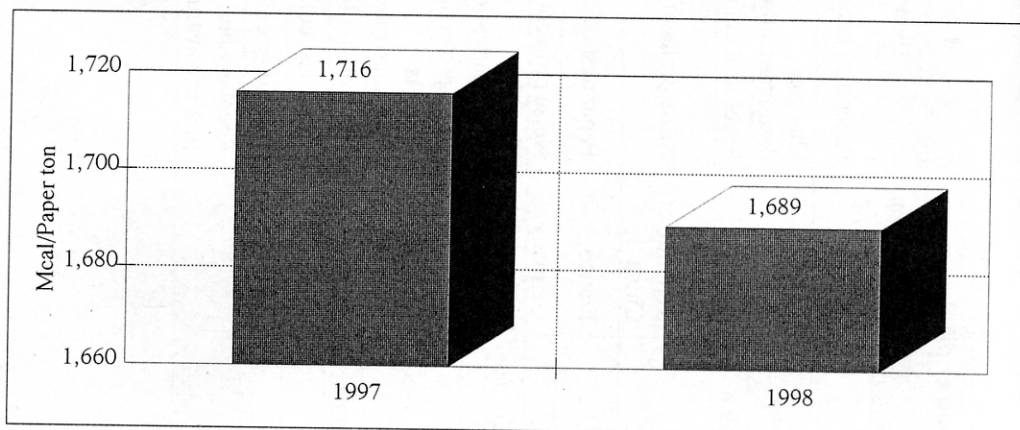


Figure 5. CO₂ emissions per Ton for Industrial Paper Manufactured at Cheng Loong

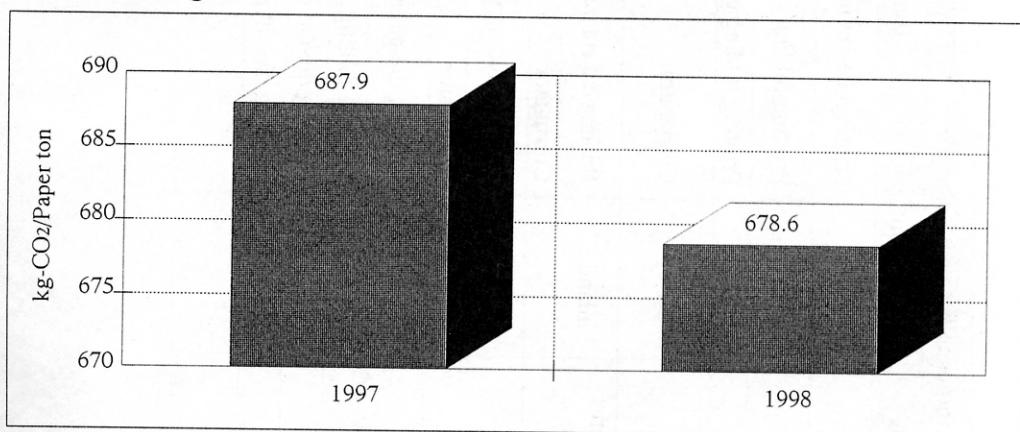


Figure 6. Oil Consumption at Cheng Loong's Corrugated Container Plants

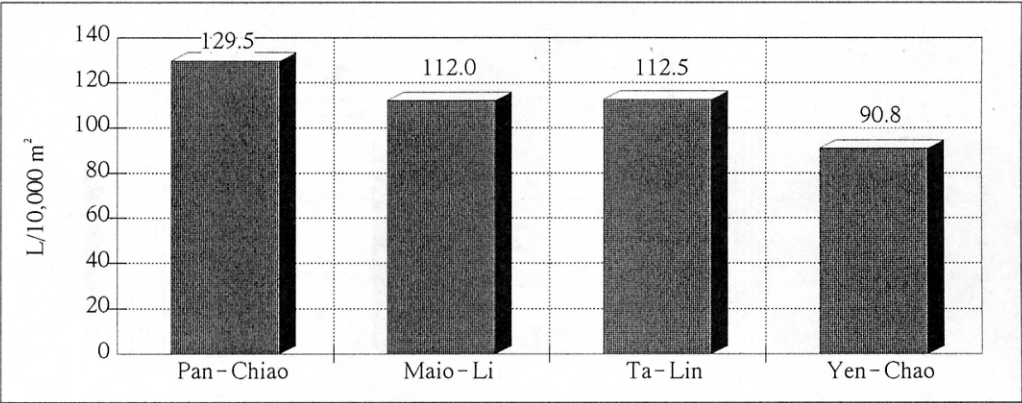
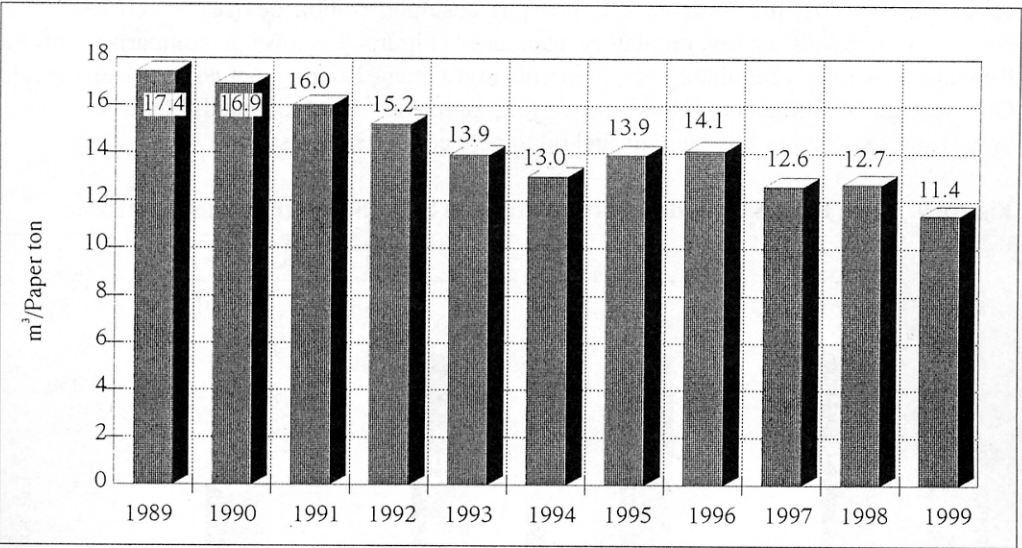


Figure 7. Water consumption per Ton of Paper Manufactured at Cheng Loong Paper Mills, 1989-1999



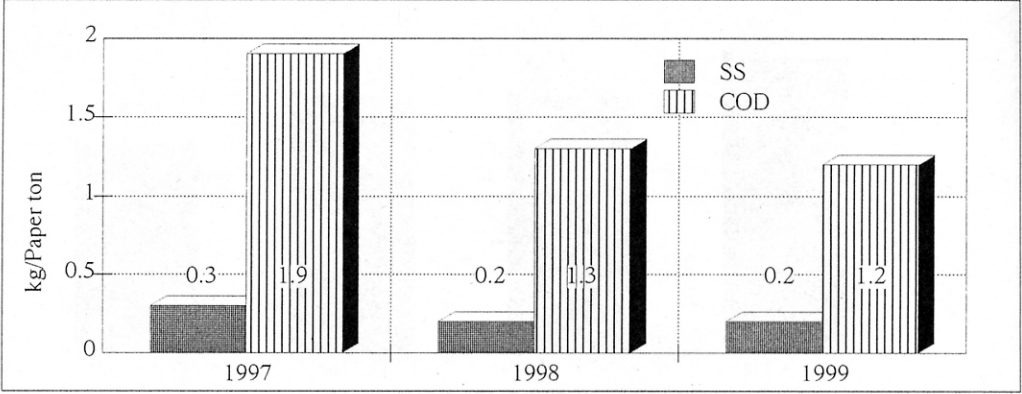
Going Beyond Compliance

Cheng Loong is committed to achieving superior environmental performance and in many cases has performed beyond the basic requirements of regulatory standards.

Wastewater effluent

All effluent must undergo treatment before being discharged into the environment. At Cheng Loong, the quality of wastewater discharged actually surpasses the standard set by the government. Figure 8 shows the average volume of suspended solids (SS) and chemical oxygen demand (COD) per unit product. Our corrugated container plants have reached their target of zero-discharge by installing water recycling systems and improving their overall use of water.

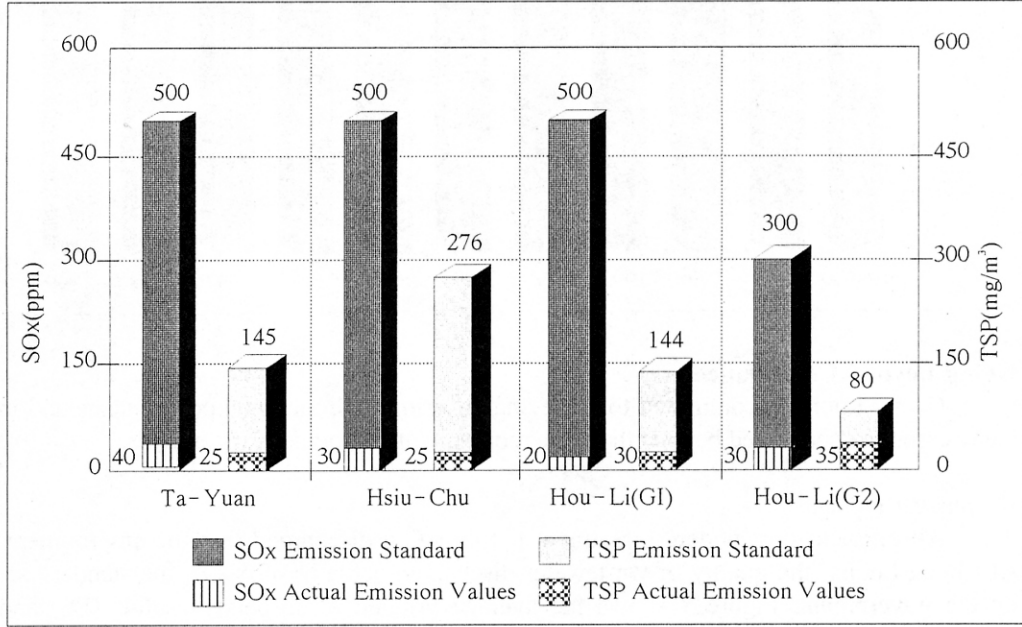
Figure 8. Effluents per ton of Paper Manufactured at Cheng Loong



Air emissions:

Although paper mills typically rely on coal for energy, Cheng Loong's mills are equipped with dust precipitators and flue gas desulphurization devices which reduce air emissions to levels below regulatory standards. Figure 9 shows a comparison of the Republic of China's regulatory requirements and Cheng Loong's actual emissions levels. Our corrugated container plants' converting processes have adopted Flexo-ink (water based) and switched to low-sulphur fuel oil to help control air emissions.

Figure 9. TSP (Total Suspended Particulate) and SOx (Sulphur Oxides) Emissions



Implementation of Corporate Synergy System

In 1995, Cheng Loong initiated an industrial waste minimization program with the help of China Technical Consultants Inc. (CTCI). Following a thorough evaluation of our operations, we developed and implemented a waste minimization plan and with rewards for facilities with exceptional performance. As a result of our efforts (see Table 4), all of our plants were awarded prizes for “national excellence and individual achievement in industrial waste reduction.” In addition, our corporate office was also recognized for its efforts in coordinating the work of the entire Cheng Loong group.

Table 4. Results of Industrial Waste Minimization

	Year/Number of projects				Cost Savings (NT\$ 1,000/Year)			
	1996	1997	1998	1999	1996	1997	1998	1999
Pan-Chiao Plant	16	13	20	22	5,110	8,512	3,245	9,138
Ta-Yuan Mill	20	42	43	47	19,353	37,735	52,210	44,293
Ta-Yuan Plant	16	20	22	23	3,783	11,059	7,536	8,630
Hsin-Chu Mill	22	31	20	22	11,848	9,517	10,003	27,181
Miao-Li Plant	29	16	36	12	4,580	3,982	14,704	7,171
Hou-Li Mill	32	118	48	57	29,911	77,232	20,472	26,357
Ta-Lin Plant	16	12	6	14	16,782	6,164	1,150	5,724
Yen-Chao Plant	18	23	10	26	4,042	3,707	3,393	26,784
Total	169	275	205	223	95,409	157,908	112,713	155,278

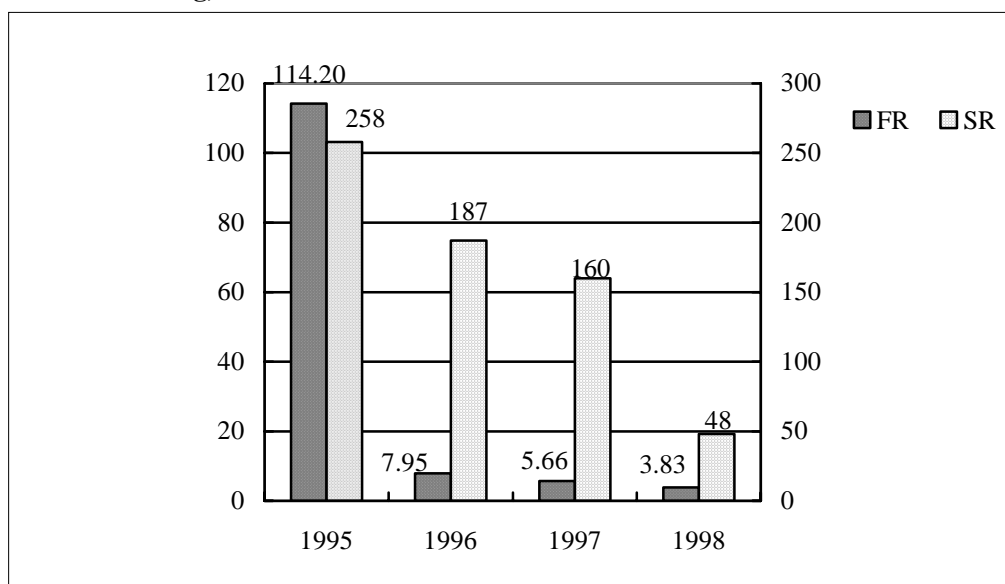
Development of Green Products

The Republic of China’s Green Mark (eco-label) requires that packaging containers be made of recycled paper, and it has additional criteria regarding the manufacturing facility itself. Due to their distinguished records in environmental protection and quality assurance, our plants in Pan-Chiao, Miao-Li, Ta-Lin, and Yen-Chao are consistently successful in applying for Green Mark certification for their products. In addition to pursuing cleaner production, our environmental policy places a strong emphasis on developing green products and encouraging “green consumerism” among our customers. Ultimately, Cheng Loong hopes to help improve the green competitiveness of the Republic of China’s paper industry as a whole.

Health and Safety Management

In 1994, Cheng Loong requested assistance in developing health and safety management systems from the Industrial Health and Safety Center of the Industrial Technology Research Institute. Together, we developed a Voluntary Protection Program (VPP), which has now been implemented in all of our factories. Due to the success of this program, our plants were certified by the Council of Labor Affairs as Voluntary Protection Organizations in 1998 which allowed us to procure preferential insurance rates (see Figure 11 for safety performance data).

Figure 11. Disabling Frequency Rate (FR) and Disabling Severity Rate at Cheng Loong, 1995-1998



Developing a Corporate Synergy System (CSS)

In 1996, Cheng Loong's Ta-Yuan plant was selected by the IDB to serve as a central factory in a CSS system. Under the CSS program, large companies partner with the government to encourage suppliers to develop industrial waste minimization programs. Government agencies sponsor the training of the suppliers, and corporate partners use their purchasing relationships to guarantee supplier participation. Cheng Loong worked with the Foundation of Taiwan Industry Service (FTIS) to establish a waste minimization program that integrated both our upstream and downstream satellite factories (see Figure 12). Table 5 shows the results of Cheng Loong's CSS.

Information Sharing

Cheng Loong actively seeks to participate in demonstration programs sponsored by the government. Program results are shared with other industry members and the general public. We welcome visitors from academia and industry and take every opportunity to attend relevant activities sponsored by other organizations.

Figure 12. Members of Cheng Loong's CSS

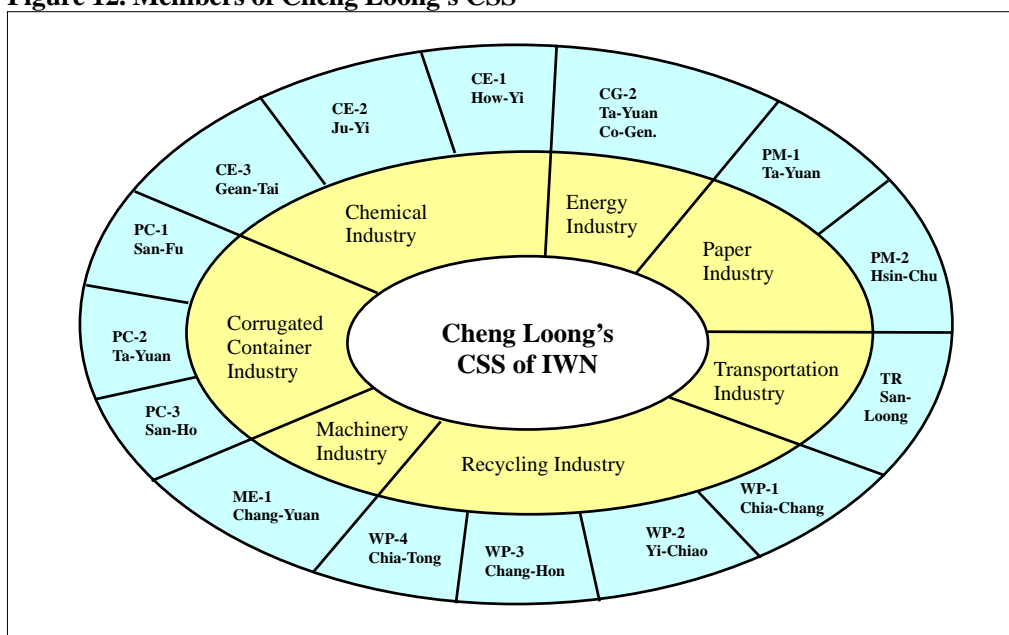


Table 5. Results of Cheng Loong 's CSS

Company	Employees	Suggestions	Executed case	Investment (NT\$1,000)	Effectiveness (NT\$1,000)
A	288	210	173	11,140	33,446
B	100	98	92	625	14,601
C	15	21	9	680	2,500
D	50	66	51	3,660	11,600
E	19	22	21	856	2,402
F	155	45	42	301	4,228
G	140	44	28	897	3,756
H	141	455	335	1,680	8,170
I	37	56	37	120	1,278
J	13	10	10	1,760	761
K	58	26	22	4,740	10,000
L	5	14	14	410	1,835
M	5	8	8	62	864
N	6	13	13	410	1,700
O	6	13	13	410	2,745
Total	1,038	1,101	868	27,751	99,886
Average suggestions are 73 cases/plant.					
Average investment cost: NT\$1.85 millions/plant.					
Average effectiveness: NT\$6.66 millions/plant.					
Average ratio of cost effectiveness 1:3.6					

THE REPUBLIC OF CHINA PAPER INDUSTRY'S OVERALL CONTRIBUTION TO SOCIETY AND ENVIRONMENTAL PROTECTION

The Republic of China ranks 14th in the world in the production of paper products, and our annual per capita consumption stands at 9th in the world. Our recovery and reuse rates for paper rank number one for the world. Therefore, the Taiwanese paper industry's accumulated efforts have helped improved efficient use of forest resources, reductions in greenhouse gases, and overall economic efficiency. Based on statistics available as of 1999, the following other comments can be made:

- Domestic recovery of waste paper has reached a volume of 2.814 million tons. Recovery of waste paper is of tremendous value to society, including social benefits amounting to NT\$19.49 billion and reducing the amount of new investment required in incineration capacity by up to NT\$37 billion.
- Total waste paper consumption has now reached 3.924 million tons, which has positive implications in terms of conservation of forest resources. The Republic of China's use of waste paper instead of virgin product has indirectly conserved an estimated 66.71 million grown trees and prevented an additional release of 5.88 million tons CO₂ emissions that would have resulted from the incineration of the waste paper.
- The Republic of China's effluent standard is defined in terms of concentration. The industry's success in industrial waste minimization and considerable investment in water recycling equipment has lowered both water consumption and reduced COD discharge per unit product. The improved performance has allowed the government to develop a new, higher effluent standard to encourage continued efforts to improve water conservation.
- Methods for calculating waste paper reuse vary among countries. By the Republic of China's methodology, our reuse rate is 72.7 percent. However, by Japanese standards we have achieved a level of 76.6 percent. Using western methodologies, we achieve an even higher 90.2 percent.
- In 1995, our Hou-Li paper mill served as an IDB demonstration project to lead the development of ISO 14001 in the Republic of China. Now, 23 factories accounting for half of the industry's total production capacity have received ISO 14001 certification, and more will soon be added.
- Pursuant to a resolution of National Energy Conference in 1998, the Taiwan Paper Industry Association organized a task force on CO₂ reduction. The task force will monitor energy consumption, research ways to improve energy efficiency, and develop a CO₂ reduction plan for the paper industry.

CONCLUSIONS

Based on our experience at Cheng Loong, we can draw a few conclusions regarding the paper industry and environmental protection.

- It is clear that waste paper is the primary raw material for the paper industry in the Republic of China. We may, therefore, conclude that the domestic paper

industry has already admirably fulfilled its responsibilities to the global community regarding waste recovery and reuse. Through its efforts, the industry has prevented the emissions of additional greenhouse gases and helped protect the global environment.

- CO₂ emissions are effectively minimized through the installation of energy-conservation equipment, well-designed management systems, and the use of co-generation equipment.
- The overall volume of pollution discharges have substantially decreased, and water consumption has been reduced. The synergy between the two trends can be seen in both the environmental and economic benefits.
- Aggressive implementation of industrial waste minimization and the ISO 14000 series of standards is key to the long-term sustainability of the paper industry. In addition, as Cheng Loong's experience shows, good implementation can lead to regular recognition of efforts through awards and other forums.

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11. ECO-DESIGN AND ECO-EFFICIENCY IN EVERLIGHT CHEMICAL

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ABSTRACT

EverLight Chemical Industrial is engaged in the manufacture of high-tech chemicals. We realize that the earth has limited resources and appreciate the importance of sustainable development. As a responsible global corporate citizen, EverLight supports worldwide environmental movements. To fulfill our commitment to environmental protection, Everlight became the first chemical company in Taiwan to obtain ISO 14001 certification. The company has made clear strides in reducing the volume of pollution produced, and has also greatly improved its manufacturing and pollution prevention measures. EverLight's efforts to move toward cleaner production cover the whole product life cycle. Concrete successes have been enjoyed by using spray drying, to reduce the volume of wastewater, and by using hydrogenation to replace the original use of iron powders. In order to match the direction of environmentalism, EverLight Chemical has not only implemented active research and development into pollution prevention technology, but has set the raising of eco-efficiency and the expansion of resource productivity as its new management foci for the beginning of the next century. In the future, the company will work hard not only to reduce the amount of pollution generated by our operations, but also to implement a life cycle assessment of products and plan ways to reduce the load on the environment. Through these efforts, we hope to achieve our goals of "Design-for-the-Environment."

INTRODUCTION

The EverLight Chemical Industrial Corporation was established in 1972 as a producer of dyestuffs. After many years of hard work, its dyes have become extremely competitive, with annual sales of 20,000 metric tons in 1988. The company has become one of the top 10 dyestuffs manufacturers globally. Apart from dyes, the firm is also actively expanding into UV absorbers, bulk pharmaceuticals, electronic chemicals, and new materials such as Sol-gel. The company has positioned itself as a "high technology chemical producer" for the 21st century.

In order to match the direction of environmentalism, EverLight Chemical Industrial has not only actively implemented research and development into pollution prevention technology, but has set eco-efficiency and expanding resource efficiency as its new management foci. In the future, the company will not only work hard to reduce the

amount of pollution generated, but will also set criteria for new product design and plan ways to reduce the load on the environment. Through these efforts, the company seeks to achieve its goals of “Design-for-the-Environment.” The company’s major achievements in safety, health, and environmental management over the last five years are outlined in Table 1.

Table 1. EverLight’s Environmental Achievements, 1995–2000

Date	Activity	Sponsor
1996.10	Obtaining ISO-14001 Certification	DNV
1997.04	Awards for Excellence in Energy Conservation	MOEA
1998.03	Awards for Excellence in Pollution Control	EPA
1998.07	Voluntary Protection Program Accreditation	CoLA
1999.01	Application of Environmental Cost Accounting	Everlight
1999.01	Life Cycle Inventory in Dye manufacture	Everlight
1999.07	Corporate Environmental Report	BCSD, Taiwan
2000.01	Establishment of OHSAS 18001	IDB,CTCI

Abbreviations:

DNV – Det Norske Veritas.

MOEA – Ministry of Economic Affairs.

EPA – Environmental Protection Agency.

CoLA – Council of Labor Affairs.

BCSD – Business Council of Sustainable Development in Taiwan.

IDB – Industrial Development Bureau, MoEA.

CTCI – China Technical Consultants Inc.

ECO-DESIGN

New products are under environmental scrutiny from the first stage of the development process. In order to demonstrate compatibility with the environment, new products must undergo an environmental impact assessment during the planning stage. At each stage in the incubation pipeline for new products, environmental aspects must be evaluated by specialists, with results approved by the steering committee. After passing through the stages of verification and validation, the final designs must be reviewed according to their final environmental impact inventory data and their eco-efficiency is calculated. This environmental inventory database is a great help to the researchers in the effort to design environmentally sound products. The step-by-step, stringent evaluation process ensures that new products have the lowest environmental impact possible. Figure 1 depicts the new product design process and Table 1 shows an example of the Environmental Inventory Worksheet used at EverLight.

ECO-EFFICIENCY

Eco-efficiency is an indicator used around the world to relate company environmental performance to value creation. Eco-efficiency “is reached by the delivery

of competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing ecological impacts and resource intensity throughout the life cycle to a level at least in line with the earth's estimated carrying capacity." Application of eco-efficiency principles supports the monitoring and reporting of environmental and economic progress toward sustainability and facilitates decision-making by management and external stakeholders.

The creativity and innovation of the business community are the most important elements for improving eco-efficiency. Therefore, the following categories explain the progress that EverLight Chemical Industrial has made in reducing its negative environmental impact.

Air Pollution Minimization

During the process of manufacturing dyestuffs, particles and acid aerosols are created. To comply with the Air Pollution Control Act and industrial hygiene regulations, the company invested in facilities to effectively reduce air mists along the product line including: scrubbers, venturi towers, cyclones, packing towers, and baghouses. The interception of particles and aerosols is now over 99 percent. The air quality in the workplace fully complies with occupational safety and health standards and with environmental regulations.

Wastewater Treatment

Wastewater treatment is the most significant concern in the dye manufacturing industry. Due to various characteristics of dye synthesis, the volume and quality of the wastewater stream change frequently. Pollution prevention during processing is always our major objective as part of the continuing improvement of our environmental management system. Important recent projects included the recycling of waste acid into ferrous sulfate and the replacing of iron-powder reduction with hydrogenation. The former has effectively lowered the cost of coagulation, while the latter has significantly reduced the amount of iron sludge generated by our facility.

Significant progress has also been made in the treatment of our final effluent. Technologies and facilities to remove color and turbidity have already progressed to the tertiary treatment stage. The use of the advanced oxidation process is one successful example. Ozonation is a state-of-the-art technique, which effectively converts pure oxygen into ozone. In order to overcome the solubility problem of ozone, a venturi injector is used to completely coalesce the high velocity waste stream and ozone gas. The air-liquid two-phase stream is introduced into a pressurized vessel to oxidize the recalcitrant organic compounds in sufficient retention time. The effluent can be either recycled into an aeration tank to improve biological treatment efficiency, or can be directed into a neutralization buffer vessel for discharge. Ozonation promises to reduce the refractory COD and color in a highly efficient manner with less sludge. Through the combined application of pollution prevention and treatment technologies, our performance has improved greatly in recent years. Some environmental measures listed in Figures 2, 3, and 4. The operation of our wastewater treatment unit is depicted in Figure 5.

Solid Waste Minimization

Within the dyestuff manufacturing process, the solid waste problem has received a high level of attention. In addition to efforts to recycle and reuse wastes, costly incineration technologies have also been adopted to further reduce the volume of the waste sent to landfills. The first small-scale fluidized bed incinerator in Taiwan, designed by the Industrial Technology Research Institute, was built in 1995 in EverLight Factory 3 to incinerate waste solvents. Since 1999, all three EverLight factories have built their own incinerators to reduce the volume of industrial waste sent to landfill. The total volume of solid waste has been dramatically reduced to three percent of the original amount. A newly designed rotary kiln incinerator for sludge produced from wastewater treatment will soon be operational. As a result, additional reductions in waste volume are expected.

CONCLUSION

Over the past twenty-eight years of conducting business, EverLight Industrial Corporation has not only continually improved the technical standard and quality of its products, but has also unceasingly sought perfection in its environmental technology. As we march into the next century, EverLight Chemical will clearly unite its principles of economically, socially, safe, and environmentally balanced development to manage its five major areas of business. Creativity and innovation, ever higher eco-efficiency, and eco-design and research have already become key success factors in the culture and consciousness of EverLight. We believe that continuing to improve in this way and always striving to be better will surely allow us to achieve our goals of green production and sustainable development.

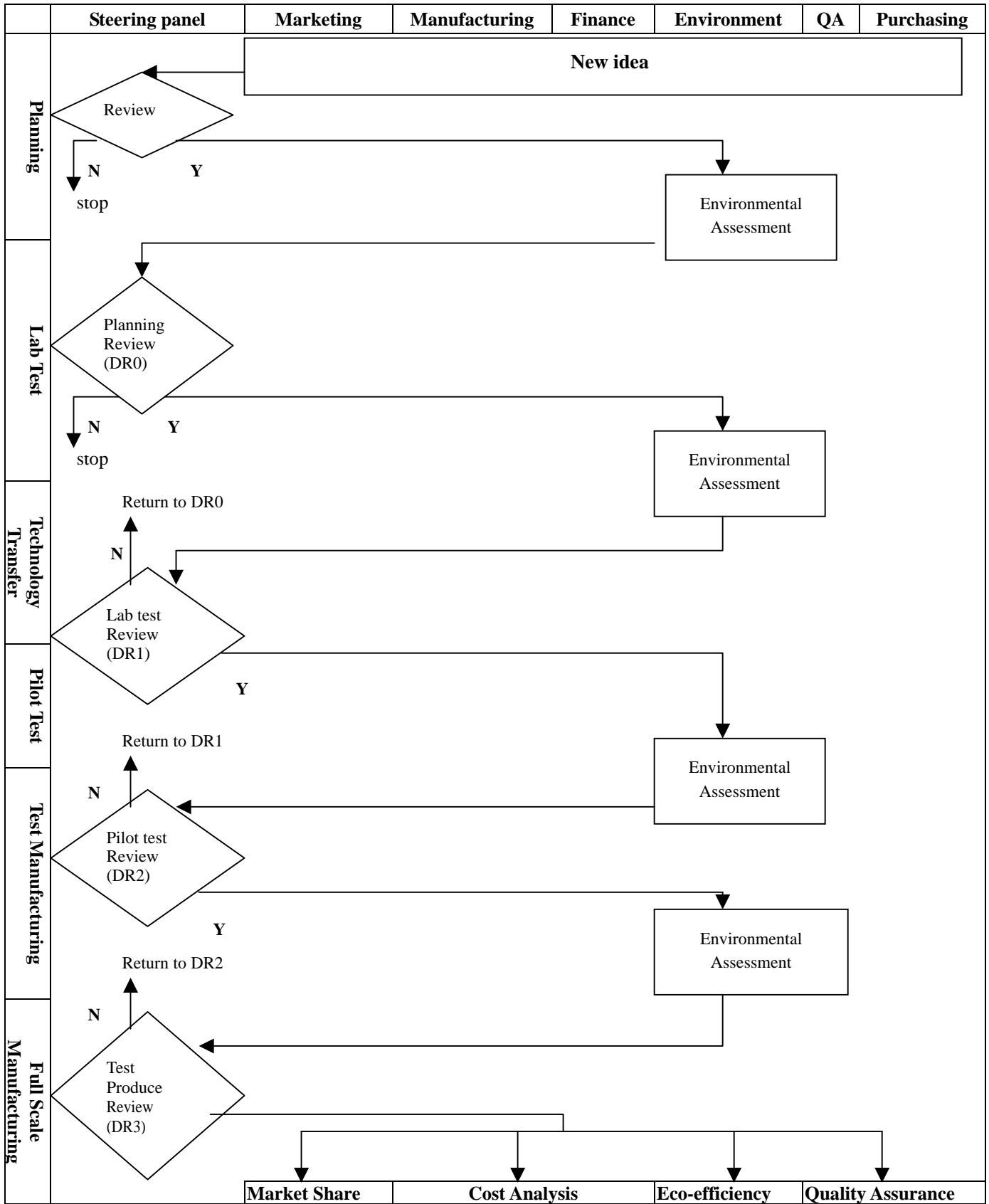


Table 2. Environmental Impact Inventory Worksheet

Product Name:

Investigator:

Date :

Duration : /yr /mon /date TO /yr /mon /date

Phone:

[illegible]

Figure 2. Electricity Use per ton of Product, 1995-1999

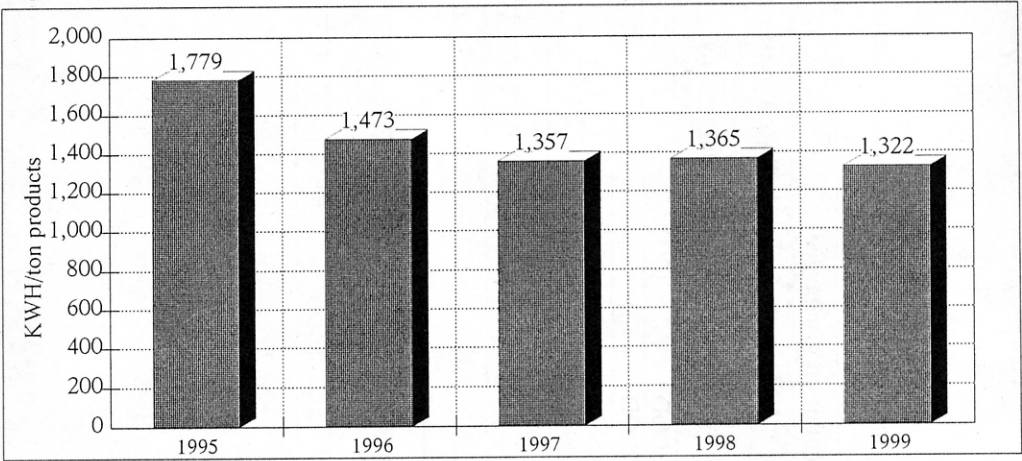


Figure 3. Well Water Use and Volume of Wastewater Discharged, 1995-1999

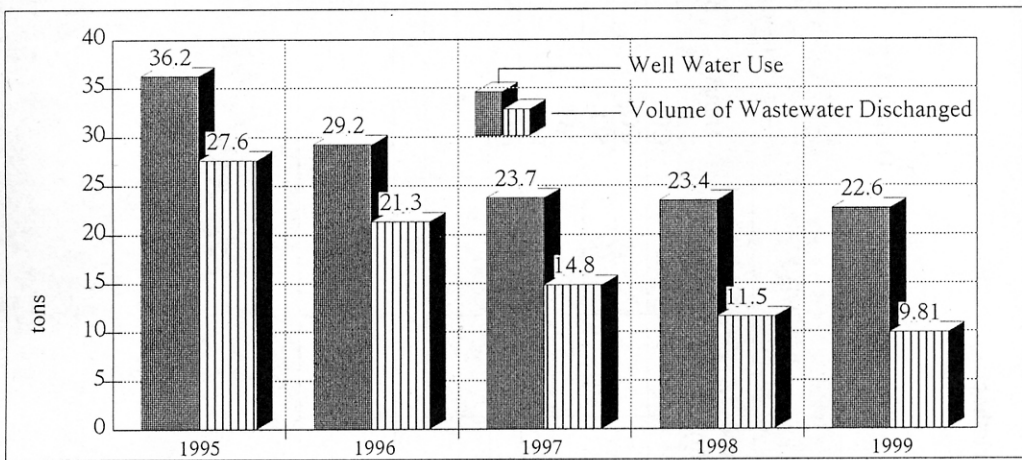


Figure 4. COD Generated per ton of Product, 1995-1999

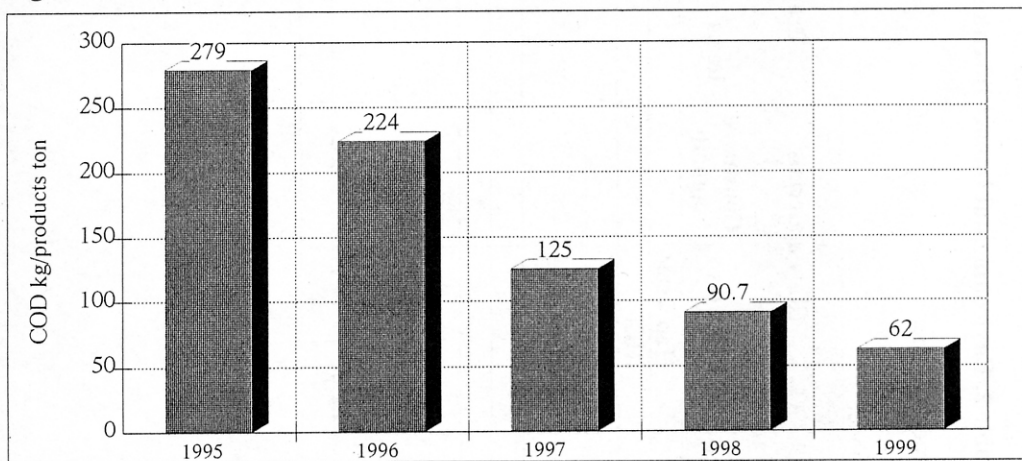
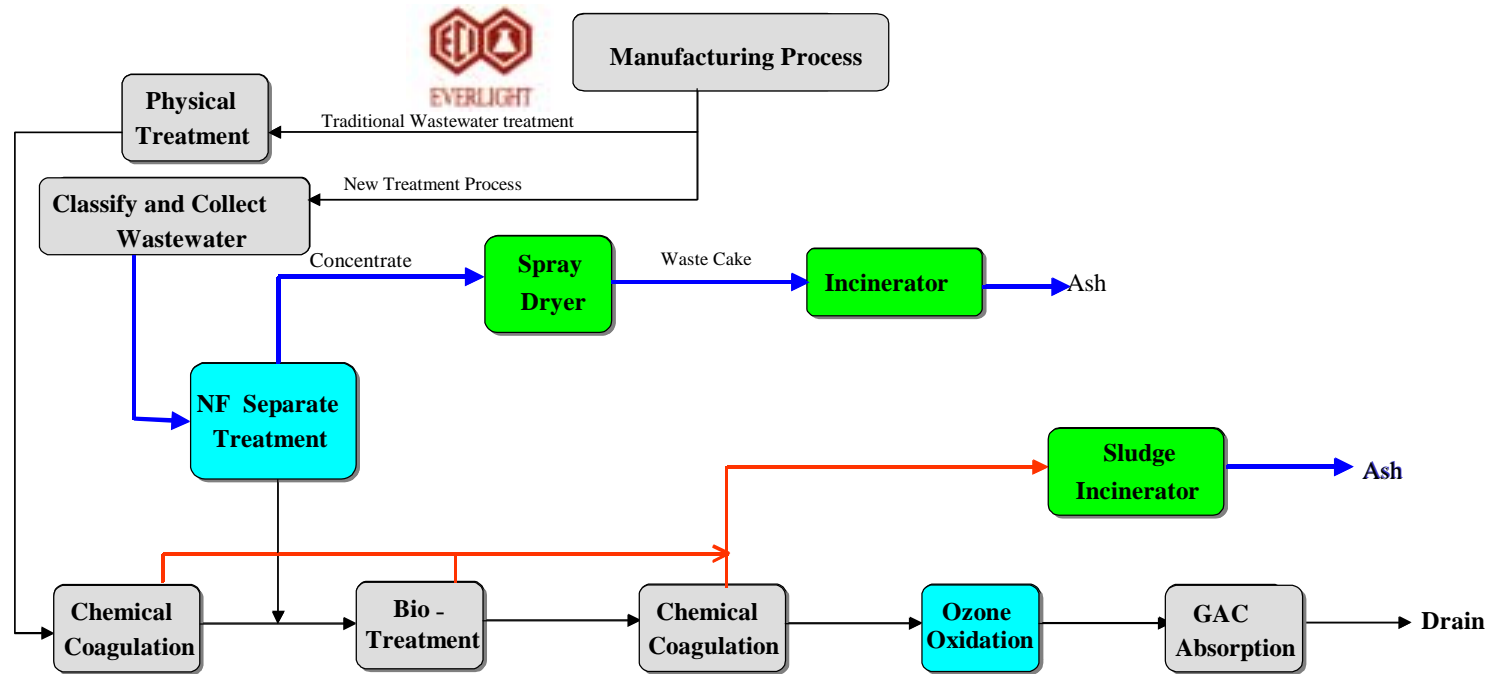


Figure 5. Flow Diagram of EverLight Wastewater Treatment System



12. ACER ENVIRONMENTAL REPORT

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CURRENT STATUS OF THE COMPANY

Acer Incorporated, founded in 1976, is involved primarily in the design, manufacture, and sale of computer systems, components, and consumer electronics products. Acer currently has 12 factories and 39 assembly centers worldwide, and the company sold 7.5 million personal computers in 1998. Not only is Acer ranked eighth globally, but the firm is also third in Latin America, and fourth in the Asian region (excluding Japan). It is ninth in the US market and has already moved into tenth place in the European market. Moreover, it is ranked Number One in more than 10 other countries. Additionally, Acer has established an outstanding global sales network with over 200 agents and more than 10,000 retail locations worldwide. Acer is also a major global OEM supplier.

Acer Inc. constructed its Hsinchu factory in 1981. In 1987, the company moved to the Hsinchu Science-Based Industrial Park, where Acer Inc. established its first production line. This is also one of the largest computer production points in Asia. The Hsinchu plant manufactures products including motherboards, desktop computers, notebooks, SIMM boards, servers, interface cards, consumer electronics, multi-media communications products, and applications software.

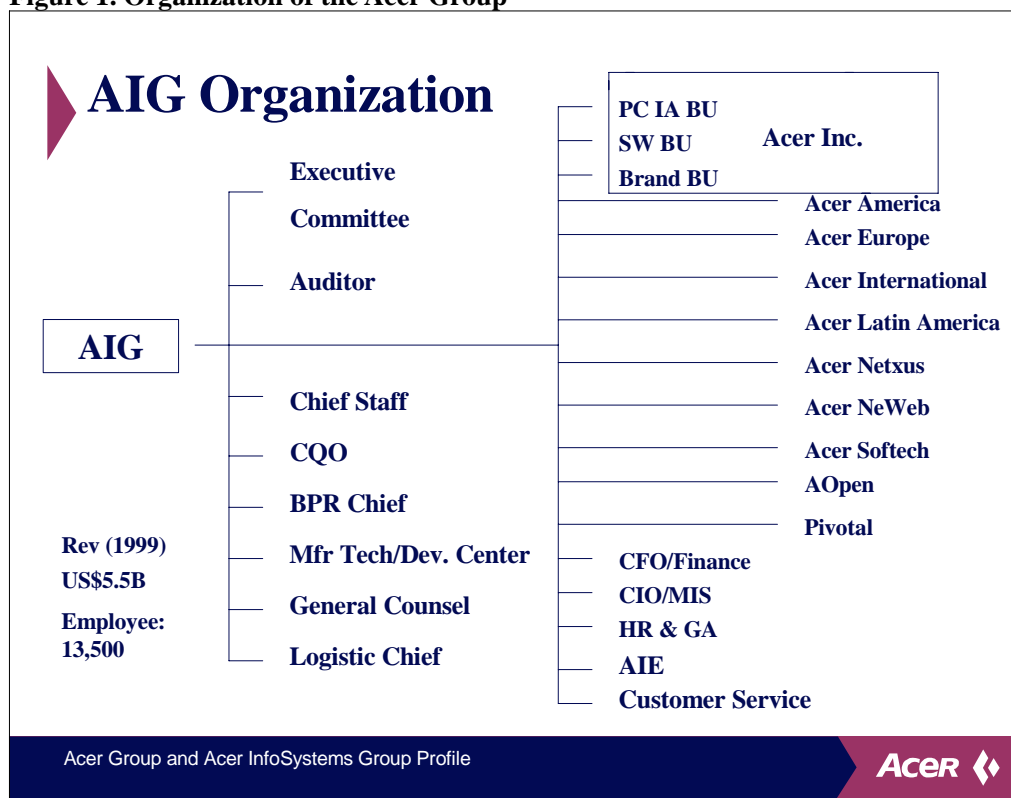
Since the company's founding, Acer has imported microprocessor technology, continually developed its R&D capabilities, established its own brand name, and internationalized as a company to participate in the revolution that information is bringing to human life. At the same time, Acer also instituted its concept of "fresh perspective," seeking to achieve creativity and change in its products, management, sales and service. As a result, Acer has received much recognition from the media. *The Far Eastern Economic Review* gave Acer a Number One rating as Taiwan's leading enterprise three years running. In April of 2000, Acer received the nod from *Reader's Digest* for the "Super Brand" status in the computer category for the 2nd consecutive year. Currently, Acer is moving into its third phase of development, in which its mission is to "provide fresh technology to be enjoyed by everyone, everywhere." At this time, Acer is also actively promoting its software business, and constructing the forward-looking IT community project, "Aspire Park." This will blend IT business operations with high-tech community living, will increase Taiwan's value-added in informatics; increase the nation's competitiveness, and will be effective in making information technology universal. It will also help to make a step toward making the "human island of technology" a reality.

Scope of Operations and Organization

The organization of the Acer Group is shown in Figure 1.

- Total Revenue: US\$ 5.5 billion (1999).
- Number of employees: 13,500.
- Number of Stockholders: 280,000.

Figure 1. Organization of the Acer Group



MAJOR ENVIRONMENTAL TOPICS

As a manufacturer and global supplier of personal computers and peripherals, Acer Inc. understands that all products, services, and activities can have an impact on our living environment. Since Acer Inc. established its factory in 1981, the company has constantly striven to reduce pollution in every aspect, and to minimize its impact on the environment. Apart from requiring employees to improve end-of-pipe treatments and reduce the use of resources, we also consider the environmental impact of a product's life cycle.

For example, in 1991 we made a break from traditional computer design, and led others in the industry in developing a personal computer assembled without screws. Using an innovative six-part molded assembly, the unit is easy to disassemble and facilitates the classification of materials during segregation for handling and recycling. In

January of 1993, in the culmination of a year's manufacturing and R&D effort, Acer Inc. eliminated all CFC cleaners from its circuit board production, reducing by several hundred tons the amount of CFC used annually. At the same time, Acer Inc. also requested its contractors and suppliers to cooperate in doing the same, and helped provide guidance. Also in 1993, we joined the United States Environmental Protection Administration's (US EPA) Energy Star Computers Program. In 1997, Acer Inc. again led the industry by obtaining ISO 14001 certification for environmental management systems, and, in June of 1998, issued its "Product Green Design Guide and Review Procedure." This requires product design to be accompanied by a checklist to guarantee that each product's planning and design incorporates environmental considerations right from the start.

ENVIRONMENTAL POLICY AND PROSPECTS

Acer Inc. holds to the principle that enterprises have the responsibility to protect the environment. After more than a year of work developing its internal systems, Acer Inc. obtained its ISO 14001 certification in September of 1997. Moreover, in 1999 Acer Inc. also launched a promotion for Hsinchu factory to initiate self-inspection on labor safety and health.

Environmental Policy

The environmental policy of Acer Inc. states that: "We have devoted ourselves to saving energy associated with our production and our products and to implement recycling programs for all of our key wastes. We will also prevent pollution by adopting lower pollution technologies...Acer Inc. is committed to implementing continual improvement and prevention of pollution."

Safety and Health Policy

The core of Acer Inc.'s safety and health policy is: "We believe firmly in work safety and health, as the only way to stress production." The full policy is presented in Figure 3.

EMS Safety and Health Committee

Acer Inc.'s "EMS Safety and Health Committee" is under the TQM Guidance Committee, and is headed by CEO Simon Lin. The committee structure is shown in Figure 4.

Figure 2. Acer Inc. Environmental Policy



Acer Incorporated Environmental Policy

As a manufacturer and worldwide distributor of computers and related peripherals, Acer Incorporated recognizes that its activities, products and services may impact on the environment. In order to reduce this, we are devoted ourselves to saving energy associated with our production and our products and implement recycling programs for all of our key wastes. We will also prevent pollution by adopting low-pollution technologies wherever feasible and by a careful selection of raw materials and suppliers.

Acer incorporated is committed to complying with all relevant environmental legislation and regulations and other requirements to which the company subscribes, and will exceed these where possible.

Acer incorporated is committed to implementing continual improvement and prevention of pollution.

The responsibility of implementing the company environmental management system is vested in the chief environmental management representative who reports directly to the president.

A handwritten signature in blue ink, appearing to read "Mike", is written over a horizontal line.

President of IPG
March 19,1998

Figure 3. Safety and Health Policy for Acer Incorporated Hsinchu Factory

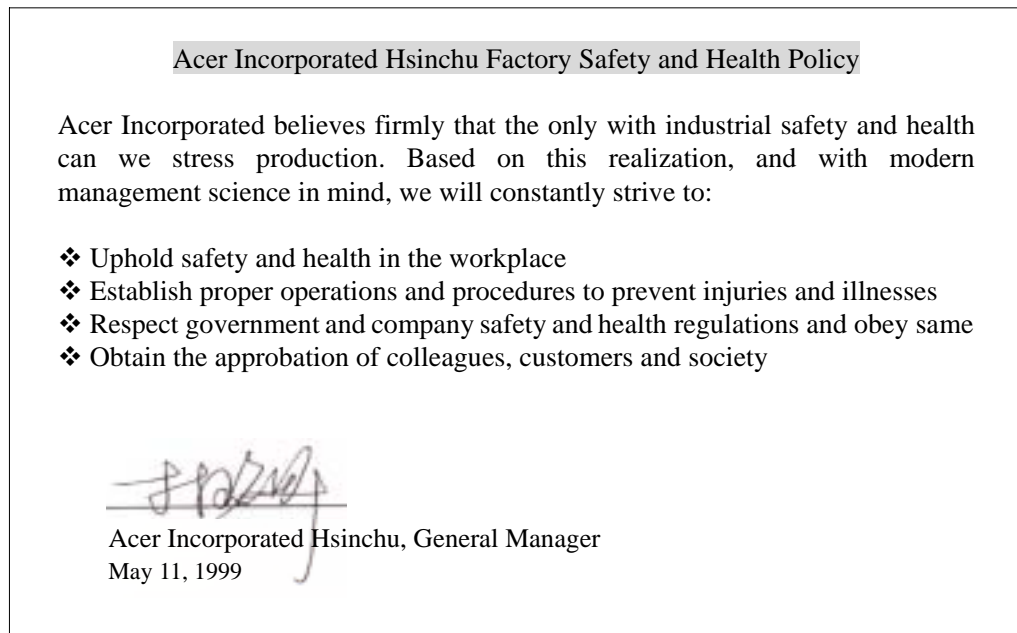
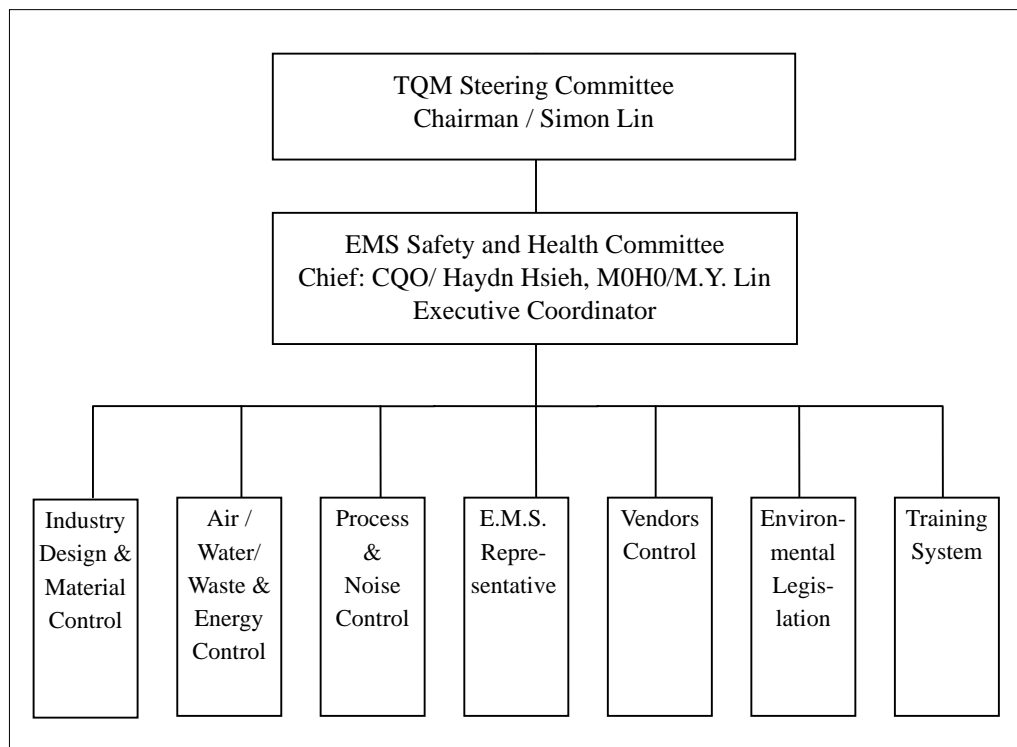


Figure 4. EMS Safety and Health Committee



ENVIRONMENTAL INITIATIVES: DEVELOPMENT RECORD

Acer Incorporated is one of the largest computer-assembly factories in Taiwan, and we have fully incorporated environmental protection concepts and measures into our operations. Whether in product manufacture, energy use, or packaging and recycling design, we always make our best effort to consider the environment. We always adhere to environmental standards. Apart from regulating ourselves, Acer Incorporated also extends environmental concepts and methods to its suppliers and contractors, inviting the entire industry to come together to work for the environment. Table 1 shows Acer Inc.'s important environmental protection milestones since 1991.

Table 1. Acer Incorporated Environmental Protection Milestones

1991

- ✎ Promoted a screw-less PC that was easy to disassemble and recycle.
- ✎ Developed an on-screen user's guide to replace the printed user's guide.

1992

- ✎ Developed technology to upgrade computers with ChipUp Technology to eliminate the pollution caused by discarding outdated equipment.
- ✎ Developed an energy-saving multi-media personal computer, the AcerPAC.
- ✎ Began use of recycled paper and corrugated materials for computer packaging in Holland and Taiwan, replacing traditional Styrofoam.
- ✎ Began use of water-soluble inks to print packaging materials, replacing oil-based printing inks which contain heavy metals.
- 🏆 Awarded the 1st Republic of China Enterprise Environmental Protection Award.

1993

- ✎ Led the industry early in the year in eliminating use of CFC cleaners from the motherboard manufacturing process.
- ✎ Executed total recycling in German branch.
- 🏆 Won the Republic of China Ozone Layer Protection Association's "Outstanding Achievement" award.

1994

- ✎ Used Ni-MH batteries to replace harmful Ni-Cd batteries.
- 🏆 Won first place in the German BUND Organization Information Industry Environmental Assessment.

1995

- ✎ Asked all outside contractors to cease use of CFCs.
- ✎ Established waste computer recycling network point in German Branch.

1996

- ✎ Promoted "Protect the Environment Daily" campaign in its offices.

Continued...

Table 1. Acer Incorporated Environmental Protection Milestones (...continued)

1997

- ☛ Won a rating of “Good” in the German BUND Organization Information Industry Assessment, along with HP and Siemens Nixdorf.
- ☛ Certified in ISO 14001.

1998

- ☛ Established the “Product Green-Design Guide and Review” procedure.
- ☛ Promoted “Acer Inc. Industrial Safety, Health and Environmental Protection System” between Acer Inc. and satellite factories.

1999

- ☛ Promoted the self-inspection system on Labor Safety and Health in Hsinchu Factory .
- ☛ Won the Republic of China Environmental Protection Administration’s “Office Environmental Award.”

2000

- ☛ Establishing “Environmental Performance Evaluation Project” in Hsinchu Factory.

ENVIRONMENTAL INITIATIVES AND PERFORMANCE

Acer Incorporated views industrial waste reduction and environmental protection as a company responsibility, operating in tandem with the concepts of enterprise management. The following sections describe Acer Inc.’s experience in industrial waste reduction and environmental protection, including: green design, green manufacturing, green packaging, recycling and reuse, and other important product life-cycle environmental initiatives.

Green Design

Acer Incorporated integrates the concept of environmental protection into the product- planning stages. Our efforts have included the development of the “Product Green-Design Guide and Review Procedure,” the manufacture of energy-saving computers, and the design of an on-screen users’ manual.

Development of the “Product Green-Design Guide and Review Procedure”

Acer Inc. issued our “Product Green-Design Guide and Review Procedure.” These procedures demanded a new way of planning, and asked that planning managers, industrial designers, and product design engineers all fill out a “Green-Design Guide and Review Checklist” during the course of product design. These checklists guarantee that each product’s planning and design fit environmental considerations right from the start of the planning process.

Development of energy-saving computers

Acer Inc. brought out a multi-media function and automatic energy-saving system in the AcerPAC personal computer in April of 1992. This model incorporated automatic energy saving capabilities in powered-down mode, for which Acer applied for a patent. The same year, Acer Inc. joined the United States Environmental Protection Administration's Energy Star Computers Program, becoming the first foreign enterprise to participate in this program to promote energy savings and environmental protection. In 1993, Acer won an Energy Star certificate from US Vice President Al Gore.

The standard process for saving energy consists of reducing a computer's energy consumption to 30 W or less in powered-down mode. By so doing, energy consumption is cut by half. According to US EPA statistics, if personal computers were all equipped with energy saving capabilities, the United States could save US\$ 1 billion dollars in energy costs annually. This would in turn reduce emissions from power plants by an amount equivalent to the emissions created by 2.5 million cars in a year.

On-screen user's guide

In 1991, Acer Computer led the industry in providing an on-screen users' guide to replace the traditional printed user's guide. The users' guide displays pictures and text directly on the computer's monitor, which not only makes the documentation more convenient and more personalized, but also reduces deforestation and energy expended in papermaking.

Application for TCO certification

The Swedish Confederation of Professional Employees (TCO) is an organization made up of white-collar workers from various fields within Sweden. Its 1.3 million members include engineers, secretaries, teachers, and many others. This organization's main work is to set stringent environmental protection and ergonomic standards to protect its members and to ensure that they enjoy a good, safe working environment. TCO'92 and TCO'95 dealt with environmental standards, mainly for computer monitors. TCO'99 standards were divided into five major categories, making application for certification for systems and keyboards possible. In Taiwan, Acer Peripherals, Inc. and Mitac were among the first group of companies to obtain such certification. As most Taiwan companies already subscribe to TCO'95, no further applications will be accepted as of early next year. However, for monitors with their 18- to 24-month lifespan, the term is expected to extend to the year 2000. At that time, the European market will subscribe to TCO '99. Acer Inc.'s affiliate OEM factories applied for TCO'95 and TCO'99 certification in 1998, and obtained TCO'99 certification for the Acer brand in 1999.

Green Manufacturing

Acer Incorporated subscribes to the concept of reducing energy consumption and doing its best to use raw materials with minimal pollution. This includes doing research and development into SMT manufacturing processes that do not require rinsing, DIP wave soldering requiring no rinsing, and other advanced low-polluting technologies.

Announcement of CFC rinse-free circuit board

Acer Inc. imported the SMT technology manufacturing process around 1990 due to difficulties in rinsing PCB from small-footprint parts. In order to guarantee quality, CFCs

were used to rinse remaining flux. Based on environmental considerations, as well as on tariff pressure from foreign governments, Acer Inc. established a working group in 1990, which worked in coordination with Taiwan's Industrial Technology Research Institute, to search for an alternative. After over a year of effort, Acer Inc. announced in January of 1993 that it had eliminated all CFCs washing from its circuit board production. This reduced the amount of CFCs and marked successfully development of a PC circuit board manufacturing process which does not require CFC chemical rinsing. Furthermore, Acer Inc. developed a suitable timetable to ask its subcontractors to also stop using CFC rinsing processes, and invited the ITRI Chemical Engineering Institute to a workshop to provide Acer's contractors and suppliers with the technology to switch from CFCs.

Acer Inc.'s huge success in this endeavor shows not only the Republic of China's technological capabilities in the information industry, but also its ability to adapt and determination to promote environmentalism. It has also benefited the Republic of China's overall industrial image.

Table 2. Actual and Projected CFC Usage

Year	Actual CFC usage	Projected CFC usage
1991	15.41	-
1992	19.65	-
1993	0	36
1995	0	236.3
1996	0	354.54

Unit: Metric Tons.

Note: * Projected usage figures are for continued use of CFCs.

Development of DIP rinse-free technology

The DIP wave soldering process helps maintain product quality. Originally, DIP pure water was used to rinse. However, in order to reduce the use of water and energy, in July of 1994 Acer Inc. began to use a DIP method requiring no rinsing. This reduced consumption of resources and the production of wastewater. Detailed data is shown in Table 3.

Table 3. Resource Consumption in DIP Wave Soldering

Year	PCB quantity (Kpcs)	Clean water use (metric tons)	Electricity consumption (degrees)
1991	682	4,992	29,952
1992	931	4,992	29,952
1993	1,135	4,992	29,952
1994	2,192	1,871.6	12,480
1995	4,033	0	0
1996	5,780	0	0

Supplier management

Apart from Acer's own internal efforts at environmental protection, the production and distribution methods of suppliers and contractors also have an indirect influence on Acer's own environmental performance. In 1998, Acer Inc. set up the "Acer Inc.

Industrial Safety, Health and Environmental Protection System” to promote industrial safety and provide guidance on environmental issues. The system is also designed to encourage interaction between Acer Inc. and satellite factories to improve industrial safety and environmental management practices in satellite factories. The system reduces management risk and helps improve the operations in satellite factories, thereby achieving a win-win result.

Implementation of the system included: planning discussions; periodic meetings to track progress; education and training; on-site guidance for the satellite factories; evaluation of satellite factory performance; and publication of the results. The plan followed the PDCA management flow system.

Green Packaging

In terms of green packaging, Acer Inc. has led efforts to develop corrugated paper packaging for computers to replace and reduce the use of styrofoam packing materials. Moreover, we also use unbleached paper boxes and water-soluble inks to reduce the use of solvents.

Replacement of styrofoam with corrugated paper

Beginning in January of 1993, Acer Inc. replaced all styrofoam packing materials with corrugated paper. In Taiwan, this unprecedented method of packing computers was successfully developed by the Industrial Design R&D Division. Currently, many patent applications have been submitted in relation to this method. Moreover, Acer Inc. has also replaced plastic bags with paper bags for the packing of floppy drives, cables, and other computer parts.

Use unbleached paper boxes and water-soluble inks

In recent years Acer Computer has used printed, unbleached paper boxes to reduce the use of oil-based inks. Acer also tries its best to use water-soluble, one-color printing to replace oil-based printing inks that contain heavy metals.

Recycling and Reuse

Whether in industrial design or the use of raw materials, Acer Inc. performs classification, recycling, and reuse of resources. In this way, Acer achieves its goals of resource conservation and cost reduction.

Designing easily dismantled computers

One important consideration in resource recycling is waste classification. In July of 1991, Acer Inc. made a break with traditional computer design and led the industry in the development of a personal computer assembled without screws. This computer model used an innovative six-part molded assembly, which was easy to disassemble, and which could be quickly divided into its component parts. In this way, the classification of materials for segregation for handling and recycling is facilitated. After testing, it was shown that, on average, only sixty seconds was required for dismantling operations. Moreover, Acer Inc. also asked its suppliers to provide easily recyclable parts.

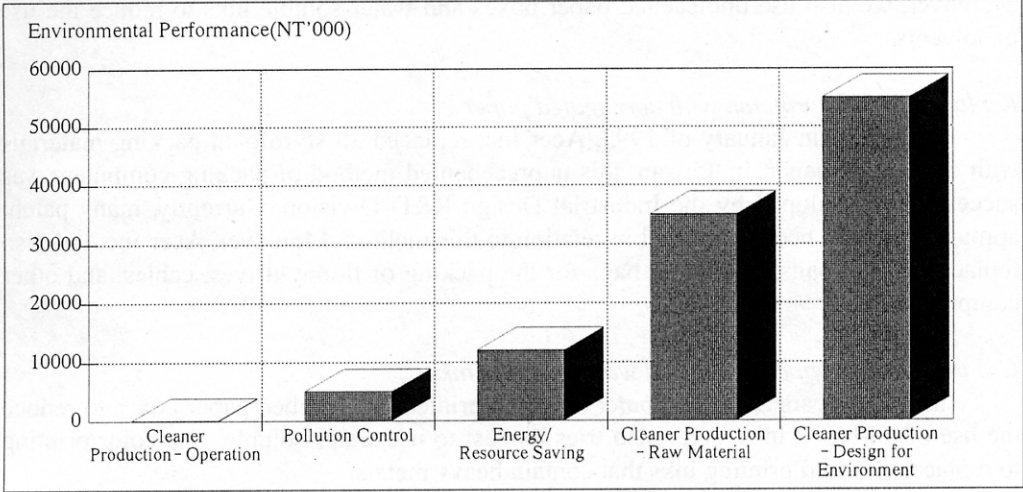
Production line resource recovery trays

On the production line, many raw materials, such as chip sets, CPUs and the like, are stored in anti-static trays after they enter the factory. If these materials enter the waste stream directly after use of the parts, this not only creates waste, but is also a waste of resources. Consequently, after use, the anti-static trays are classified and collected, and sold to integrated circuit packaging firms for repeated use.

ENVIRONMENTAL PERFORMANCE

Figure 5 shows an evaluation of Acer Inc.'s environmental performance in 1998, including: cleaner production, pollution control, and energy and resource conservation.

Figure 5. Environmental Performance Evaluation Statistical Graph



MARKET RESPONSE

Acer Inc. views industrial waste reduction and environmental protection as a necessary company responsibility in tandem with the concepts of enterprise management. From green design, manufacturing, and packaging to recycling and reuse to industrial waste reduction to office environmentalism and the like, Acer is working for the environment. All these reflect Acer Inc.'s commitment to and results in the area of environmental protection. Acer Inc. is not only a world standard in technology and competitiveness, we have also been cited by "CommonWealth," the biggest social and political magazine in Taiwan, as a "1998 Banner Enterprise." Acer Inc. earned the highest assessment for "shouldering enterprise responsibility" (environmental and social) from CommonWealth.

AWARDS AND ISO CERTIFICATIONS

In 1992, Acer Inc. was awarded the Republic of China's (ROC) first Enterprise Environmentalism Award. In 1993, Acer Inc. won the ROC Ozone Layer Protection Association's "Outstanding Achievement" award. In terms of awards from overseas, in 1993 the AcerPAC, the 250+ function computer, won the US EPA's approval to carry the Energy Star sticker. In 1994, Acer Inc. won first place in the German BUND Organization Information Industry Environmental Assessment. In 1997, Acer Inc. won a rating of "Good" in the German BUND Organization Information Industry Assessment, along with HP, Siemens Nixdorf, and other international firms. Acer Inc. obtained ISO 14001 certification in September of 1997. In 1998, the "Acer Inc. Industrial Safety, Health and Environmental Protection System" extended environmental protection to suppliers and contractors.

Acer Inc. has been continuing to promote its environmental concepts, whether in product manufacturing, energy use, packaging materials or recycling design. Whatever the area, Acer Inc. makes an effort to reduce pollution, and we always adhere to the local environmental standards wherever we operate. Along with strictly regulating our own activities, Acer Inc. further extends its environmental concepts and methods to its suppliers and contractors, inviting the entire industry to come together to work for the environment and to conserve natural resources. Let's do our part for the Earth we all rely on.

13. ENVIRONMENTAL POLICY AND SUSTAINABLE DEVELOPMENT AT THE CORPORATE LEVEL

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ABSTRACT

The earth's rapidly emerging environmental crisis has been widely discussed with reference to recent environmental trends. The principles of sustainability and natural rules, including the nutrient cycles, grazer food chains, and decomposer food chains etc, are outlined here, the better to provide a better overall picture of sustainable development. The industrial schemes to reduce environmental impact are then substantiated in terms of these principles and rules. The essence of environmental policy, environmental management systems, and the principles of cleaner production at corporate level are discussed. The paper closes with the experiences of the China Steel Corporation in environmental reporting, waste recycling, and cooperative efforts to promote waste recycling in steel mills.

INTRODUCTION

Is There Another Millennium?

A thousand years is a very long time for human beings, but merely a flash in the 4.6 billion-year history of Earth. Over the last 4.6 billion years, the earth has evolved into a very unique state, a vivid and beautiful spot in the universe, not only livable but also a comfortable habitat for countless living things.

Since the ancient times, human activities have been oriented towards self-satisfaction with little concern for environmental conservation. The industrial development in the 20th century, accelerated by fast population growth and the use of advanced technologies, has followed this trend. Industrial development can be characterized as: resource depleting, energy intensive, and pollutant generating. Moreover, it resulted in a re-distribution of crucial substances in natural environment, including:

- *Carbon and sulfur* released from burnt fossil fuels and forming CO₂ and SO_x in the atmosphere;
- *Heavy metals* extracted from underground mines and eventually contaminating the soil and water; and

- *Chlorine* from inorganic substances often forming dioxins during the course of thermal processes.

Over the years Mother Nature has found ways to maintain a clean and sustainable environment for the living world. However, over the last few decades, the environmental impact from rapid economic development and industrialization has largely overloaded the Nature's capacity. Consequently, the environmental and ecological balance on Earth has been seriously disrupted, as indicated by the recent environmental trend shown in Table 1. Global warming, ozone holes, abnormal weather, extinction of species, and the emergence of new illnesses and diseases are just a few of the symptoms reflecting the rapidly emerging environmental crisis (Figure 1).

Table 1. Major Trends in the Global Environment

Human population	+1.7%/year	Living species	-4/hour
Fertile land	-2.5%/year	Greenhouse gases	+1%/year
O3 in ozone layer	-3%/year	Aerosol	+1%/year

Source: Carley and Spapens, 1998.

Moreover, these devastating environmental conditions are not easily reversed, due to the following reasons:

1. *Insufficient awareness about the environmental crisis:* Environmental effects become apparent at a much slower pace than most things in the daily life of humans. It is quite natural that human beings pay attention to factors whose impact is directly apparent in their daily lives –such as food, clothing, housing, entertainment, and their financial condition– and remain insensitive to the slowly changing environment. This situation is only becoming further exaggerated as industrialization continues to increase the pace of our daily life.
2. *The huge inertia in human society:* The activities of human society are not environmentally friendly in general. As the human population has grown by 6 billion people at the end of 20th century, it represents a huge inertia and momentum against the conversion to a sustainable society.

As a result, the current environmental crisis is only to intensify in the next century. Environmentalists have tried to estimate the environmental load in the next century. The results shown in Figure 2 suggest that the Global Environmental Impact (GEI) at 2050 will be ~10 times of current level (the so-called Factor-of-10 scenario), provided the ratio of Environmental Impact to GDP remains the same.

Figure 1. The Emerging Environmental Crisis Due to Rapid Industrialization

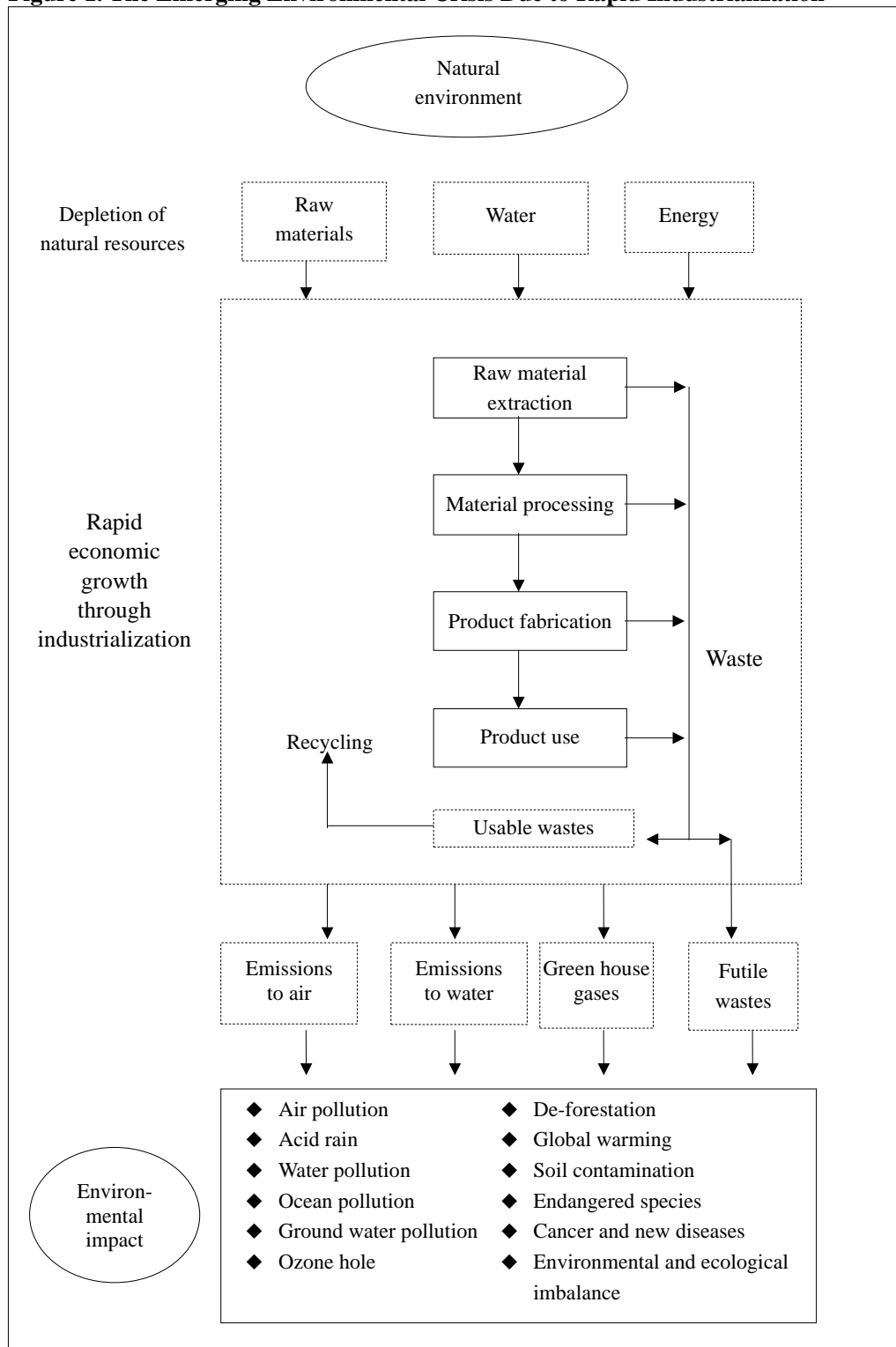
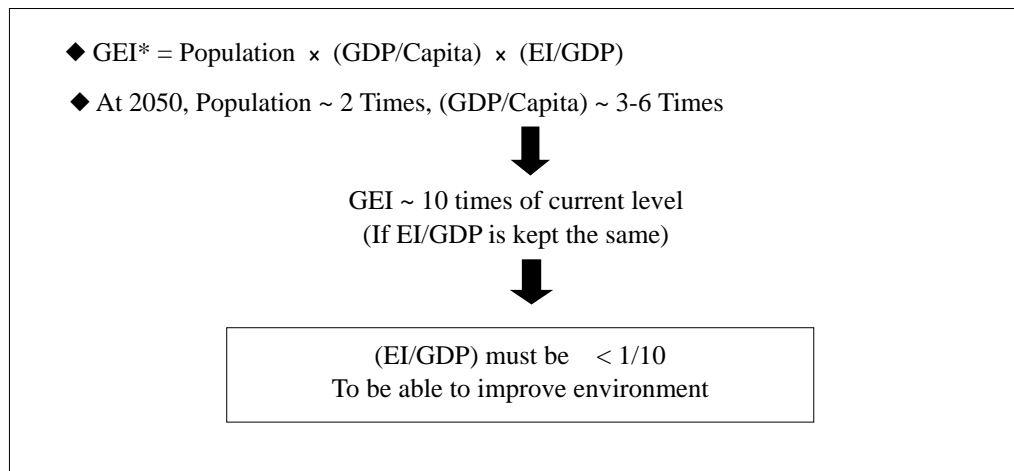


Figure 2. The Factor-of-10 Scenario



Note: *GEI = Global Environmental Impact.

With this understanding, there is little reason to be optimistic about the next millennium unless profound changes are initiated and can materialize their impact quickly.

Sustainable Development: An Urgent Issue Requiring More Action

Sustainable development (SD), a concept that has been proposed to provide solutions to this environmental crisis, was introduced into developed countries over a decade ago. In recent years, it has continued to gain more recognition around the world. Nevertheless, the significance and the urgency of this subject may not be fully understood by the public or the industrial sector, if judged from their current activities. Therefore, much additional effort is needed to promote this concept, and to translate it into concrete actions.

Principles of Sustainable Development

Environmental scientists (Chiras, 1991) have summarized their understanding of sustainable principles based on the observations of nature. These principles can be elaborated and outlined as both ethical principles and operating principles.

Ethical principles

1. *Comply with natural rules.* Humans are a part of nature and subject to its rules. Human beings violate the rules of nature at their own risk;
2. *Cooperate with natural forces.* Humans must not dominate nature, but should learn to cooperate with its forces;
3. *Share limited resources fairly.* The world has a limited supply of resources that should be shared among all living things (existing or to come), since all are in the same boat and closely related to each other;
4. *Balance material and intellectual needs.* The environmental impact (EI) of human society originates from its material needs for better food, clothing, housing, transportation etc, while little comes from the intellectual needs.

Balancing our needs better (based on cultivating an environmentally friendly mindset) will significantly reduce the EI of human society; and

5. *Global cooperation:* All human beings are faced with the same environmental crisis, despite the differences in industrial, economical, cultural, or living conditions. This crisis can be resolved only when the global village acts like a team. Therefore, to create an environmental consensus for global cooperation is also quite critical.

Operating principles

1. *Control population.* The human population has been growing steadily for centuries. There is no doubt that humanity must find a way to stabilize the size of its population in order to guarantee a sustainable future;
2. *Conserve resources and energy.* Cut back unnecessary consumption of resources/energy and use only what is needed;
3. *Recycle materials as secondary resources or energy.* Use products/materials over and over before turning them into futile wastes, and also seek to use energy in a cascading manner;
4. *Increase renewable resources or energy.* Renewable resources and energies (e.g. trees, wind, or solar energy) should be chosen over non-renewable ones (e.g. plastics, synthetic cloth, fossil fuels) whenever possible;
5. *Reduce EI through all activities.* The EI from human activities should be reduced as much as possible. Otherwise, our EI could accumulate and be returned to human society through the natural rules; and
6. *Formulate a worldwide win-win situation.* The formulation of a worldwide win-win situation incorporating both economic and environmental issues is a necessary and challenging task.

Natural Rules for Sustainability

Eco-system, an abbreviation for the words “ecological system,” is used to describe an interdependent and dynamic biological, physical, and chemical system in environmental science. From the study of natural eco-systems, environmental scientists have discovered the following systems for maintaining the environmental/ecological balance on Earth (Chiras, 1991, Peavy et al, 1985):

1. *Purification mechanisms for air and water.* Mother Nature has its own ways to purify the global commons on the earth (i.e., air and water);
2. *Nutrient cycles for Water, Carbon (C), Nitrogen (N), and Phosphorus (P), etc.* These cycles are the mechanisms through which Mother Nature supplies sustainable nutrients to all living species on the earth. Among these, the “carbon cycle” and “nitrogen cycle” are depicted in Figures 3 and Figure 4 respectively;
3. *Grazer food chains and food webs.* Most living species on Earth are in the grazer food chains/webs (Figures 3 and 4). Human beings are at the top of the chains/webs, and are rapidly over-populating ecosystems; and
4. *Decomposer food chains.* Many fewer species live in decomposer chains than grazer food chains. These species, living on the remains/wastes generated by the grazer food chains/webs, are the natural means for waste recycling (Figures 3 and 4).

Figure 3. “Carbon Cycle” in Nature

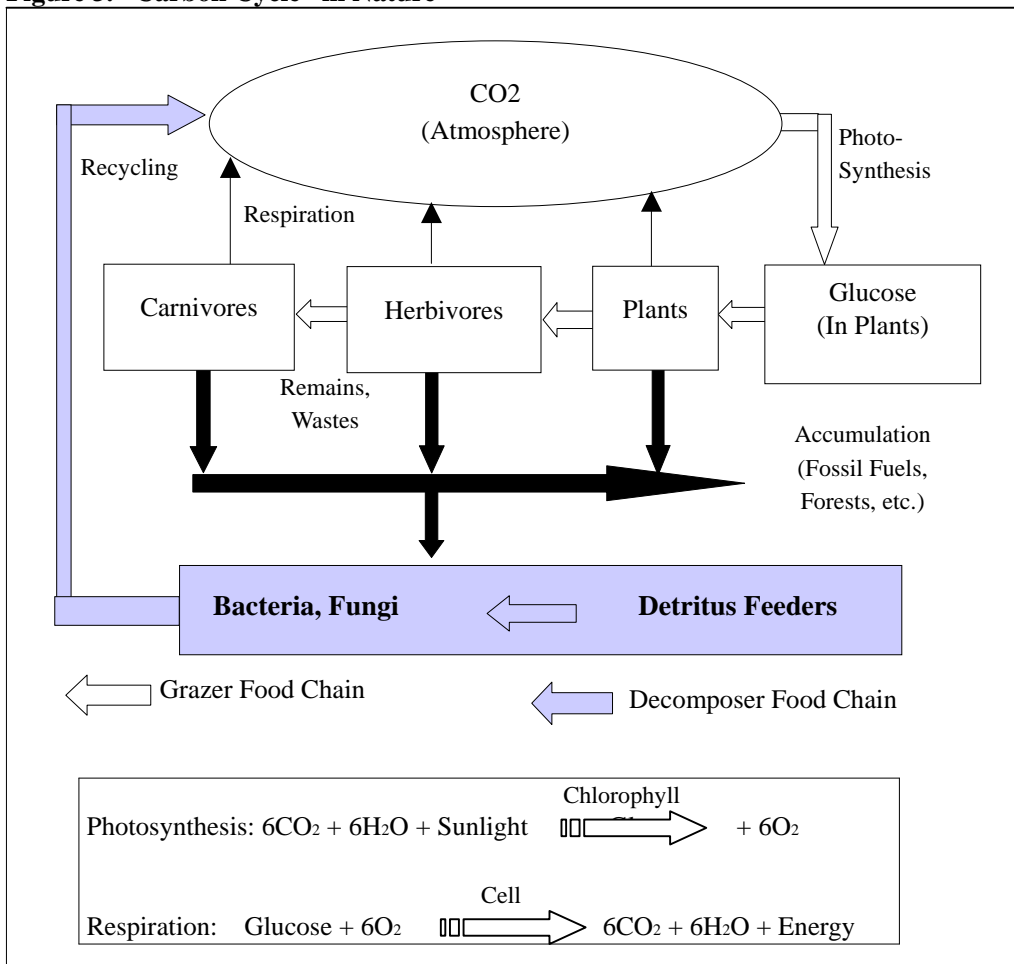
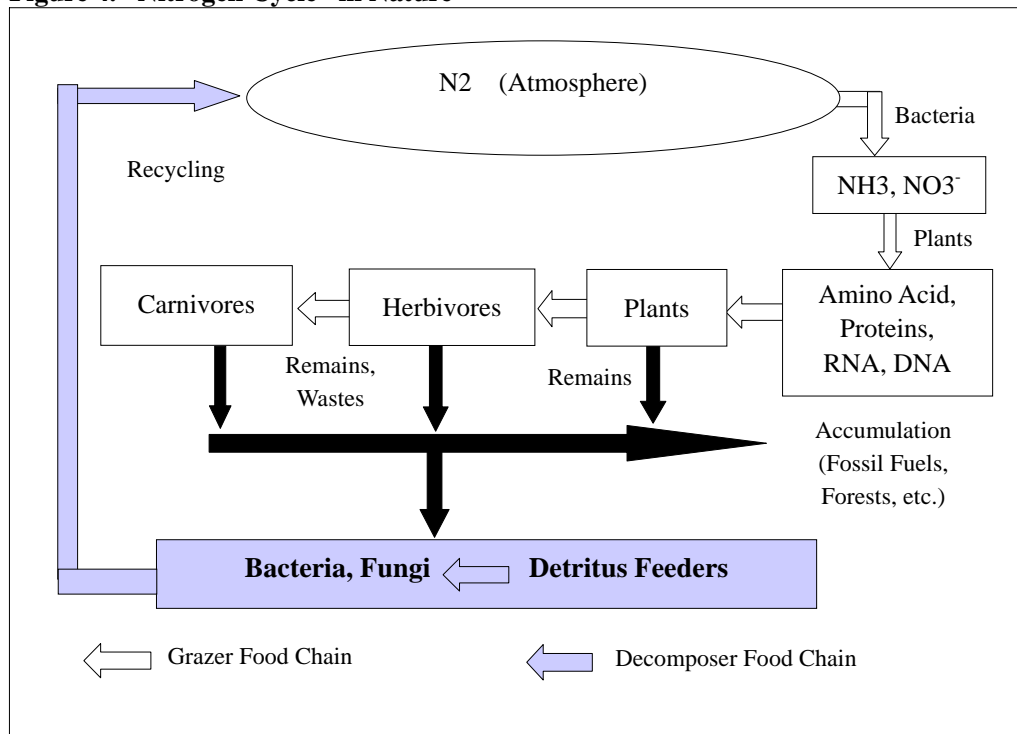


Figure 4. “Nitrogen Cycle” in Nature



SCHEMES TO MINIMIZE INDUSTRIAL ENVIRONMENTAL IMPACT

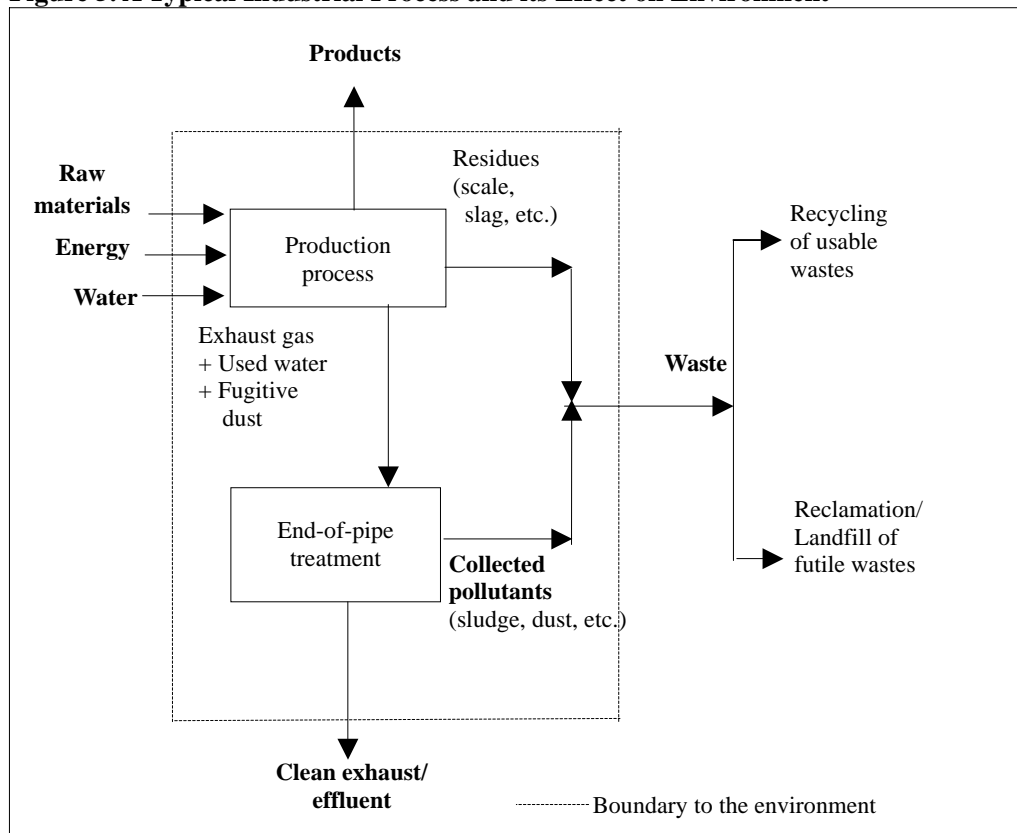
An industrial process and its effect on the environment can be simplified as shown in Figure 5.

Figure 5 implies that environmental impact can be reduced in an industrial process by applying the following cleaner production (CP) approaches:

- *Improved production technology.* A fundamental cleaner production approach is to minimize the consumption of resources/energy while maximizing the functions of products by use of improved production technology in existing or new processes;
- *Proper use of end-of-pipe treatment.* The EI of a production process can be reduced by proper use of end-of-pipe treatment technologies to clean up exhaust gas/effluents and to capture the fugitive dust; and
- *Proper handling of wastes.* A major means to reduce EI lies in the recycling of usable wastes while minimizing the EI of wastes that must be disposed of by landfill, incineration or other such means.

The major constituents of industrial wastes are residues from the production process and the collected pollutants from end-of-pipe treatment systems (Figure 4). The handling of industrial wastes is a critical part of CP and SD because:

Figure 5. A Typical Industrial Process and its Effect on Environment



- *It is the final step in pollution control.* End-of-pipe treatments are widely used in the pollution control of exhaust gas, fugitive dust, and used water. However, they do not solve the pollution problems completely, as they only collect the various forms of pollutants and transform them into other types of wastes for final handling.
- *It concerns a wide range of harmful substances.* Industrial wastes contain a wide range of concentrated pollutants that are incompatible or hazardous to the natural environment. Their EI could be very high unless properly treated.

Based on the above discussion, the schemes to minimize the EI of industrial activities can be listed as follows:

1. *Maximize the amount product function for each unit of EI generated.* This is a key focus of green design or ecological design;
2. *Product sharing.* The demand for a hardware-type product can be replaced with a rental service or sharing among customers. Rental cars and rental carpets are good examples;
3. *Repeated use of products.* The EI of a product can be largely reduced if it is used over and over. Good examples include the reusable shopping bags or utensils made of stainless steel;

4. *Cascade use of product.* The reuse of a discarded product in a function or situation that is less demanding is another way to reduce EI. Examples include the use of waste paper for Xeroxing, the use of second hand cars/Xerox machines, as well as the goods in the flea market;
5. *Repeated or cascade use as component.* A similar effect could take place if a product is reused as a component;
6. *Recycling as material.* A waste can also be recycled as a material. The repeated recycling of scrap in steel manufacturing is a good example;
7. *Cascade use of energy.* Another scheme for recycling (although not as preferable) is the use of combustible waste as an energy source; and
8. *Return to the earth at minimal EI.* Unless human beings can develop a closed-loop society that recycles everything, a portion of our wastes must be returned to the earth in some form. It is our responsible to find a form and manner that minimizes EI.

In light of the framework outlined above, a few principles should be noted:

1. *Combined greening paths are possible.* The more recycling paths are available for a product, the more environmentally friendly the product will be;
2. *More alternatives for downstream products.* The available recycling paths for downstream products (such as a motor vehicle) are more varied than the upstream products (such as steel or plastics) by their nature; and
3. *Biodegradability is the trend.* Biodegradable materials, closely mirroring the “decomposer food chains” in natural environment, are more environmentally friendly. They will become more popular in future.

WHAT TO DO AT CORPORATE LEVEL: A MATTER OF VISION AND POLICY

Corporate level managers play the key roles in environmental policy making and in the promotion of CP and SD. The essence of their contributions are discussed as follows:

1. *Create a culture with environmental vision.* Environmental vision, along with other top managerial issues, should be continually updated and built into the corporate culture. Corporate employees will then follow this vision in their daily operations;
2. *Integrated environmental policy and Environmental Management System (EMS).* Environmental policy and EMS will be indispensable in future. However, their effectiveness may not be apparent unless they are properly integrated with other corporate policies/systems;
3. *Setup a useful diagnosis system.* Continual diagnosis and monitoring of the corporate EMS, resembling the physical checkups of human body, is necessary to pinpoint the overlooked or abnormal spots. De-bugging and improvement for sustainability can be made accordingly; and
4. *Consider strategic factors wisely.* Strategic issues should be decided carefully since they could have a tremendous impact once implemented. For example, upgrading technology is an important aspect of moving towards CP and SD.

The related strategic issues include:

- *Should you be an innovator or follower in technology implementation?* The innovation of an environmental technology requires specific niches and is normally associated with a high cost and risk. The first user of the technology also faces a high risk due to the low maturity of a new technology. Hence, many companies seek to avoid such risks as much as possible.
- *Should you be the sole owner, create a joint venture, or contract out?* This issue depends highly on the nature of the technology and the specific local conditions. While each may have its merits and shortcomings, a simplified and professional approach is normally the best choice.
- *Do you apply total accounting?* The net economic value or environmental results of a CP drive may be miscalculated or under-estimated. For example, dioxin is a critical issue in future waste recycling. Evaluation any related technology without taking it into account will not provide accurate results.

HOW TO DO THE JOB IN PRACTICE

This is a difficult subject, with its answer largely depending on the objective and subjective conditions of the company. For this reason, only general principles are discussed hereafter:

1. *Follow environmental trends in a timely manner.* Information on global trends toward CP and SD from various channels should be consolidated. The information should be incorporated into routine corporate activities timely to improve overall environmental performance and competitive edge.
2. *Strengthen internal environmental management systems.* The effect of an EMS can often be improved by strengthening its components, followed by the streamlining up of the whole system. However, this does not occur by itself. It can only be achieved through with proper conceptualization and consistent efforts to improve.
3. *Clarify current status and problems.* Benchmarking based on the best available technology helps provide a broad perspective on CP and SD. However, appropriate steps towards improvement can only be taken when the current status of a company is clearly defined and the true causes of problems addressed.
4. *An open-minded approach is always helpful.* Environmental issues are highly delicate, and an open-minded approach can often help avoid misunderstandings and mistakes, thereby establishing a sound basis for further action.
5. *Develop your own solution.* Despite the global nature of CP and SD trends, it is not practical to expect the same solutions worldwide for common environmental problems. Geological, cultural, infrastructure, and regulatory differences change the specific circumstances drastically from place to place. Collect appropriate information and knowledge locally and globally, but use it with your own experiences and wisdom as a guide.

EXAMPLES FROM THE CHINA STEEL CORPORATION

Corporate Environmental Reporting (CER) and waste recycling are two of the major environmental issues that CSC is currently working on. The following sections share some of the experiences of CSC in this area, including a description of a recent joint effort by the steel industry to promote waste recycling.

Upgrading EMS Through Corporate Environmental Reporting (CER)

The effectiveness of a corporate EMS can be improved if linked to a proper environmental reporting scheme. This is one of the key reasons why CSC is currently preparing a CER. CSC is using a step by step approach to environmental transparency through the release of a CER. This is due to the delicate cultural and environmental situation in the Republic of China. Ultimately, the publication of a CER should not create serious problems that require a significant investment in resources to resolve. Otherwise, not only would the publication of CER result significant costs for the company, but the experience would discourage further spreading of the practice of writing a CER.

The elements and principles that CSC has taken into account in the preparation of CER are outlined as follows:

1. Multiple stakeholders and readers;
2. Reader-friendly style with simple and proper verification;
3. Follow low-input/high-output sustainability principles;
4. Integrate with other environmental management tools;
5. Comply with local conditions and culture;
6. Increase environmental transparency and disclosure step-by-step;
7. Prepare a “CER Supplement” for overall scope and internal use;
8. Maintain continuity and consistency over time;
9. Select proper environmental performance indicators; and
10. Optimize the mode and frequency of CER publication.

Waste Recycling – A Delicate Issue Requiring Wise Planning

Locally or globally, it is not uncommon to see a recycling project fail to meet its expectations. In fact, even in developed countries, many recycling plants were closed for this reason (Southwick, 2000). Some of the important elements to success are as follows:

1. *Need for localization.* The effectiveness of a recycling project is highly dependent on dynamically evolving local conditions. For example, each location has unique environmental conditions, regulations, industrial infrastructure, energy costs, culture, resources, and needs at that specific time. As a result, the optimal solution varies from place to place. Consequently, simply copying a project with little further thought can lead to highly unsatisfactory results.
2. *Planning and feasibility study – the critical stage.* Planning and conducting a feasibility study are the critical steps in waste recycling just as in any other long-term project. The many potential approaches, the varying waste characteristics, and the need for localization often make planning a challenging job.

3. *Customer-focus to achieve a win-win situation.* A waste recycling project often involves parties with quite different backgrounds and interests. The objective of planning is to create a win-win situation for each of the relevant parties. A customer-focus will help identify the true needs, limitations, and problems, and thereby lead to the most practical solution.
4. *Acquisition of reliable baseline information.* The basic data regarding the wastes (e.g. the generation rates, chemical/physical characteristics, and the critical concerns for potential applications) may not be as clear as one expects. Furthermore, this information is subject to change due to numerous causes. Therefore, continual updating and long-term projection of this basic information is necessary to provide a reliable baseline measure.
5. *Search of available technologies.* A good understanding of the available technologies will provide a sound basis for waste recycling projects. However, barriers could easily arise between the potential suppliers and users of technologies. This is more likely in less developed countries due to lack of sufficient information.
6. *Good communication and coordination.* The importance of communication and coordination among the relevant parties can never be over-emphasized in waste recycling. Indeed, communication within one party itself can sometimes be a problem.

Horizontal Cooperation in The Republic of China's Steel Industry

CSC is developing a cooperative CP model in the Republic of China's steel industry. CSC's effort was linked to the Republic of China Steel and Iron Industries Association, National Chen-Kung University, and the Chinese Institute of Mining and Metallurgical Engineering. Two separate CP workshops were held in October 1999 and May 2000 to promote waste recycling in the steel industry. Technology suppliers around the world were invited to introduce mature recycling technologies to steel makers in the Republic of China. The special features, operational performance, cost-effectiveness, and competitive edges of the technologies were the focus of the discussions. Individual discussion sessions were arranged after the workshops so that the potential customers and suppliers of these technologies had a good opportunity for an in-depth exchange to develop a mutual understanding.

The formulation and evaluation of recycling projects (individual or integrated) in the steel industry will be followed up in the near future. As a result of these workshops, steel makers are in a much better position to resolve their waste recycling problems.

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14. GREENING THE MARKET: THE EFFORT BY FUJI XEROX AND THE GREEN PURCHASING NETWORK, JAPAN

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BACKGROUND

Mass production, mass consumption, and mass waste are frequently discussed around the world as among the most serious environmental challenges waiting to be tackled. It is as if human beings were eating up the earth, gaining weight and size as something that we call “the Economy,” and producing a mountainous amount of wastes in the process. We must do something to counter both the exhaustion of natural resources and the build-up of waste with no sites for disposal.

Who uses natural resources? Manufacturers who produce and supply products. Who buys and uses the products? Buyers or consumers. Given this simple relationship, we can identify a need for the environmentally friendly products manufactured in environmentally friendly factories to be sold to a Green Market (environmentally conscious consumers). These days, quite a number of companies are making very strong efforts to “green” their products. However, in order for their efforts to be rewarded, they badly need buyers for their green products, something that I refer to as “the Green Market.” Therefore, development of Green Products and the Green Market must occur in partnership to resolve our serious environmental challenge.

MANUFACTURERS AND THE GREEN MARKET

In this article, I am going to present two activities as examples of efforts to create the Green Market in Japan. One is an effort by Fuji Xerox Co., Ltd. which has been moving aggressively to green their products by reusing parts from discarded products, placing them in new products to reduce overall resource consumption. Fuji’s effort drew the attention of Japan’s Ministry of Trade and Industry (MITI) which visited the company to learn about the program. Based on its review, MITI eventually drafted a new regulation, entitled the New Amendments to the Recycling Law, to encourage reuse of parts rather than the recycling of materials returned from discarded products. MITI now considers reuse preferable to recycling. The other effort that I will discuss in this paper is the development of the Green Purchasing Network, a non-profit organization which endeavors to create the Green Market by encouraging the purchase of green products.

What should manufacturers do to help green the market? As I see it, there are two areas of action:

1. *Creating environmentally friendly products*
 - Greening products;
 - Recycling products; and
 - Building zero-emission factories.
2. *Implementing Green Purchasing*
 - General commodity purchasing; and
 - Materials purchasing.

THE EFFORT AT FUJI XEROX

This is a story of how to move a company towards contributing to the overall greening of the market as well as an illustration of how even a small effort at a private business can move the government and society towards better environmental programs.

Fuji Xerox was founded in 1962 and is jointly owned by the Xerox Corporation in the United States and Fuji Photo Film, Ltd. of Japan on a 50-50 basis. Xerox divides its world market into three areas for marketing Xerox products: Xerox Corporation covers North and South America along with local marketing companies such as Xerox Canada Ltd.; and Xerox China. Xerox Limited, headquartered in England, is 100 percent owned by Xerox Corporation and covers Europe, East Asia, Russia, and Africa; Fuji Xerox operates in Southeast Asia and in the South Pacific in Australia, New Zealand, and elsewhere. As of the end of 1997, Fuji Xerox employed 28,400 people, Xerox Corporation had 91,400, and Xerox Limited employed 21,900.

The basis for our environmental activities at Fuji Xerox is recognition of the fact as cited in our brochure that “with resources that we receive from the Earth, we engage in commercial and industrial activities to produce what we need, but we also produce waste.” Fuji Xerox has been working aggressively to reduce environmental impacts across all of our business activities and throughout the life cycle of our products. Our activities are based on our vision to “achieve zero landfill (zero emission) through development of a closed loop system” within the company.

In working toward such a vision, it is also my perception that speedy implementation is essential. We are a business entity and not well suited to discussing major actions in a conceptual manner. You could say that my belief is: “Just do it!”

Green Product Development

I think that in order to obtain well focused, synergistic efforts company-wide to develop green products (as for success in any activity), it is essential to develop and establish a clear understanding of what steps are needed in order to achieve which goals. This common vision should be shared by people in all functions of the company. In March of 1994, Fuji Xerox developed the “Fuji Xerox Green Concept” to drive a company-wide effort for organic and synergistic development of green technologies and products.

The “Green Concept” was important because it reaffirmed several important concepts and ideas. First, it confirmed Fuji Xerox’s desire to become a “socio-company” by establishing both a quality management system (QMS) as well as an environment management system (EMS). The two systems go together very closely just like two wheels of a bicycle.

A QMS is indispensable for making good product concepts a reality. QMS is usually drawn as a pyramid and the same structure can be used for drawing an EMS. A key point about both systems is that the base of the pyramid is the staff of the company. On top of the staff base, you must have a quality-oriented management team along with a managerial organization and Total Quality Management Tools. The company's internal operation results in customer satisfaction as an output that leads to business rewards as measured by indices such as Return on Assets (ROA). The same structure can be seen in the environmental management system pyramid: eco-minded staff and management develop eco-products at eco-factories resulting in social satisfaction and social profit.

It is also very important to show your company what needs to be done to make a green product, so Fuji has developed a "Green Product Concept." Our strategic goal or objective is to reduce the use of natural resources by greening all aspects of the products, including not only the equipment itself, but also packaging or materials by incorporating green factors into product design. It should be emphasized that these green factors must be developed in conjunction with product safety factors such as electrical, mechanical, and material safety.

Green factors can be broken down into three categories: resource saving, reusability, and usability. Under resource saving, you have strategies such as: using less material through downsizing, making lighter products with fewer parts, designing products with a longer life span not only physically but in terms of less obsolescence. Reusability is regarded as increasingly important in Japan and has already resulted in new legislative requirements such as the New Recycling Law. Given the strong emphasis on reuse, this category considers aspects such as ease of disassembly, cleaning, and re-assembly as well as recyclability of materials and absence of hazardous materials. For usability, you must design "NOHAD" products: manage noise, odor, heat, and dust to allow comfortable, healthy usage. Usability also includes human interface factors such as accessibility or ease of operation as well as the physical size of the product. Fuji Xerox introduced a "Recycle Design Guide" in January of 1995 which was developed through more than two years of joint efforts among American and European Xerox engineers to apply these considerations to practical product design.

Based on our Green Product Concept, our staff began undertaking analysis of products and rethinking of design. Researchers, for example, did a Life Cycle Analysis (LCA) using carbon dioxide (CO₂) as the key factor to identify priority technology themes. The results showed that the highest volume of CO₂ emissions across the life cycle of black-and-white copiers come from the paper, while emissions during the life cycle of full-color copiers come primarily from electric power consumption. The difference is due to the fact that full-color copiers use four cycles to make one page of full-color copy, and therefore consume more power. From these kinds of findings, we started developing new technologies, some of which have already been successfully incorporated into new products recently introduced into the Japanese market. For example, we now offer copiers with such environmental features as no stand-by power, which can lead to significant savings.

In terms of copy paper for black-and-white copiers, Fuji Xerox has a long history of developing environmentally friendly papers –dating back to 1972, when Fuji introduced the first pulp-saving lightweight copying paper in Japan. The most advanced environmentally friendly copying paper, "Green 100," which is made from 100 percent recycled paper pulp including both pre- and post-consumed, went to market in March of

1997. Green 100 has 70 percent whiteness which is more environmentally friendly than the regular 80 percent whiteness paper, and the product comes in 100 percent recyclable humidity protection wrapping paper. The product is delivered in a 100 percent recycled/recyclable corrugated paper-board box and is even wrapped with recyclable wrapping tape!

There are several examples of achievements of the effort by Fuji Xerox for greening products. We developed products to meet the standard of the Eco-Mark for Copiers in Japan (the Japanese Eco Label) and registered 35 models. In addition, we also registered 78 models under the Energy Star Program for copiers and printers, making us the leader in terms of the number of models registered under the category of Advanced Multifunctional Equipment & Digital Copiers. J.D.Power rated Fuji Xerox as No. 1 in its customer satisfaction survey for printers in 1999. We also received the Energy Saving Excellence Award from the Minister of the Energy-Saving Agency for DocuColor 1250, the first and only full-color multifunctional digital device to receive the award in Japan.

Product Recycling

Another environmentally as well as socially serious challenge is how to properly handle the large amount of waste products generated as a result of our current economic system's mass production/mass consumption oriented business operations. The problem is particularly severe given the shortage of landfill sites in many countries. So, now let me discuss the very important environmental activity of product recycling, which can reduce such wastes.

Xerox as a group has been working actively for many years on a very important concept for product stewardship: the Xerox Closed Loop Recycling Concept. The Concept itself is very simple and quite well known these days, but it is not easy to put into effect. Any product starts with raw materials that are fabricated into components and then assembled into machines or products to be distributed to customers for use. Following use, products are usually disposed of in a landfill without any further reutilization. Under the Closed Loop Concept, either the whole product or components are reused instead of being disposed of in a landfill.

Within the Closed Loop Concept, we have priorities for reuse. The first priority is for product reuse –a step which is relatively easy to do especially when products are marketed on a rental basis. However, the rental model is not used by all industries. The second priority therefore is component reuse, which can be implemented across the board whenever technically possible. Lastly comes material recycling. Through these priorities, we aim at Zero Landfill by establishing a “Closed Loop System” under the company's management and control. This prioritization is a key factor in balancing the ecological and economical goals within the company, allowing a commercial organization to be successful in creating environmentally sustainable operations.

When we discussed our environmental strategy with our top management, we presented the concept of the “recycling spectrum.” Drawn as a diagram, the Y-axis depicts the level of added value. The X-axis shows the level of fabrication of materials starting with raw materials with almost no value at the far left and moving towards “remodel” with the highest added value at the far right. “Remodel” is our company's internal terminology for a returned product that has been remanufactured into a new product with upgraded features and performance. Fuji Xerox backs all of our remanufactured products with a 100 percent quality guarantee.

We used the diagram to discuss the problems with typical recycling strategies. Most manufacturers such as Fuji Xerox invest enormous amounts of money (tens of billions of yen every year in the case of Fuji Xerox) and many worker-hours in various areas such as R&D, Product Design Engineering, and so on. The goal of these activities is to change raw materials with little value into high value products. When companies look at material recycling, they often perceive it as hard to justify in financial terms since it often leads to higher production costs which then translate into higher prices which are usually rejected by consumers. The problem lies in the process of recycling. Converting a used product back into a raw material requires large amounts of energy and money. The raw material must then be remanufactured back into a high value product, again requiring large amounts of energy and money. As a result, material recycling is not easy to justify economically. Therefore, our thinking was to concentrate our efforts on recycling high-value products/components directly back into high value products/components –on other words reuse rather than recycle.

From a life cycle perspective, reuse is also justifiable. The Environment Committee of Japan Business Machines Manufacturers Association (of which I served as the Chair until recently) undertook a LCA of CO₂ emissions associated with copying machines. The study showed that recycling waste machines back into materials such as iron or copper can naturally result in slightly lower emissions across the product life cycle. However reuse of components from 100 percent of production (based on 13.6 percent of reused parts per machine by weight) can almost offset the amount of CO₂ emissions.

This is why Fuji Xerox is actively pursuing the reuse of parts from post-consumed products back into new products. Parts or components naturally have a much higher added value than raw materials along making it easier to economically justify our activities. Since its establishment in 1962, Fuji Xerox has used a “Rental System” instead of sales as a business model, so we already have an efficient and effective channel for collection of post-consumed products in hand. In addition, we also have a very well organized direct technical maintenance service network which is essential for collecting the product quality information which is necessary to operate a high-quality recycling/reuse operation. Post-consumed products are collected from the field, categorized, and sent back to appropriate manufacturing sites according to their reuse classification. Those machines categorized as having reusable components are sent to our factory, disassembled, and cleaned. Parts that meet our stringent Fuji Xerox Quality Standards are selected, put into assembly lines, and incorporated with other newly fabricated parts into new products backed by our 100 percent Quality Guarantee. Our first product from this system was launched in December of 1995 after several years of elaborate preparatory work.

Of course, there have been many obstacles to implementing our reuse program at Fuji Xerox. One example was opposition raised by our marketing department early on in the development of the program. Fuji Xerox had an explicit policy that when we market products with reused parts, we must inform our customers. We knew from experience that we can lose credibility with our customers if the customer wasn’t aware of our reuse program at the time of purchase and the equipment later encounters quality problems. Since competition in the field has been fierce, our sales people worried that discussing the fact that products could contain reused parts on top of the already time-consuming regular sales discussions would harm their productivity. It was therefore a very tough decision for Fuji Xerox to make. We had a full-day meeting to discuss whether or not to

move forward with implementation. The meeting was attended by 70 senior management representatives including the President of Fuji Xerox along with other executive managers such as the Vice President of Product Development and Manufacturing, Vice President of Marketing, and the heads of major functional organizations. I coordinated the meeting myself since the concept had originally been proposed by me. Eventually, after long and difficult discussions, I said to the President: "Mr. President, it is your decision on which way to go." After some thought, the President finally said, "I think we should do this for the environment. However I understand the concerns raised by marketing, so let's do our best to support them." So the program moved forward and marked an important point in the history of Fuji Xerox.

When the first product from our reuse program was launched, it was reported by several large national newspapers including Nikkei, the largest financial newspaper in Japan. After five years of implementation, we had 42 models with reused parts using approximately 1,400 tons of reused parts into new products, and saving 4000 C-tons of CO₂ emission as of 1999. We are targeting the amount of resource savings through the reuse of parts to reach 1,600 tons or 25 percent of models to be produced in the year 2000. Fuji Xerox also received the Science & Technology Minister's Earth Environment Award for Recycling Operations. We also received the NEKKEI Technology Award for Plastics Recycling Technology due to more than two years of hard work with a vendor to find ways to reuse high value plastic covers.

Fuji Xerox's "Reuse of Parts" concept was incorporated into the first Green Purchasing Guideline for Copiers and Printers developed by the Green Purchasing Network (GPN) in 1997. Soon after, the Japanese Government developed its own green purchasing guidelines for use in government offices and also incorporated standards to purchase copying machines with reused parts. Now, this guideline has even become law. Six new environmental laws were enacted in Japan in the year 2000, including the Green Purchasing Law to encourage central and local government offices to purchase environmentally friendly products with reused parts. The Ministry of Trade and Industry of Japan also came to Fuji Xerox to learn about our efforts to reuse parts and later added an amendment to the Recycling Law to encourage the copy machine manufacturing industry to increase its parts reuse practices. Fuji Xerox's efforts to reuse parts is now growing beyond being the effort of a single company to become a trend throughout the industry and greater society. From this experience, we learned that when you develop a good idea or concept, you have the potential to influence the government or broader society.

Zero Emission Factory

Mass production along with its accompanying mass consumption produces large volumes of waste in the course of operation of manufacturing sites. The waste is especially a social and business problem in countries such Japan which face a shortage of disposal sites. Therefore, facilities that manufacture green products must strive to become Green Factories or Zero Emission Factories.

On April 6, 1997, an article introducing efforts towards zero emissions and zero landfill of solid wastes at one of Fuji Xerox manufacturing plants appeared in Asahi, one of Japan's largest newspapers. The article led NHK, the largest public TV station in Japan, to do a special news story on the factory on May 11, 1997.

Our supply factory has been working for years to reduce its off-site solid waste disposal and finally succeeded in realizing its goal of becoming a waste-free (Zero

Landfill) factory. The factory accomplished this objective by recycling 100 percent of their waste and cooperating closely with suppliers to achieve this goal. However, it was not easy to achieve. The site reduced its landfill from 2,000 tons in 1991 to zero by March 1997 through a process of thoroughly categorizing recyclable wastes and concerted daily efforts by every individual employee. The key for success was the combination of the system of categorization (which eventually led to 62 categories) and the individual effort by all the employees. Examples of these tremendous efforts are the reuse and recycling of wastes such as: recycling used toner cartridges into new cartridges or into new raw materials; recycling photo-receptive drums back into aluminum raw materials; using waste toner in cement fabrication; powdering glass bottles for mixing into paving material; recycling paper cups back into paper products such as toilet rolls; and reuse of solvents. The factory also became certified to ISO 14001 Environment Management System (EMS) standards.

At our management meeting in September 1994, I proposed to our top management that we review and fine-tune our EMS based on DIS 14001 (still draft then). We did not need ISO certification as an export passport (as it was called in Japan in those days), since we marketed our products to Europe and America through our partner Xerox companies. However, we decided to seek ISO 14001 certification to accelerate our efforts to develop a strong EMS within the company as well as to make our system and efforts visible outside of the company.

In 1997, all manufacturing sites in Japan and our plants in Korea and Australia achieved ISO 14001 certification. In addition, all three factories in Japan achieved our Zero Landfill, 100 percent Recycling goal in 1999. The Ebina Plant, the largest of our factories in Japan, received the Best Plant Award from MITI as well as awards for its work in energy conservation.

Green Purchasing

In order to produce and supply green products from factories, we purchase large amounts of materials, office goods, and other products. Naturally, we must also buy environmentally friendly products for us to be an environmentally friendly supplier.

The Fuji Xerox Green Purchasing Policy announced in April 1997 states: "Based on Fuji Xerox's environmental policy for purchasing all goods and services for our business activities and giving thorough consideration to buying needs, we shall purchase environmentally friendly goods and services from environmentally friendly manufacturers". Under this policy, we use internally developed buying guidelines for purchasing general office goods as well as parts for production. The green purchasing ratio of office goods is approximately 50 percent of the total purchase.

Conclusions Regarding Product Greening

As way of conclusion for my discussion of the business effort at Fuji Xerox, let me introduce our mission statement and shared values. In our concept of "shared values," customer satisfaction is the first priority, and environment is the second. These shared values were developed through extensive discussions among representatives from various countries and levels of Fuji Xerox and its operating companies.

From my experience in developing our green strategy at Fuji Xerox, I can say that the management and the employees are the key to success in moving the organization, and eventually society, towards a better environment. However, we also need a good

driver who believes in people, can conquer difficulties with their enthusiasm, and is confident that the effort will be successful.

When a company decides to “do it right” both environmentally and economically, it can make a major contribution toward greening the market. Therefore I believe that if and when all businesses and other institutions such as governments decide to work closely together, tremendous things will be accomplished.

THE GREEN PURCHASING NETWORK OF JAPAN (GPN)

It is not enough only for manufacturers to develop and supply green products into the market. Companies also badly need ecologically minded consumers or buyers who place a priority on purchasing green products. In other words, green companies need a green market. In reality, however, the green market is developing slowly while the earth’s environment is deteriorating quickly. The question of how to develop the green market has been a tough challenge for Japan.

In 1995, Japan’s Environmental Agency took the initiative in organizing a purchasers’ network to stimulate the growth of a market for environmentally friendly products. In February of 1996, GPN was launched with 73 charter members including Panasonic, Sony, NEC, Fuji Xerox, Canon, Ricoh, Nippon Steel, local governments, environmental NGOs, and consumers’ organizations. As of April of 2000, GPN had grown to 2,134 members and was continuing to grow steadily. Of the 2,134 members, 1,595 are private businesses, 306 are local prefects or municipal governments, and 233 are NGOs.

The Green purchasing Network (GPN) is a non-profit organization with an annual budget of approximately US\$ 500,000. To cover expenses, we collect membership dues which have intentionally been kept very low. We request approximately US\$ 100 from local governments and small businesses and US\$ 40 for NGOs. Larger corporations (more than 5,000 employees) are asked to make a voluntary contribution of US\$ 400. Another source of income is from sales of Environmental Data books and organization of seminars or other such events. The Environmental Agency of Japan and a handful of foundations also support the GPN.

The GPN is actively working in several areas to promote green purchasing with our primary focus on preparing Green Purchasing Guidelines and Environmental Data Books for Product Selection, organizing conferences and exhibitions, and giving Environmental Award Prizes.

General Green Purchasing Guidelines

Our first activity was to publish the General Principles of Green Purchasing to help guide the purchase of various kind of products. The principles became the basis of for individual product category guidelines.

The General Green Purchasing Principles consist of three primary principles. The first principle is to ask buyers to “consider the environmental impact of a product at all stages of its life cycle.” This general suggestion is followed by eight detailed criteria:

1. Degree of use of harmful substances and chemicals;
2. Resource and energy efficiency;

3. Sustainable nature management;
4. Long-term serviceability;
5. Reusability;
6. Recyclability;
7. Recycled material content; and
8. Impact of final treatment and disposal.

The second principle recommends that buyers assess the overall environmental quality of manufacturers in terms of their environmental policies, management systems, and overall performance. The third principle encourages buyers to collect as much environmental information as possible when purchasing products.

Product Specific Guidelines

Product specific guidelines based on the GPN's General Purchasing Principles have been developed for 13 individual product categories including:

1. Copying and printing paper;
2. Copiers, printers, and facsimile machines;
3. Personal computers;
4. Stationery and office supplies;
5. Office furniture;
6. Toilet and tissue paper;
7. Lighting apparatus and lamps;
8. Automobiles;
9. Refrigerators;
10. Washing machines;
11. Air conditioners;
12. Television sets; and
13. Uniform and work wear (to be released soon).

To select products for guidelines, extensive surveys are conducted among the members of GPN, followed by discussion within the Executive Committee. The final decision takes into consideration the level of environmental impact of the product as well as its popularity among purchasers.

As an example, the Guidelines for copying machines, printers, and facsimile machines are based on the following seven criteria:

1. Reduced energy consumption with stand-by mode;
2. Two-sided copy or print functions;
3. Recyclable designs;
4. Use of reused parts and recycled materials;
5. Collection and recycling of used products and cartridges;
6. Low ozone emissions; and
7. Avoiding the use of selenium.

In GPN Guidelines, we do not establish any numerical or quantitative thresholds to determine "good" or "bad," rather we simply indicate environmentally friendly qualities

and encourage buyers to select products with the lowest possible impact. Recently, we decided to extend our Guidelines to address service sectors whose role in environmental impact is becoming increasingly important. The Executive Committee chose hotels as the subject of the next guideline, which is going to be a very exciting challenge for us.

Environmental Data Books

An *Environmental Data Book for Product Selection* is a document that provides purchasers with quantitative and qualitative environmental information on a given product category in accordance with the relevant guidelines for the category. Data Books are designed in a tabular format with product brand names shown vertically and environmental aspects listed horizontally. The aspects for the Data Book on Copiers and Printers includes the following topics:

1. Energy efficiency;
2. Compliance with International Energy Star standards;
3. Two-sided copying function;
4. Incorporation of reused parts;
5. Use of recycled plastic; and
6. Price and copying speed.

It should be noted that in the guidelines for copiers and printers, “Incorporation of Reused Parts” has become a standard for the very first time. However, the decision was made only after long and controversial discussions among GPN members, since reusing parts was not a common practice in Japanese industry in 1996 when the Data Book was drafted.

It is essential to note that these Data books do not specify which product is better or worse for the environment. In other words, the GPN does not recommend a specific brand to purchasers. Instead, the Data book provides detailed environmental information on products in order to allow purchasers to compare among products and select the item that best fits their needs and values. In this sense, we could say that GPN’s Environmental Data Books are similar to the Type III environmental labeling that is currently under discussion in ISO.

Increasing the level of detail provided by the Data Books poses some difficulties, the biggest of which is the lack of data and/or information from manufacturers regarding the products –either because manufacturers are unwilling to disclose data or because they simply do not have the information themselves. A second barrier is comparability. Product comparisons are only meaningful if measurement and calculation methods are consistent among manufacturers. To date, the quantitative information shown in our Data Books has been limited to items that are available from most major manufacturers.

After compiling all the data gathered from manufacturers, we publish Data Books and also place the information on our Internet web-site. Data books are updated at least once a year, and the information on our web site data is revised two to four times a year depending on the characteristics of the product group. The price of Data Books ranges from ¥500 to ¥1000.

GPN guidelines and Data Books have already significantly influenced Japanese industry. The impact is not only due to the use of our guidelines and Data Books by purchasers making their buying decisions, but also because for many companies it is the

first time that their products have been compared with competitors' products from an environmental perspective. That is essential.

It should also be noted that GPN's Environmental Data Books could well be the very first books released anywhere in the world to allow consumers to make such detailed comparisons of products' environmental performance at a glance.

Conferences and Exhibitions

Conferences and exhibitions are other important activities for GPN, especially in local areas where information on environmental issues is limited. Therefore, we hold regional conferences and exhibitions in collaboration with local governments to promote green purchasing in various parts of the country. In 1998, nine local conferences were held which gathered approximately 200 participants. In 1999, we increased the number of conferences to eleven cities.

Environmental Awards

The Green Purchasing Award is another effective way to encourage institutions to enhance their green purchasing activities. We annually select and award organizations that have shown excellent performance in implementing green purchasing initiatives or promoting the concept within our society. Through the course of the evaluation, the award process uncovers many success stories which are often useful learning experiences for other GPN members. In 1998, GPN awarded the very first GPN Grand Prize to the Shiga Prefectural government, and awarded it to Fuji-Xerox Corporation in 1999.

INFLUENCE OF GPN

Through the activities of the GPN, Japan and its green purchasing efforts have widely been reported in various newspapers, trade journals, and on television. There have also been many seminars held in Japan on green purchasing, sponsored by both government agencies and private organizations. The members of GPN are now leading the development of the green market through their commitment to implement green purchasing practices. They are also encouraging and motivating manufacturers to become more aggressive in designing and marketing environmentally friendly products. It should also be noted that the success of the GPN triggered the establishment of a European version of GPN (the Green Purchasing Network, Europe) which should help globalize the effort to development the green market.

OVERALL CONCLUSION

We now understand that extensive efforts by both manufacturers and consumers/buyers are required to resolve the environmental challenges that we face every day. If everyone can commit to doing something for the betterment of the environment starting from today, even a very small step, it will contribute towards the greening of the market and the resultant re-greening of the earth. Let's do it now!

15. THE GREEN CONSUMPTION MOVEMENT: THE ROLES OF GOVERNMENT, BUSINESS, ACADEMIA, NGOs AND CONSUMERS

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THE GREEN CONSUMPTION MOVEMENT

During the 1950s, the growth of demand for consumer products, known as the “revolution of rising expectations,” was considered a benchmark of development and was encouraged in the developing world. However, the emulation of the environmentally damaging consumption practices of the industrialized world in the rapidly growing developing economies has made a major contribution to global environmental stress.

In the 1980s and early 1990s, there has been increased awareness among consumers that their purchasing choices affect the environment. Consumers are urged to consider not only the quality of goods, but also the conditions under which goods are made and to distinguish “needs” from “desires.” Therefore, the emphasis was on providing green products for niche markets serving affluent consumers.

At the 1992 Earth Summit in Rio, a chapter devoted specifically to the relationship between consumption habits, production patterns, and sustainable development was included in Agenda 21. The chapter indicates that a good policy for sustainable production and consumption depends on support from all parties and that it is in the public interest to help the parties to speed the learning process in order to realize all the possibilities for a greener market.

THE DEFINITION OF SUSTAINABLE CONSUMPTION

In January of 1994, the Symposium on Sustainable Consumption was held in Oslo, Norway. A working definition for sustainable consumption was proposed as “*the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generation.*”

A key issue was the extent to which the needed improvements in environmental quality can be achieved through the substitution of more efficient and less polluting products and services (patterns of consumption), as opposed to reductions in the volumes of products and services consumed (levels of consumption).

KEY PLAYERS

Five parties are identified as the key players in the movement toward green consumption: governments, businesses, academia, non-governmental organizations (NGOs) and consumers. Governments set laws and regulations, establish incentives and infrastructure, provide information, lead through public procurement, and measure overall progress within the country. Businesses are manufacturers, retailers, and financiers and providers of products and services. They are also very important consumers. Academia develops technology and tools to help businesses supply green products and services. NGOs, particularly environmental, consumer and social NGOs, monitor government and business behavior. They are usually the promoters of initiatives too. The consumers, being also voters, householders, and workers, are the key to success.

Since the Earth Summit, great progress has been made on advancing the conceptual framework for green consumption and promoting discussion of the issue among the five major players. However, there is also considerable inertia against change. The reason is that the conventional economic growth model and its vision of prosperity has become the basis for political consensus and stability for many economies.

EXAMPLES OF INITIATIVES

Sustainable consumption initiatives fall into two categories: (1) improving products and (2) changing patterns. Different approaches that have been taken by various economies and major players are summarized in Table 1.

LESSONS LEARNED

The actual impacts of these programs are for the most part still unknown, largely because most initiatives have been in place too short a time to allow for analysis of their effectiveness. However, some preliminary conclusions can be drawn:

1. It has proved easier to improve products than to change consumption patterns. Academia can be helpful in the development of innovation;
2. Economic instruments or policies, such as subsidy reform and ecological pricing, are hard to implement, but offer greater leverage for change;
3. Education and awareness-raising initiatives have generally brought limited changes on their own. A limited percentage of population, roughly 10~15 percent, has been identified as “green consumers” in developed economies. Using popular media for initiatives is essential, but very expensive;
4. Ecolabelling schemes have been moderately successful in changing the purchasing decisions of the consumers;
5. With its immense purchasing power, public procurement represents a more accessible market for green products and services than individual consumers;

Table 1. Examples of Sustainable Consumption Initiatives

Types of initiatives	Examples	Major players
Improving products		
Product innovation	<ul style="list-style-type: none"> Floor Covering Services, <i>Interface</i> Remanufactured Copiers, <i>Xerox</i> The Green TV, <i>Philips</i> 	Business
Regulation	<ul style="list-style-type: none"> Extended Producer Responsibility, <i>Germany</i> Restrictions on Disposable Products, <i>Korea</i> Efficient Toilets, <i>Australia</i> Takeback of Home Electrical Appliances, <i>Republic of China</i> 	Government
Economic instruments	<ul style="list-style-type: none"> Sulphur Tax, <i>Sweden</i> CO₂ tax, <i>Norway</i> Differential Car Taxation, <i>Korea and Austria</i> Tax on Waste, <i>Denmark</i> Waste Disposal Charges Based on Volume, <i>Korea</i> Pricing Packaging, <i>Harare</i> Air Pollution Control Fee, <i>Republic of China</i> 	Government
Ecolabelling	<ul style="list-style-type: none"> The Blue Angel Eco-label, <i>Germany</i> The Nordic Swan Eco-label, <i>Scandinavia</i> Forest and Marine Stewardship Councils Energy Star, <i>USA</i> Green Mark, <i>Republic of China</i> 	Government NGO
Public procurement	<ul style="list-style-type: none"> Green Purchasing Network, <i>Japan</i> EU Green Purchasing Network, <i>EU</i> Ethical Trading Initiative, <i>UK</i> Government Procurement Law, <i>Republic of China</i> 	Government NGO
Changing patterns		
Developing a strategic vision	<ul style="list-style-type: none"> Transport Consultation, <i>Scotland</i> The Capital Territory Future Water Supply Strategy, <i>Australia</i> Strategic Environmental Assessment, <i>Russia</i>, Sustainable Europe Campaign, <i>EU</i> 	Government Business NGO
Planning and demand side management	<ul style="list-style-type: none"> Restrictions on Car Use, <i>Sao Paulo</i> Transport Management, <i>Singapore, Curitiba</i> Promoting Alternative Transport, <i>EU</i> Demand Side Electricity Management, <i>Canada</i> 	Government NGO
Redirecting public spending	<ul style="list-style-type: none"> Upgrading Traditional Housing, <i>China</i> Kampung Improvement Program, <i>Indonesia</i> Investment Program for a Sustainable Society, <i>Sweden</i> 	Government

Continued...

...continued

Types of initiatives	Examples	Major players
Education and awareness raising	<ul style="list-style-type: none"> • Trans-Century Environmental Tour, <i>China</i> • Reducing Disposables in Hotels and Restaurants, <i>Korea</i> • European Young Consumer Competition, <i>Greece</i> • Greening the Office Campaign, <i>Republic of China</i> 	Government Business NGO
Supporting community action	<ul style="list-style-type: none"> • Pro-Local Supply, <i>Austria</i> • Global Action Plan for the Earth, <i>International</i> • Environmental Home-guard, <i>Norway</i> • Alliance for Common Procurement, <i>Republic of China</i> 	Government Business NGO
Capacity building	<ul style="list-style-type: none"> • Organic Trade Promotion, <i>International</i> • CIDA Energy Efficiency, <i>India</i> • Environmental Management Systems, <i>International</i> 	Government Business Academia

- Working closely with local people to identify their problems, needs and their priorities is critical to implementing demand-side management measures. However, only combining the best of modern technology and traditional values can help prevent the export of unsustainable consumption patterns caused by globalization;
- Collective measures are particularly successful at transforming market conditions to become more favorable to sustainable consumption;
- The target groups for sustainable consumption are: women, because they have influence over many consumption choices; the elderly, because they carry traditional values of frugality; youth, because they represent a high proportion of the population in poor economies; the affluent middle class, because they have the most buying power and are usually the most educated;
- More innovative regulatory, cultural, and market instruments need to be developed because changing consumption patterns is a new goal for environmental policy. Alternative approaches to environmental regulation which create the conditions for sustainable consumption have to be institutionalized; and
- The benefits of sustainable consumption in terms of price, quality, convenience, and pleasure need to be demonstrated.

THE REPUBLIC OF CHINA'S EXPERIENCE WITH SUSTAINABLE CONSUMPTION

The Republic of China's experience with sustainable consumption entered a new era when the Environmental Protection Administration (EPA) decided to promote the ecolabelling program in late 1993. The program, called the Green Mark, was totally sponsored by the EPA and considered a 'carrot' to encourage businesses to manufacture or provide green products and services. The term 'green' here is defined as 'low polluting, recycled/recyclable and resource saving.' It is a Type I program in nature with the following characteristics:

1. It is selective: only products with the best environmental performance (usually 20 to 30 percent) may be awarded a license to use the Green Mark logo;
2. It has pre-set criteria: for each product category, there is a pre-set and published criterion with multiple requirements. For example, the laundry detergent criterion requires no phosphate, no fluorescent agents and 90 percent biodegradability;
3. It involves an independent third-party who acts as a certification body to control the rightful use of the license and the logo; and
4. It uses life cycle assessment as the scientific basis for developing and evaluating product criteria to ensure that there is a positive net environmental benefit from the Green Mark product.

As of the year 2000, the Environment and Development Foundation (EDF), the implementation body for the Green Mark, has published criteria for 62 products, including office equipment, home appliances, writing instruments, cleaning products, construction material, recycled goods and others. A total of 862 products are licensed to use the logo. The production value of these products is estimated at 23 billion NT, or 7.6 billion US dollars.

To develop the criteria for each product category, experts from both academia and the specific business sector involved were invited by EDF to develop a consensus on all the requirements. The Green Mark Review Committee, with representatives from government, business associations, academia and NGOS, would then review and approve the draft criteria.

Promotion of the Green Mark has been restricted by our limited program budget. In the first few years, the main target audience for promotion was the manufacturers. Starting from 1998, about one third of the budget was spent on public education, including exhibitions, newsletters, seminars, and other promotional material. A survey done in 1998 showed that over 55 percent of consumers could identify the logo. However, the percentage of consumers who have bought a logo product is still very low. Thus, EPA and a key group of legislators decided to push for the insertion of a green procurement provision into the new Government Procurement Law.

Effective May 27, 1999, Provision 96 of the new Government Procurement Law states that government agencies may give preference to green products over traditional products as long as both have comparable functional characteristic. Green products may receive a maximum of 10 percent price preference over traditional products. Green products are classified as: (1) Green Mark products and (2) non-Green Mark products.

The latter are defined as (a) products that are low polluting, recycled/recyclable or energy saving; and (b) products that are resource saving or use renewable resources. Products falling under the non-Green Mark category wishing to meet definition A (outlined above) must be identified, registered and promulgated by EPA, whereas products wishing to meet definition B shall be identified by other government agencies (still unannounced).

In 1999, the purchasing power of government agencies amounted to 14.3 billion US dollars, shown in Table 2.

Table 2. Purchasing Power of Government Agencies in US\$ Billion, 1999

	Central Government	Local Government	Others*	Total
Products	1.5	0.7	2.6	4.8
Services	0.4	0.2	0.5	1.1
Construction	1.9	3.8	2.7	8.4

Note: * Includes national colleges/universities, hospital and government-owned businesses.

Since Provision 96 covers green products only, the market size for government green procurement is estimated at a minimum of US\$ 50 million per year (based on a market share of 1 percent.) Among them, office equipment and utilities, lighting and cleaning products alone amounted to US\$ 13 million in 1999.

In order to make the government green procurement plan successful, the following are some of the key directions for us to pursue further:

- Obtain full support from both the decision-making and the implementation levels within the purchasing departments of the various government agencies;
- Ensure the development of enough green products to allow sufficient choice;
- Provide an open and fair process for identifying green products;
- Maintain a well-managed, steady flow of green product related information; and
- Establish clear goals and targets with an effective monitoring program.

Government green procurement is also considered a part of the “Greening the Office Campaign” sponsored annually by the EPA. Starting in 1998, government agencies and businesses have been encouraged to enter this an annual contest. Organizations are evaluated by experts against the following standards:

1. Is there a long-term strategy and structure for promoting the “greening the office?”
2. Is the environmental performance of a product considered when making purchasing decisions?
3. Is there a waste recycling and reuse scheme in place?
4. Is there a resource (electricity, water and paper) reduction scheme in place?
5. Is there a documented education program on sustainable consumption for the employees?

The overall tidiness of the facility and safety measures are also recorded and scored. Finally, the top winners of this campaign are publicly honored and given an award by the EPA.

Communities are also good targets for changing consumption patterns. Many communities in the Republic of China participated in the activities organized by the Procurement Alliance for Common Products. The Alliance was started in 1993 as a membership (mainly housewives) association and incorporated as a private company in 1998. Organically grown agricultural products and preserved food products are purchased at bargain prices, individually packaged at the Alliance's warehouses, and then distributed to member buyers. The Alliance is expected to soon expand its scope of products to include electrical appliances, clothing, and cosmetics. It also publishes newsletters and organizes many educational activities. Currently, the Alliance has over 2200 members.

CONCLUSION

The examples mentioned above help demonstrate the respective roles of government, NGOs, business, academia, and consumers in the movement towards sustainable consumption. Much has been achieved on sustainable consumption over the past decade. The need to change consumption is now accepted. While many problems remain, sustainable consumption is only as difficult as we make it. There are many things which can be put into action now. For instance, ecolabelling of the service sectors, electronic trading of green products, and development of sustainable consumption indicators to record achievements and monitor progress. Let's do it!!

16. AN OVERVIEW OF THE INDUSTRIAL WASTE MINIMIZATION: CORPORATE SYNERGY SYSTEM IN THE REPUBLIC OF CHINA

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ABSTRACT

Of the approximately 90,000 firms in Taiwan, more than 96 percent are small and medium-sized enterprises (SMEs) with either a capital investment of less than US\$ 1.5 million or fewer than 200 employees. In total, SMEs generate about 50 percent of the gross production of all enterprises in Taiwan.

This paper will discuss the use of Corporate Synergy Systems (CSS) in promoting improved environmental management among SMEs. A CSS is a management mechanism, and through which a group of companies work together to achieve certain goals, such as the improvement of product quality, working environment, etc. A CSS consists of a headquarters/central firm, its upstream suppliers, and downstream OEMs.

For many years, the Industrial Development Bureau (IDB) of Taiwan has sought to develop effective methods to assist SMEs in implementing Industrial Waste Minimization (IWM) techniques to improve their environmental management efforts. In 1995, the IDB commissioned the Foundation of Taiwan Industry Service (FTIS), a technical consulting organization, to apply the CSS as a tool to implement IWM in SMEs. Today, the CSS has proved successful, and combined with IWM, has become IWM-CSS.

Due to the success of IWM-CSS since 1995, the IDB has annually chosen companies from different sectors to serve as central firms to promote IWM-CSS, including machinery manufacturing, paper mills, applied electronics, computer manufacturing, and semi-conductors. With cooperation and encouragement from the central firms combined with the efforts of the IDB and its consulting companies, hundreds of SMEs have implemented IWM. Today, the implementation of Environmental Management Systems (EMS) and Occupational Health and Safety Management Systems (OHSAS) has become a global trend. The IDB and the FTIS are now trying to use IWM-CSS to help SMEs face the challenges related to developing ISO 14001 EMS and OHSAS.

This paper presents the background and the concept of applying CSS to implement IWM, and is followed by a brief description of the achievements on the implementing experiences. Finally, it will discuss the possibility of applying the CSS mechanism to implement ISO 14001 or OHSAS 18001 in Taiwan.

INTRODUCTION

SMEs usually lack the financial resources, technical expertise, and manpower to apply environmental measures to improve their environmental performance. In addition, the public generally places less pressure on SMEs than on large enterprises regarding environmental, health, and safety issues. As a result, SMEs are comparatively less active in environmental programs in Taiwan. For example, the IDB has initiated voluntary IWM programs since 1989, and so far more than 500 firms have applied for and received assistance from the IDB in IWM implementation. However, less than 10 percent of the 500 firms who received assistance were SMEs.

In the face of the globalization of economic activities and strong international competition, companies must improve their product quality and public image, while simultaneously controlling the cost of production. To accomplish this, large companies must take great care in selecting their suppliers. Thus, under the leadership of large companies, supply chains have become more integrated for the sake of cost control and quality assurance. "Greening supply chains" has been viewed as a key approach to "multiply" the concept of cleaner production all over the world. The IDB has therefore been working to leverage the CSS mechanism to introduce the idea of greening supply chains as well as to induce SMEs to apply IWM.

Under the sponsorship of the IDB, the FTIS chose the first central firm in 1995, and then cooperated with the central firm to select suppliers to establish the first IWM-CSS. Through influence and encouragement of the central firm, many SMEs have joined the IWM-CSS team since then. SMEs joining the IWM-CSS begin by training staff. In the subsequent steps, SMEs conduct a plant audit, set objectives, and propose IWM options. Through implementation of the options, they produce economic benefits and improved environmental performance.

Thus far, the FTIS has promoted nine IWM-CSSs with central firms from different industry sectors, including machinery manufacturing, paper, applied electronics, computers, motor manufacturing, textiles, and specialty chemicals. These central firms worked with more than 130 suppliers to jointly implement the IWM programs.

CHOOSING AN APPROPRIATE CENTRAL FIRM

At the beginning of each fiscal year, the IDB publishes bulletins to solicit companies to serve as the central firms in new IWM-CSS programs. Strong candidates for serving as central firms should have: experience in implementing IWM; good cooperative relationships with its suppliers; and a demonstrated commitment from its top management to provide the necessary resources to run an IWM-CSS program. Through an open evaluation process, the IDB and the FTIS will select qualified companies to serve as the central firms in the new programs.

To understand why satellite firms would like to join an IWM-CSS, one needs to consider the problems and characteristics special to these firms. Generally, SMEs have relatively few staff and little extra capital, so they are constantly engaged in manufacturing activities. In order to make a profit or even just to survive, SMEs must be extremely flexible in meeting the demands of its buyers/central firms. Thus, when a central firm strongly requests its suppliers to participate in IWM-CSS, companies will

generally comply. Through implementation of a IWM-CSS, it becomes possible for central firms to use a variety of parameters to rank their suppliers, including product quality, financial ability, and environmental performance.

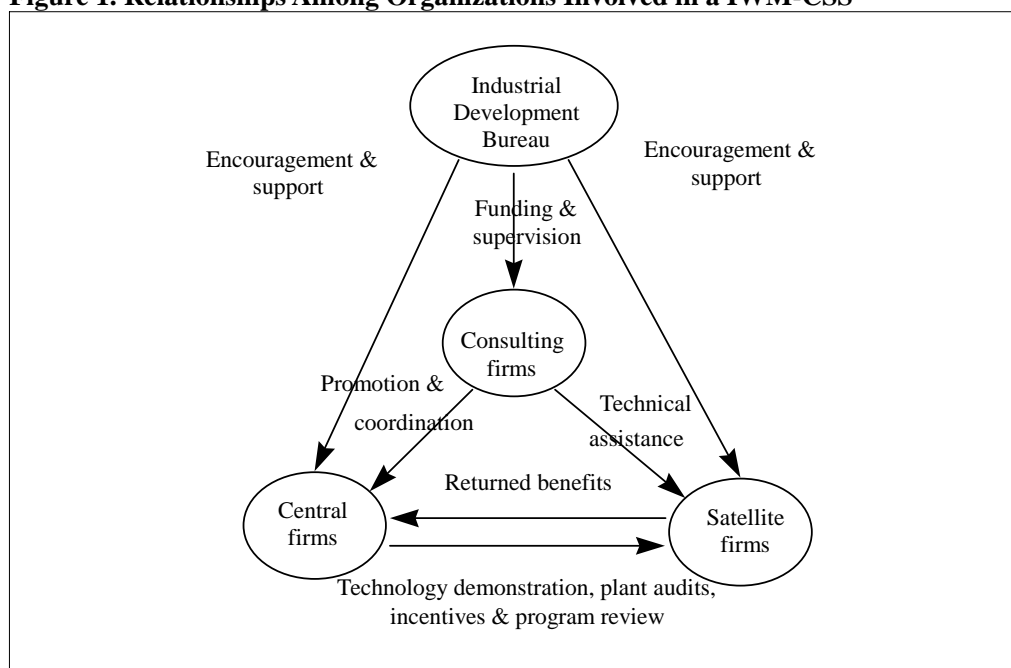
In any IWM-CSS program, the central firms play a key role in initiating, organizing, and maintaining the system. They have to help, encourage, and coordinate all of their satellite firms in implementing various IWM activities. Given their desire to improve their image and position in competitive markets, many large companies are willing to take on the responsibility of asking and helping their satellite firms to implement IWM. In this way, the central firms can also reward those firms dedicated to good environmental management by providing special credit treatment, placing additional orders, supplying free staff training, and other measures.

ENGAGING SUPPLIERS IN AN IWM-CSS PROGRAM

Once selected to be the central firms for the new IWM-CSS programs, the chosen companies need to obtain commitments from a sufficient number of suppliers to join the IWM-CSS. Typically, the central firms hold a seminar with the IDB and the FTIS to explain the basics of IWM-CSS to their suppliers. The seminars cover topics such as the concept of IWM, steps in implementing IWM programs, the roles and responsibilities of the participating firms in a CSS, and the program schedule. Following the seminar, the central firms ask the suppliers' (also referred to as satellite firms) top management to make a commitment to join the program.

A successful IWM-CSS program relies on securing the commitment of decision-makers in each satellite firm. Companies must then closely follow the methodology and implementation schedule. A successful IWM-CSS also depends on close collaboration among the four major parties: the IDB, the consultant (FTIS), the central firms, and the participating satellite firms. The specific roles performed by these organizations are shown in Figure 1. The role of the IDB is to provide funding and encouragement. Central firms are responsible for proposing requirements and supervising their satellite firms. Under a contract with the IDB, the FTIS serves as a consultant to help keep the IWM-CSS program running, and is responsible for bringing all parties together. FTIS also is responsible for other logistics such as providing technical assistance, review of programs, assisting with process audits, and overall management of the program. With regard to the satellite firms, each of them must organize an internal team to take charge of the IWM program.

Figure 1. Relationships Among Organizations Involved in a IWM-CSS



IWM-CSS IMPLEMENTATION WORK AT SUPPLIER FACILITIES

Once central and satellite firms have been chosen, the focus of the IWM-CSS moves to the facilities of the satellite firms. The program consists of a facility audit, training courses, team member meetings, and technology demonstrations, and further steps to ensure that a suitable plan is developed and implemented. The combination of activities leads to achieving environmental improvements usually with economic benefits. The FTIS uses the seven steps listed below to assist each satellite firm to develop an IWM program.

Step 1

The on-site work begins with training sessions for the staff of each participating firm. Two kinds of training courses are designed. The awareness classes, which introduce the concept of IWM, benefits and barriers, general approaches, and OHSAS issues, are basically for the management level employees. The technical classes, including plant audit procedures, IWM opportunity assessment methodology, and available IWM measures and practices, are designed for the process and operation staff.

Step 2

Each participating firm has to establish an IWM team to take charge of the program and to coordinate the efforts of the plant. Management must lead the team while the employees are required to participate by proposing and implementing IWM measures.

Step 3

Plant audits are conducted for each participating firm to examine the plant operations in detail to determine the sources of waste and to prioritize the pollution problems. This step can also integrate with the OHSAS issues, and the IWM teams can also consider the environmental issues and risks related to occupational health and industrial safety. Based on the auditing data, each firm needs to set clear goals for improving their performance in the first year.

Step 4

Firms are encouraged to solicit proposals from employees on new methods to reduce working risks or improve the working environment. Employees can often provide many excellent IWM or risk-reducing options if given a chance. Firms can use a variety of methods such as training courses, personal meetings, employee brainstorming sessions, or incentives.

Step 5

Each firm establishes a suitable process to rank the proposals or options, through which the high priority pollution or risk problems are identified. The professional staff evaluate the technical and economic factors and provide sufficient data for the decision-makers to select the best option to either resolve the problems or to keep them under control. There are many options that can easily reduce the environmental impacts, such as changing the workers' attitudes, good machinery maintenance, or separating waste streams.

Step 6

Following the start of IWM program implementation in each firm, the FTIS holds periodic meetings for the IWM-CSS members. Through the meetings, the members can share experiences and information, and discuss any problems that they have encountered. Moreover, with the participation of the IDB and the central firm in the meetings, the group meetings become a very good communicating mechanism for encouraging these firms to improve continuously.

Step 7

Actions are taken to maintain and sustain the IWM programs for continued growth and expanded benefits within each firm as well as in entire IWM-CSS. In this step, the IDB and the central firms provide recognition or other rewards and incentives to the outstanding satellite firms of the IWM-CSS.

THE ACHIEVEMENTS OF IWM-CSS PROGRAMS IN TAIWAN

IWM-CSS programs are conducted on an annual cycle. Currently, there are over 10 active IWM-CSSs in Taiwan, which clearly demonstrates that the CSS mechanism is a very useful tool for implementing IWM. As the concepts of environmental management systems (particularly the ISO 14001 model) are very similar to IWM, CSS can also be a useful tool for promoting implementation of ISO 14001 and OHSAS. Therefore, in 1998, the IDB began incorporating aspects of ISO 14001 and OHSAS into the IWM-CSS

implementation. The following section provides some examples of successful IWM-CSS programs from recent years.

TECO's IWM-CSS

Teco Electric and Machinery Co., Ltd. established the first IWM-CSS in 1995. Teco is one of the largest electrical equipment manufacturers in Taiwan. Teco highly values environmental protection and its corporate image, and each of its manufacturing factories has won National IWM Outstanding Awards every year. At the request of Teco's general manager, 18 suppliers joined Teco's IWM-CSS and more than half of them were SMEs. Teco's IWM-CSS members and performance are shown in Table 1. During 1995, Teco's IWM-CSS implemented a total of 2,119 IWM options. These options required a capital investment of US\$ 453,000 and yielded a profit of approximately US\$ 5 million. Teco's IWM-CSS has now been expanded to 32 firms, many of which have reported production cost reductions of more than 20 percent as a result of practicing IWM.

Table 1. Results of TECO's IWM-CSS Program, 1995

Firm code	Business/Product	Number of employees	CP options proposed	CP options implemented	Investment US\$ (1,000)	Benefit** US\$ (1,000)
1	Appliances	102	40	28	3.6	54.6
2	Appliances	350	1,805	1,612	1,392.9	1,788.2
3	Electric motors	380	565	306	13.6	322.5
4	Electric motors	340	62	53	255.0	2,239.6
5	Electric equipment	850	14	1	*	
6	Printed circuit boards	280	12	8	3.6	26.9
7	Electronics	50	6	6	*	20.0
8	Electronics	54	4	4	*	4.1
9	Packaging	44	13	13	5.4	19.8
10	Packaging	260	71	18	3.9	100.2
11	Plastic	95	8	8	*	26.1
12	Plastic	37	2	1	*	*
13	Metal processing	280	34	28	168.9	336.8
14	Metal processing	47	6	3	*	
15	Parts fabrication	22	4	4	*	2.1
16	Brass tube processing	33	3	3	*	5.4
17	Brass tube processing	36	17	17	2.57	42.5
18	Molding	50	7	6	*	7.1
Sum		3,310	2,673	2,119	1,849.5	4,993.6

Note: * Indicate investment data not available.

Cheng-Loong's IWM-CSS

The Cheng-Loong Paper Manufacturing Company organized the second IWM-CSS program in 1996. Cheng-Loong's IWM-CSS consisted of 10 upstream suppliers that provided waste paper, machinery, chemicals, energy, and transportation services, and 3 downstream buyers who were paper container manufacturers. With more than 90 percent of the participating firms being SMEs, Cheng-Loong's IWM-CSS implemented 868 IWM options in one year. Participating firms invested a total of US\$ 991,000 in IWM which yielded a profit of US\$ 3.5 million in 1996. The members and performance of Cheng-Loong's IWM-CSS are shown in Table 2.

Table 2. Results of Cheng-Loong's IWM-CSS Program, 1996

Firm code	Business /Product	Number of employees	IWM options proposed	IWM options implemented	Investment US\$ (1,000)	Benefit* US\$ (1,000)
1	Paper	288	210	173	397.8	1,194.5
2	Paper	100	98	92	22.3	521.5
3	Chemicals	15	21	9	24.3	89.3
4	Chemicals	50	66	51	130.7	414.3
5	Chemicals	19	22	21	30.6	85.8
6	Paper containers	155	45	42	10.8	151.0
7	Paper containers	141	455	335	60.0	291.8
8	Paper containers	140	44	28	32.1	134.2
9	Energy	37	56	37	4.3	45.6
10	Transportation	13	10	10	62.9	27.2
11	Waste paper collection	6	13	13	14.6	60.7
12	Waste paper collection	5	8	8	2.2	30.9
13	Waste paper collection	58	26	22	169.3	357.1
14	Waste paper collection	5	14	14	14.6	65.5
15	Machinery	6	13	13	14.6	98.0
Sum		1,040	1,101	868	991.1	3,567.4

Sanyang's IWM-CSS Achievements

Sanyang Industry is a motor and auto-bicycle assembly and manufacturing company. Sanyang had a strong interest in improving the competitiveness of its suppliers, to reduce production costs for each part and improve the overall efficiency of the supply chain. Sanyang applied to become one of the central firms in 1998.

The year 1998 also marked a change in the IWM-CSS program. Due to the strong successes during the period from 1995-1997, the IDB decided to launch three new IWM-CSS in 1998, and also decided to expand the program to include occupational health and safety practices. During the first three years of the program, the government found that it was extremely difficult to separate environmental and safety issues when

providing assistance to SMEs. As a result, the FTIS integrated numerous OHSAS techniques into the IWM-CSS program in 1998.

Sanyang's IWM-CSS consisted of 15 firms all of which were Sanyang's suppliers. As part of the integration of industrial safety elements into the IWM-CSS programs, the FTIS used the Voluntary Protection Program (VPP) checklist as a tool to evaluate the risks to workers in each firm. The schedule of overall IWM-CSS was essentially the same as in previous years, except that FTIS also addressed industrial safety issues at each group meeting or on-site visit. After one year of work, Sanyang's IWM-CSS resulted in substantial economic benefits, improved environmental performance, and significant reduction of risk. Achievements are summarized in Table 3.

Table 3. Results of Sanyang's IWM-CSS Program, 1998

Benefits		
Economic	Total investment:	US\$ 4 million/yr
	Total benefits:	US\$ 1 million/yr
Environmental	Water saving:	17,000 ton/yr
	Reduction in electricity use:	4.4million kwh/yr
	Waste recycled	1,600 ton/yr
	CO ₂ reduction:	1,700 ton/yr
	CO reduction:	1,500 ton/yr
	HC reduction:	7,400 ton/yr
Safety	On average, each firm gained 27 points in the VPP evaluation.	

Ford's IWM-CSS Program

The Ford Motor Company was one of the central firms chosen for the 1999 IWM-CSS program. Ford consulted with FTIS on how to assist its satellite firms in establishing ISO 14001 EMS as part of the IWM-CSS. There are an increasing number of international companies in the market that are asking their suppliers to obtain ISO 14001 certification in a short time frame. As the concept and methodology underlying ISO 14001 are very similar to IWM, experience with IWM facilitates establishing an ISO 14001 EMS easier. Therefore, an IWM-CSS program is also a useful mechanism for helping SMEs to establish ISO 14001 EMS. As a result of the new corporate policy requiring that all Ford suppliers obtain ISO 14001 certification before 2003, Ford Taiwan wanted to help its suppliers meet the challenge.

Both ISO 14001 and IWM share the common themes of pollution prevention and continuous improvement, and have similar approaches for implementation. The major difference between IWM and ISO 14001 is that ISO 14001 is a certifiable standard, while IWM is simply a voluntary effort. The requirements for documentation and procedures in an IWM are not nearly as stringent as ISO 14001. A comparison of ISO 14001 and IWM requirements is provided in Table 4. The Table demonstrates that if a company can meet the requirements of ISO 14001 at each step of implementing an IWM-CSS program, it will have a strong start towards obtaining ISO 14001 certification. However, incorporating ISO 14001 into an IWM-CSS means that program implementation will be slower than if the companies practiced IWM only.

Table 4. A Comparison of ISO 14001 to IWM

ISO 14001 requirements	Consistent with IWM	Inconsistent with IWM
4.2 Environmental Policy	Commit from top management	IWM only requires internal commitment. ISO requires clear policies and public announcements.
4.3.1 Environmental Aspects	Survey and evaluation process are similar.	ISO requires not only survey and evaluation, but also review of product quality, environmental impacts, and specific evaluation procedures and methods.
4.3.2 Legal and Other Requirements	Comply with environmental and other regulations.	ISO stresses the compliance with integrated regulations and requires the documentation of compliance.
4.3.3 Objectives and Targets	Targets for waste minimization.	IWM is a proactive program. ISO requires an enforceable program
4.3.4 Environmental Management Programs	Plan for waste minimization.	Both are similar. However, ISO stresses auditing obligations and responsibilities.
4.4.1 Structure and Responsibility	Waste minimization structure	Both require participation from all employees. However, IWM is a temporary arrangement while ISO is a permanent structure with clear responsibility.
4.4.2 Training, Awareness and Competence	Educational training and rewards for good performance.	ISO requires planning all employees' training and keeping records of training.
4.4.3 Communication	Attend IWM meetings and present IWM results.	ISO stresses keeping records of internal and external communication, policy announcements, and publication of special achievements.
4.4.4 Environmental Management System Documentation	Set up IWM models.	ISO requires enforceable management structure.

Continued...

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ISO 14001 requirements	Consistent with IWM	Inconsistent with IWM
4.4.5 Document Control	Requires maintenance, record, protection, and operation.	ISO requires a stronger documentation management mechanism
4.4.6 Operational Control	SOP	IWM SOP is incomplete and limited to the SOP of process, machine and facility.
4.4.7 Emergency Preparedness and Response	Pollution prevention and industrial safety.	IWM is less complete than ISO.
4.5.1 Monitoring and Measurement	Review and improvement.	Both require scheduled supervision and quantification. IWM needs to strengthen its process and record keeping.
4.5.2 Non-conformance and Corrective and Preventive action	Project execution, modification, and audit.	ISO has the expectation of continuous improvement.
4.5.3 Records	Must keep records of results.	ISO's records trace back to past activities, products, and services.
4.5.4 Environmental Management System Audit	Quantify results and audit program effectiveness.	ISO specifies clear audit procedures.
4.6 Management Review	Specify the next round of activities after review meeting.	Both have the mechanism for starting new activities. However, ISO requires a standard procedure and documentation.

SUMMARY AND CONCLUSION

The IDB, the FTIS, and the IWM-CSS members have been dedicated to the implementation and continuous improvement of IWM-CSS programs in Taiwan. After five-years of effort and research, the IWM-CSS mechanism is now well developed in Taiwan, and is even well prepared to fully incorporate ISO 14001 or OHSAS issues. Given the success of the program, it is hoped that in the near future, large enterprises will voluntarily initiate their own IWM-CSS programs, rather than depend on financial support from the IDB.

IWM-CSS can help build the capability of Taiwan's industries to face the global economic competition. Through cooperation between the central firm and the satellite firms towards the goal of greening supply chains, companies can not only improve their product quality, but also their public image. Taiwan as a whole can benefit from a safer working environment and a cleaner environment.

17. STRATEGIES AND MECHANISMS FOR GREEN PRODUCTIVITY IN THE APO MEMBER COUNTRIES IN THE ASIA-PACIFIC REGION

Augustine Koh
Director of the Environment
Department
Asian Productivity Organization
Tokyo

BACKGROUND

Green Productivity (GP) strategies work towards the objective of simultaneously enhancing productivity and environmental performance in multiple aspects of development. The Asian Productivity Organization (APO) seeks to realize its objective by: raising consciousness of Green Productivity concepts and applications; performing the roles of think-tank, catalyst, regional adviser, institution builder, and information clearing house on Green Productivity; and promoting and disseminating Green Productivity skills, techniques, and experiences in agricultural, industrial, and service sectors as well as community development arenas. Wherever feasible, these goals are achieved through the application of techniques, technologies, and management systems appropriate to the users.

The Green Productivity Program (GPP), as defined by the 1996 Manila World Conference, is a holistic approach to development. The goal is the optimization of productivity and environmental compatibility to achieve sustainable development in APO's member countries. GP is defined as a strategy for enhancing productivity and environmental performance for overall socio-economic development. It is the application of appropriate techniques, technologies and management systems to produce environmentally compatible goods and services. In GP, there is a shift in the emphasis from that of a pure environmental or quality approach to that of an integrated strategy.

INTRODUCTION

Most developed countries have accepted the need for the integration of the concepts of quality, cost, and environment in their production processes and systems for overall positive socio-economic development. In Japan, the word "quality" is synonymous with simultaneous improvements in quality, cost, and environment. This could also be said for large companies in almost any country, worldwide. However, for the small and medium-sized enterprises (SMEs) in many countries, promotion of environmental management faces a difficult and uphill battle, while the concept of improvement is synonymous with "improved profits." Most SMEs produce only to meet the immediate needs of customers in their own country. As a result, cost is usually the

main purchasing criterion. To help integrate the needs of large companies with those of SMEs, the APO is attempting to integrate the concept of “greening the supply chain” into the overall framework of GP. APO’s goal is to help achieve the vision of sustainability for both large companies and SMEs.

In addressing the concept of developing a green supply chain, GP promotion efforts must take into account the different socio-economic and political needs of the APO’s member countries. Buyers in many countries still tend to concentrate mainly on one purchasing criterion (e.g., cost). Elements of quality and or environment performance will only be considered if there are internal pressures such as legislation, or external pressures such as market expectations. To promote the concept of a green supply chain, the APO’s strategy will be to leverage market forces to provide financial incentives and stimulate further integration between large companies and SMEs.

The APO’s overall mandate is to improve the productive capacity of small and medium-sized enterprises (SMEs). SMEs are important to the Asian economies, as more than 90 percent of all enterprises in Asia fall into this category. SMEs employ over half of the workforce, contribute nearly half of the gross domestic product (GDP), and produce approximately 35 percent of the exports in many countries. Most of the SMEs in the region employ fewer than 100 people and have a capital of less than US\$1,000,000. (Note: the official definition of an SME differs from country to country).

While SMEs are important to the national economy, they are also the major culprits in the ongoing degradation of the environment and the natural resource base in many Asian countries. Although often not the largest individual polluters in sub-sectors, SMEs often pollute more *per unit of output* than large firms operating in the same sector. SMEs have attributed their problems in achieving compliance to various constraints such as:

- Lack of access to new technology;
- Lack of skills;
- Lack of capital to invest;
- Low profit margins;
- Small and variable scales of operation; and
- Low productivity.

SMEs have long cited these restraints in debating how to manage their pollution problems effectively. SMEs will only consider using an approach that carries a win-win formula. Any strategy to address these problems must be a two-pronged approach that both enhances productivity and leads to better environmental performance.

The Rio Earth Summit of 1992 provided the push for the APO member countries to begin following the principle that sustainability must be a fundamental consideration in overall socio-economic development. In this context, the APO established a Special Program for the Environment (SPE) in 1994, under a special grant from Official Development Assistance of the Japanese Government. The main objective of the SPE is to strengthen and upgrade the ability of National Productivity Organizations (NPOs) to address the environmental issues and problems raised by researchers and the Rio Earth Summit. To avoid duplication of the activities organized by other international organizations, APO has identified and developed a niche area called Green Productivity.

STRATEGIES AND MECHANISMS: GREEN SUPPLY CHAIN IN GREEN PRODUCTIVITY

The trend toward a green supply chain has shown that enterprises today can not only satisfy consumers' needs by upgrading product quality and service but must also remain in compliance with increasingly stringent environmental regulations, actively promote environmental management, and guarantee their own good environmental performance. Considering the importance of green production and zero-risk production processes to the ability of enterprises to achieve the vision of sustainable development, "green trade" promises to become an indispensable model of sustainable economic and trading activity.

In response to the global trends in green trade and the new expectations of Japan's "Recycling Law" and "Product Assessment Process Scheme," many large Japanese companies have begun to integrate environmental considerations into product design. A number of companies now consider concepts such as raw material reduction, energy conservation, use of changeable parts and components, product recyclability, product safety, and reduction of packaging volume and weight at the product design stage. In addition to the above-mentioned laws and regulations, the government also enacted the "Design for Environment Guidelines" in April of 1999 to reduce the environmental burden created by products. Beyond their own local initiatives, Japanese companies increasingly consider it important for their international partners and synergy corporations (suppliers) to concurrently undertake similar activities.

GP Demonstration Program on Greening the Supply Chain

The APO is looking into the possibility of a demonstration program that would involve both large companies and their suppliers. The first pilot project would be between a large Japanese company and their suppliers in the Asia-Pacific region.

The vision shared by most Japanese companies is to achieve sustainable development through the recycling and the reuse of the earth's limited resources. Japan has a total of about 7,000 companies in the APO member countries, and the manufacture of many products is closely tied to business relationships with SMEs in many different countries. For example, Japanese companies purchase components for use in the manufacture of personal computers in Japan from a number of different Asian suppliers. In order to meet international environmental requirements and still remain competitive, Japanese companies must now be willing to develop synergistic relationships with corporations and suppliers in all APO member countries to share their technical expertise. Specifically, Japanese companies must help develop both tools for assessing products and systems to assist with training personnel for technology transfers. Through the proposed international project, it is expected that suppliers can minimize the environmental burdens and risks created by their products. In addition, the results of the project will also provide Japanese companies with a basis for offering preferential terms of selection in their future procurement processes.

The APO is now preparing to work with a major Japanese company to identify local and other Asian suppliers to participate in our new Green Procurement Project. The APO will assist Japanese and other suppliers in:

1. Assigning personnel to participate in training in Japan on product assessment methodologies;
2. Assessing products by applying Life Cycle Assessment (LCA), Disassemblability Evaluation (DEM), and Recyclability Evaluation (REM) methodologies;
3. Managing and documenting use of hazardous chemical substances in accordance with regulatory requirements;
4. Obtaining international eco-label certification; and
5. Holding symposiums through the NPOs and the International & Regional GP Associations to present achievements.

Implementation steps

The structure of this project follows the green supply chain or corporate synergy system model developed in Taiwan. After selecting its synergy corporations (suppliers), the representatives from Japan and the Asian synergy corporations (suppliers) shall develop a detailed implementation plan. For the technology transfer component, Asian countries will select engineers to participate in workshops to learn new product assessment procedures and software, and how to apply these techniques to product design in synergy corporations. The procedures will focus on key environmental aspects of products that could help large companies in Japan improve their competitiveness. For example, assessments would include reviewing the potential for applying new technologies to substitute alternative materials for Pb, Hg, Cr_{VI}, and halogen-containing flame retardants in products. The assessments will be geared towards helping companies meet international eco-label certification requirements. Near the end of the project, a symposium will be held to present the project's accomplishments and new products with the public.

The incentive of preferential purchasing terms will motivate synergy corporations to meet the related product design and specification requirements. The demonstration project is expected to help Japanese corporations and their synergy partners to: cooperatively improve environmental performance; ensure the energy efficiency of products; minimize the amount raw materials used; increase recycling of usable materials; and stimulate use of materials that are durable, easy-to-disassemble, and easy-to-repair.

The APO plans to choose up to three synergy corporations as the targeted participants in each selected member country and begin discussing this project. At the same time, the APO and interested parties (companies, NPOs, or other GP Associations) can offer incentives to synergy corporations to participate in this project, such as technology transfer, personnel training, or preferential payment terms. To ensure the completion of this project, the top managers of synergy corporations will be expected to designate specialists to participate in the planning and training components at the beginning of the project. The specialists will meet regularly during the implementation phase to check that the project is continuing on schedule.

International eco-label certification

With the development of global green trade, many businesses have adopted green procurement practices that are gradually becoming non-tariff trade barriers. In line with the globalization of business, green procurement practices and eco-labeling are essential

for stimulating research on green products and represent important components of a successful business strategy. In the era of global green trade, promotion of transnational green procurement can reduce production costs and strengthen a company's image. In addition, cooperative efforts, such as APO's planned project, can simultaneously improve the environmental performance of both the central company and its synergy corporations, creating a win-win situation.

The APO has now adopted the green supply chain concept as a management strategy to help achieve the twin GP goals of productivity improvement and environmental enhancement. The strategy will be integrated into the five main management strategies of the Environment Department: promotion, demonstration, dissemination, international cooperation, and technical assistance.

ACTIVITIES OF THE SPECIAL OFFICE FOR ENVIRONMENT: PROMOTING A NEW PARADIGM FOR PRODUCTIVITY ENHANCEMENT IN HARMONY WITH ENVIRONMENTAL PROTECTION

The following are the major activities implemented under the Green Productivity Program:

APO World Conference on Green Productivity, 1996

For Green Productivity to be successful, efforts will have to be pooled through mutual cooperation at transnational and global levels. With this goal in mind, the APO organized the World Conference on Green Productivity in Manila in December of 1996. The "Manila Declaration on Green Productivity" was issued and endorsed by the conference delegates and has become the guiding vision for the various GP programs in the Asia Pacific region.

Green Productivity Promotion Mission (GPPM)

To raise awareness among potential GP promoters on the importance of GP in achieving sustainable development, APO organizes Green Productivity Promotion Missions for senior planning officers and senior company managers. The missions are designed to assist member countries in identifying their primary problem areas and determining opportunities to apply GP. To introduce the concept to industry, most countries start with a GPPM, similar to our event today, and then eventually integrate GP into their national programs.

To date, the APO has promoted GP in 16 out of 18 member countries. Countries such as Vietnam, Singapore, Indonesia, and Fiji have pushed GP to national policy or implementation levels. In the case of Vietnam, the national government plans to take over the lead in GP implementation once more than 60 villages have implemented GP programs. There is no uniform approach to promotion or application of GP. Each NPO has its own strengths and weakness, and the APO seeks to allow NPOs to identify their own area of need or opportunity. For example, the areas of occupational and environmental health, and safety, environmental management systems (EMS), waste prevention, and techniques for converting waste into new products for the benefit of the factory and the community at large are finding new customers in the region. In the case of Japan, its strength and area of opportunity for both itself and the other APO member

countries lies in eco-design, EMS, Life Cycle Assessment, and greening the supply chain and its quality systems.

Green Productivity Demonstration Program (GPDP)

In 1995, APO initiated the Green Productivity Demonstration Program (GPDP) for member countries. The GPDP program aims to substantiate empirically that environmental protection and productivity improvements could be profitably harmonized, especially in small and medium businesses. Through these demonstration programs, the APO seeks to help further promote the establishment of environmentally friendly factories, communities, and farms in the APO member countries. So far the APO has implemented 14 GP demonstration projects in the following areas:

- *Industrial*: Leather tannery, electro-plating, textile dye-intermediaries, food canning, precision tools, printing, paint shops, and machine tools;
- *Farms*: Vegetable, poultry, and swine farms;
- *Community*: Eco-communities; and
- *Eco-tourism*: Starting in 2000.

Green Productivity Dissemination Assistance (GPDA)

APO established the Green Productivity Dissemination Assistance (GPDA) scheme to assist national productivity organizations (NPOs) disseminate GPDP results to other SMEs as well as to build the capacity of the NPOs to provide GP-related consulting. We have found that the NPOs are better able to provide their services to industry after staff members have concluded work on EMS certification and GP. GPDP videos and technical material produced through GPDP projects are made available to all member countries. To further promote the findings of GPDP projects to non-participating members and to evaluate and review its progress, workshops, symposiums, and study meetings are held throughout the year to facilitate the sharing of information.

Human Resource Development Program

Environmental protection and improvement should be ingrained in the minds of people at all levels of society. Therefore, education to increase the awareness of the need for a better environment should be introduced at every level of schooling, starting with primary education. Most of the NPOs do not have the technical capabilities to conduct environmental education activities. APO is playing a vital role in assisting NPOs in building institutional capacity and expertise on environmental management. The National Teacher's Union of Fiji has taken the lead to prepare a GP training curriculum for use in its primary education system.

International Cooperation

To maximize its overall impact and utilization of its financial resources, the Special Program for the Environment regards collaboration with similar international organizations as important. Examples of past collaborative projects are listed below.

APO/United Nations Environment Program (UNEP) Collaboration

In 1997, the APO signed a Memorandum of Understanding with UNEP/IE, Paris for cooperation in the areas of cleaner production and Green Productivity. This has led to

the organization of joint workshops and meetings. The APO has participated in most of UNEP's High Level Forums on Cleaner Production.

Carl Duisberg Gesellschaft (CDG), Germany

The APO/CDG are jointly promoting GP in three industrial sectors (electro-plating, textiles, and tanning) in Thailand, Malaysia, the Philippines, and Indonesia. From 1998 to the end of 2001, a total of 50 GP training programs have been planned. An estimated 1,000 participants will be trained under this program.

Canadian International Development Agency (CIDA) and Green Productivity Associations

APO will collaborate with CIDA on the development of international and national Green Productivity Associations to promote GP in the region. So far Japan, Fiji, and the Republic of China have established national GP Associations. CIDA has assisted the Philippines' NPOs in promoting GP and has brought two experts to today's forum. We expect that this will go a long way toward quickly changing the face of how environmental issues are managed in the region.

Based on the findings of the APO Demonstration Program on greening the supply chain, the international and regional GP associations could cooperate with NPOs around the region to help disseminate the findings. The APO itself cannot achieve the overriding goals of sustainability; it requires the assistance of regional GP Associations and other international organizations. Partners could assist by providing interested parties with relevant information to support the planning and execution of their own GP-related programs.

CONCLUSION

APO will continue its strategy of sharing its GP experiences with others. However, the APO alone is not sufficient to meet the challenges of sustainability. It is suggested that industry and associations/non-governmental organizations should embark on R&D to improve the industry's capacity in these areas. One action that would be of great use to SMEs is to make technical information regarding GP measures and extra manpower assistance easily available. This is a vital component in the implementation of GP, as it will enhance the technical exchange amongst members. Electronic networking should be established among professional organizations to allow more efficient communication and exchange of experiences. An electronic database could contain information on related publications such as books, journals, conference proceedings, reports, technical manuals, and videos.

1. OPENING REMARKS

Yuji Yamada
Special Adviser to
the Secretary-General
Asian Productivity Organization
Tokyo

On behalf of the Asian Productivity Organization (APO), I would like to extend my heartfelt welcome to all the participants for the Top Forum on Green Productivity – A Management Strategy for Enhancing International Competitiveness by Greening the Supply Chain. I would also like to extend my grateful appreciation to the China Productivity Center for making such excellent arrangements for this important event.

As an inter-governmental regional organization devoted to productivity improvement, the APO has been endeavoring to serve its 18 member countries in the Asia-Pacific region through promotion of sustainable socio-economic development. We work primarily by developing human resources at all levels of the agricultural, industrial, and service sectors.

We all know that efforts to increase productivity would come to naught, without simultaneous improvement in environmental management. Therefore, since its inception in 1961, the APO has paid due attention to issues of environmental preservation and improvement as the basis on which the APO program of action is to be planned. In the wake of the Rio Earth Summit in 1992, the APO formulated the concept of “Green Productivity” (GP) in the belief that the key challenge in implementing Agenda 21 is finding ways to organically integrate environmental protection and productivity enhancement.

In the light of increasing economic globalization, rapidly intensifying interdependence, ever-faster technological advancement, and keener competition in the market –domestic as well as international– there is an unprecedented need for us to find strategies to remain competitive in global markets, yet to develop in a sustainable manner. To ensure sustained development and growth, I feel that nothing is more important than efforts towards continuous productivity improvement in balance with pollution prevention and environmental preservation. I believe that this vision should be at the core of our strategy for economic revitalization.

Productivity provides the framework for continuous improvement, while environmental protection provides the foundation for sustainable development. No doubt, sustainability is one of the major challenges of the new millennium. GP can be advantageously practiced in all economic sectors with the ultimate objective of materializing a better quality of life for all.

Increasingly, corporate gurus and industrial leaders are recognizing the fact that business competitiveness and environmental issues can't be isolated from each other. There is a growing number of companies worldwide who have made a firm commitment to the betterment of the environment by adopting formal and certified environmental management systems incorporating implementation of various pollution prevention

measures. By means of corporate reports, these companies are also publicly disclosing the results of their efforts toward environmental preservation and improvement. These companies are also using means such as the incorporation of environmental accounting into their overall financial management systems to increase the transparency of their efforts. All such initiatives attest to the fact that the basis for sound corporate management is not only improving the environmental performance, but is also enhancing business competitiveness, including overall financial performance. This is the very essence of the Green Productivity (GP) concept that the APO has been advocating. “Greening the Supply Chain” is one such tool or the management strategy for GP, which is drawing significant attention in a variety of sectors.

There still is not a universally accepted definition of “Greening the Supply Chain” –at least, I am not aware of one yet. I hope that our distinguished experts attending this forum will enlighten us at the APO secretariat and enrich our knowledge over the next few days by sharing their the-state-of-art knowledge on this subject. We believe that this is an important tool for increasing competitiveness –especially in international markets– while contributing to the protection of the environment.

Greening the Supply Chain, as I understand it, is rather a new concept for Asia and the Pacific region, and it is very important to adapt this management tool or strategy in accordance with the prevailing local conditions. Multinational corporations operating in global markets are already paying a significant amount of attention to this subject. However, the equally important challenge we have in promoting this concept is to determine how the concept and practices can be realized by the small and medium-sized Enterprises (SMEs), who typically account for more than 80% of all business in their respective APO member countries.

“Greening” the supply chain implies that consumers use their purchasing power to demand improved environmental performance from the suppliers upstream in the supply chain. This effect is then expected to trickle down through the entire supply chain to result in a “green” or more environmentally friendly supply chain. It is thus evident that supply chain management is a very important factor with a direct impact on overall productivity and business competitiveness.

It is against this background that today’s “Top Forum” was organized to target “top decision makers” in government and business to address this important issue. Our goal is to pool our collective wisdom through the exchange of views and experience in order to identify the ways and means best suited to pursue this concept given the specific situations of our respective countries. It is then for this top forum to turn the ideas discussed here into a reality within your own organizations and government agencies.

The APO hopes to be of assistance to its member countries through the network of National Productivity Organizations (NPOs). If you wish to pursue some of the ideas discussed in this Forum or need any further assistance, please contact the APO through the NPO in your country. We will be very happy to cooperate with you in any way that we can through the various ongoing programs and activities of the APO.

Before I conclude, let me once again extend a very warm welcome to all the participants and resource persons for this Top Forum and say that I look forward to a series of very stimulating discussions over the next three days. Thanks again to CPC for hosting this event and making all the arrangements, and I wish you all a very educational, productive, and enjoyable meeting!

Thank you very much for your attention.

2. OPENING REMARKS

Dr. Kuei-Jung Huang
Deputy Director General
Industrial Development Bureau of the
Ministry of Economic Affairs
Republic of China

Distinguished Guests, Ladies and Gentlemen, Good Morning.

I am greatly honored and immensely pleased to be invited to address the distinguished group gathered here this morning at the opening of the Asian Productivity Organization's (APO) Top Forum on Green Productivity.

On behalf of Mr. Yea-Kang Wang, Director General of the Industrial Development Bureau, or IDB, I wish to express my most sincere appreciation for the kind invitation to meet with all of you. My sincere appreciation also goes to the APO for bringing this important program to Taipei. Many of you traveled for thousands of miles from overseas. I would like to extend to you my warmest personal welcome to the beautiful island of Taiwan.

The Green Productivity (GP) concept currently being promoted by APO is indeed very closely related to our job at IDB. We are one of the key agencies in the country responsible for development and implementation of strategies to upgrade our industrial sectors. The essence of our strategy is to improve production efficiency through quality improvement, cost reductions, and environmental enhancements. All these are very much in line with the GP concept adopted by APO.

Over the past forty years, the industrial sectors in this country have undergone a tremendous transition. We have moved through several stages, starting as a center for consumer commodity and light industries in the 1950s and 1960s, before moving into capital and technology intensive industries in 1970s, and finally into high-technology industries in the 1980s and 1990s. Industry is now again being upgraded to raise the level of technology and to speed up the development of new high-technology sectors. I am proud to say that IDB has played a pivotal role as a catalyst over these 40 years of transition.

Despite our satisfaction over our progress, rapid industrialization in Taiwan has not just brought us added wealth, but has also created problems of environmental damage and resource depletion. To avert further the negative environmental trends, the IDB has worked very hard to assist our industry in improving their environmental performance. Over the past two decades, we have provided technical assistance and financial incentive programs to our industry on numerous topics, including industrial waste minimization, ISO 14000, corporate synergy systems, and occupational health and safety. All these elements are important parts of the GP concept currently being promoted by APO. IDB and its implementation partners have accumulated a great deal of experience in these elements, and I am sure that you will hear about these programs in more detail over the next few days.

To meet the needs of our industry, we have continuously revised the focus of our environmental programs over the years. I wish to point out to you that we are now in the process of developing the policy and strategy to develop a new eco-material industry and

to promote green purchasing by both public and private sectors. It is indeed very fortunate for us to have the Top Forum on Green Productivity held here in Taipei. The theme of the forum on enhancement of environmental performance through supply chain management is indeed very relevant and compatible with our new focus at IDB.

Over the last twenty years, as part of the process of developing new capabilities in industrial technologies and environmental protection, the Republic of China has cooperated with many international organizations and national aid agencies from overseas. We are very grateful to have had many opportunities to work with APO in GP Demonstration Projects. The five Taiwanese industrial facilities included in the APO's Green Productivity Demonstration Program (GPDP) have received timely assistance made possible by APO's support. Our industry has in turn benefited from the experiences disseminated through these GPDP projects.

The cooperation between APO and IDB has added a new dimension recently with the establishment of the International Green Productivity Association (IGPA) here in Taipei. With support from the IDB, IGPA began operating in Taipei in late 1999. The organization is still at an early stage of its development, and is still focused on defining its role and building participants and members. When it is fully developed, I am certain the association will closely work together with its members, the APO, and NPOs (National Productivity Organizations) around Asia to raise GP promotion to new heights.

I was informed by my staff recently that IGPA is doing very well in its membership drive. Country-level GP associations have been established in four countries so far, including Fiji, Japan, Thailand, and the Republic of China. The association has organizational members as well as individual members from India, Korea, Singapore, Vietnam, and ROC. It is indeed very encouraging to see so many people ready to participate in IGPA.

Ladies and gentlemen, the IDB strongly endorses the APO's program to promote the GP concept. My agency pledges to continue to work together with the APO on GP promotion in the region. Additionally, we also pledge to continue supporting the programs of IGPA.

Finally, I wish to express our gratitude to APO, represented here by Mr. Yamada, for the opportunity to work together with you on this program. I wish to also thank the resource people from overseas and the domestic organizations for providing timely and important information through their lectures. In addition, I wish to thank the staff of the China Productivity Center and IGPA for organizing this forum. Lastly, I also need to thank our local firms for allowing the participants of this symposium to visit their facilities during the course of this event.

To the participants from overseas as well as our domestic firms, I wish all of you a wonderful next few days in acquiring new skills and knowledge and making new friends. To the participants from overseas, it is also my hope that you will enjoy your time while in Taiwan and share with us your experiences from your own countries. It is my sincere hope that we can do more in the future to learn from each other to find better approaches to protecting our environment and to achieving sustainable development in the region.

I thank you again for the opportunity to meet with you. I wish the forum a great success and the best luck to you all.

3. OPENING REMARKS

Mr. Chieh-Kwei Hsu
Chairman
China Productivity Center
Republic of China

Mr. Yuji Yamada, Special Adviser to Secretary General of the Asian Productivity Organization (APO); Dr. Kuei-Jung Huang, Deputy Director General of the Industrial Development Bureau of the Ministry of Economic Affairs; distinguished participants; friends; ladies and gentlemen – good morning!

First of all, I would like to take this opportunity in my capacity as the APO Director for the Republic of China and Chairman of the China Productivity Center (CPC) to welcome you all here to Taipei. I would also like to thank our partner in organizing this top forum, the International Green Productivity Association, for all its hard work. It is our earnest hope that during the course of the program participants will actively interact with each other in ways that will stimulate new ideas, which they can then take back and adapt to the needs of their home countries.

As you are all aware, over the last few years there has been an increasing focus on the concepts surrounding Green Productivity (GP). In essence, I am referring to a number of disparate but related processes such as the more efficient use of existing resources through recycling, reuse, and industrial waste minimization. These processes have also been shown to bring substantial economic benefits, not only to the companies concerned, but also to the societies in which they operate. More recently, the Green Productivity movement has progressed to the point where more attention is being given to tying these elements together more closely for improved productivity and competitiveness. This is what we mean by “greening the supply chain”.

It is in this context that the new trend of green procurement has attracted much attention, as we saw at the most recent ISO 14000 meeting. Essentially such changes are driven by the trend towards increasing globalization and trade liberalization. That is to say, major exporting countries such as the Republic of China are increasingly required to meet standards of production required by target markets such as the US and Europe. Sectors where this influence has been most obvious include the electronics and home appliances industries. The increasing proliferation of devices such as PC's and associated peripherals has created a tremendous waste disposal problem. It is very likely that, in the not too distant future, many countries will begin to request that local companies take back or recycle products and their components at the end of their operational life. In the past this would have been considered an additional burden and cost, but today it is regarded as more of an opportunity.

While on the face of it, this may not seem a major step, it has nonetheless set in motion changes to the entire supply chain, as companies attempt to integrate operations with their business partners to optimize the potential of green procurement. I am referring to changes throughout the production process, from the design of greener products that are easy to recycle or re-use through the assessment of a product's full life value.

To this end, we are now seeing the development of Corporate Synergy Systems between mother plants and suppliers as well as upstream and downstream operators. This is an approach particularly suited to a country such as the Republic of China where the backbone of economic development has been, and continues to be, small and medium-sized enterprises (SMEs). SMEs benefit greatly from a system wherein “a group of manufacturing companies work together to achieve certain production or management goals,” because it gives them access to information and channels perhaps otherwise unavailable to them. This in turn makes them more able to compete on the international stage and facilitates the optimization of national resources.

We in the Republic of China feel that the time is now right for the wider promotion of greener procurement throughout APO member countries, and we are convinced that such practices will help to unlock productive potential. The ROC is therefore more than prepared and willing to offer its expertise and assistance in this area to help tailor programs to the different needs of different member countries.

Finally, I would like to give my thanks to the Industrial Development Bureau for its support –not only with our program today, but for its long-term assistance in and promotion of green productivity (including some of the GP demonstration factories that we will be visiting later.) Such support has been instrumental in the raising the popularity of GP locally and has proved to be very visionary. This has been perhaps most evident in the way that the IDB and APO have worked together over the last few years. Thanks also to the APO for providing experts from USA, Singapore, Canada, and Japan for our seminar. Thanks also to our local resource persons and plants with a special mention for the TECO Company and its subcontractor Divine Pill Industrial Company Limited. We look forward to the invaluable contribution to be made by all participants.

Though three days is a very short time, I also hope you enjoy your stay in Taipei and take advantage of your time here to experience and enjoy Chinese culture and hospitality. If you have any problems or questions please feel free to contact either myself or my staff.

Thank you.

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2. PROGRAM AND SCHEDULE

(22 – 25 February 2000)

Day 1

May 25, 2000 (Thursday)

08:00-09:00 Registration

APO/CPC/IGPA

Theme 1: Opening Remarks and Keynote Addresses

Chairperson :
Mr. Frank PAI

09:00-09:30 Opening Remarks
Deputy Director General, Industrial
Development Bureau, ROC
Chairman, China Productivity Center, ROC
Special Adviser to Secretary General, Asian
Productivity Organization

Dr. Kuei-Jung HUANG
Mr. Chieh-Kwei HSU

Mr. Yuji YAMADA

09:30-10:00 Keynote Address I:
Green Productivity: New Frontiers of
Sustainable Development

Mr. Lung-sheng CHANG

10:00-10:30 **Coffee / Tea Break**

10:30-11:15 Keynote address II:
The Eco-economy–Enhancing Productivity
and Environmental Performance

Dr. William SHIREMAN

Theme 2: Enhancing International Competitiveness
through GP and Supply Chain Management

Chairperson :
Dr. Shen-yann CHIU

11:15-11:30 Introduction of Resource and Participants

Dr. Shen-yann CHIU

11:30-12:15 Green Productivity and Supply Chain
Management

Prof. TAY Joo Hwa

12:15-13:30 **Lunch**

13:30-14:00 Linking GP, Green Purchasing and Quality
Management Systems: Connections that
Make Waves

Ms. Lynn JOHANNSON

14:00-14:30 Promoting Environmental Procurement:
The Role of Public Sector

Ms. Loretta LEGAULT

14:30-15:00 Promoting Environmental Procurement:
The Role of the Private Sector

Ms. Lynn JOHANNSON

15:00-15:15 **Coffee / Tea Break**

15:15-15:45 Eco-efficiency and an Overview of Green
Purchasing

Dr. Niven HUANG

15:45-16:30	Transforming Eco-design, Eco-efficiency, Eco-material and LCA towards Green Productivity – The Japanese Experiences.	Dr. Takeo TAKAGI
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16:30-17:00 Questions and Answers

18:30-20:30	Dinner hosted by APO (At Pacific International Business Club)
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Program Schedule (Cont'd)

Day 2

May 26, 2000 (Friday)

Theme 3: Environmental Practices of Selected Taiwan Firms

Chairperson :
Ms. Lynn JOHANNSON

09:00-09:30	Enhancing Competitive Edge through Cooperation between Large Firms and SMEs: the Center Satellite Factory System in Taiwan
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Mr. Partner C.H. SU

09:30-09:50	Application of CSS to Promote IWM in SMEs in Taiwan
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Dr. Shen-yann CHIU

09:50-10:10	The Management and Environmental Protection of Paper Industry in Taiwan
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Mr. James K.I. HU

10:10-10:30	Coffee/Tea Break
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10:30-10:50	Eco-design and Eco-efficiency in Everlight Chemical
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Dr. Jason CHU

10:50-11:10	Acer Environmental Report
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Ms. Grace LIU

11:10-11:30	Environmental Policy and Sustainable Development at Corporate Level
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Dr. Kuo-chung LIU

11:30-12:00	Lunch
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Theme 4: Technical Tour to A Corporate Synergy System

Chairperson :
Dr. Shen-yann CHIU
Mr. Calvin CHENG (TECO)
Mr. Hugo JU (DPI)

13:30-17:00	Visit the Yangmei Plant, TECO Company, and Divine Pill Industrial Co., Ltd.
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18:30-20:30	Dinner hosted by IDB/CPC (At Howard Plaza Hotel)
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Day 3

May 27, 2000 (Saturday)

Theme 5: Identification of New Roles for Government and Business: Eco-labeling and ISO 14000 as Framework for Firms Going for Green Purchasing		Chairperson : Mr. Augustine KOH
09:00–09:30	Product Eco-design	Mr. Patrick HUNG
09:30–10:00	R&D Methodologies and Products Development for Eco-labeling	Dr. Takeo TAKAGI
10:00–10:30	Greening the Market: An Effort at Fuji Xerox	Mr. Hiroaki KOSHIBU
10:30-11:00	Coffee/Tea Break	
11:00-11:40	Green Consumption Movement: Roles of Governments, Businesses, Academia, NGOs and Consumers	Dr. Ning YU
11:40-13:00	Lunch	

Program Schedule (Cont'd)

Day 3 (Cont'd)

Theme 6: Panel Discussion I- Strategies & Mechanism for Implementing CSS/GP in Member Countries		Moderator : Mr. Yuji YAMADA Dr. Shen-Yann CHIU
13:00-13:20	Strategies & Mechanism of Government in GP and CSS Promotion	
13:20-13:40	An Overview of Industrial Waste Minimization Corporate Synergy System in Taiwan	Mr. Wen-Huei CHEN
13:40-14:00	Strategies & Mechanism for the APO Member Countries and the Secretariat	Mr. Augustine KOH
14:00-14:20	Coffee/Tea Break	
Theme 7: Panel Discussion II- Roles of R&D Organizations and NGOs		Moderator : Prof. TAY Joo Hwa Dr. Chih C. CHAO
14:20-14:40	Roles of R&D Organizations in Green Purchasing	
14:40-15:00	Roles of NGOs: Green Purchasing Network, Japan	Mr. Hiroaki KOSHIBU
15:00-15:30	Questions and Answers	
15:30-16:00	Closing	Mr. Yuji YAMADA