



Asian
Productivity
Organization



Handbook on Green Productivity



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STEP 1

STEP 2

STEP 3

STEP 4

STEP 5

STEP 6



Green Productivity *Success in Six*

GETTING STARTED

- Form a Green Productivity Team
 - Conduct a Walk Through Survey and Gather Information
- *Brainstorming*
 - *Attribute Analysis*
 - *Needs Analysis*
 - *Responsibility Matrix*
 - *Checklists*
 - *Flowcharts and Process Flow Diagram*
 - *Material Balance*
 - *Benchmarking*

PLANNING

- Identification of Problems & Causes
 - Setting Objectives and Targets
- *Brainstorming*
 - *Cost Benefit Analysis*
 - *Eco-mapping*
 - *Fishbone Diagram*
 - *Force Field Analysis*

GENERATION AND EVALUATION-GP OPTIONS

- Generation of Green Productivity Options
 - Screening and Evaluation of Green Productivity Options
 - Preparation of Implementation Plan
- *Brainstorming*
 - *Cost Benefit Analysis*
 - *Eco-mapping*
 - *Failure Mode And Effect Analysis*
 - *Pareto Chart*
 - *Program Evaluation Review (PERT)*

OPTIONS FOR IMPLEMENTATION OF GP

- Implementation of Selected Options
 - Awareness Building, Training and Developing Competence
- *Training Needs Analysis*
 - *Team Building*
 - *Responsibility Matrix*
 - *Critical Path Method*
 - *Gantt Chart*
 - *Spider Web Diagram*

MONITORING AND REVIEW

- Monitoring and Evaluation of Results
 - Management Review
- *Eco-mapping*
 - *Failure Mode And Effect Analysis*
 - *Charts (control/tally, etc.)*
 - *Spider Web Diagram*

SUSTAINING GREEN PRODUCTIVITY

- Incorporate Changes
 - Identify New or Additional Problem Areas for Continuous Improvement
- The tools are repeated here since the activities are looped back to the previous steps to provide consistency and encourage continuous improvement. This empowers the people involved to build on their new knowledge with confidence for success.*



Introduction

Who should read this book?

You should! If you have an interest in improving productivity within your organization you will find ideas in this handbook to help. This book is written for those of you with a passion for learning, a dedication to a quality of life and an insatiable curiosity for doing ***better with less***. You understand that we are in a race against the challenges that humans have created for ourselves by lowering the quality of the environment. In doing so we are working unproductively. If you want to seize the opportunity to lead change, this handbook is for you.

Content

The content for this handbook originated in the Asian Productivity Organization's (APO) Training Manual on Green Productivity as the Manual for 5-Day Training Program.

The APO developed Green Productivity (GP) as a strategy to leverage the power of productivity in order to improve the quality of our environment. GP can foster the creative exchange between people to:

- achieve a better quality of life for all,
- support social justice and fairness for citizenry, and
- enhance prosperity for their enterprises.

This in itself is no small feat. It is a critical step. It is one from which each one of us must not falter. This handbook provides insight on how to progress in that direction. If it fails to assist organizations, the failure is due to the author and not the APO.

There are six chapters that form the core of this handbook. They outline the concepts, tools, techniques and the methodologies that are gaining acceptance in the APO's twenty member economies. The results in enterprise to date are evidence that GP has merit.

Why? GP has proven to be a practical approach for any type or size of enterprise. You may try one tool or a technique to start. Or, you may opt to redesign your business completely. In either instance GP has something to offer in its step-by-step guidance through a portfolio of proven concepts, tools, techniques and technologies.



Recent application of GP in community settings has shown equal success as a means of improving local economic development and environmental performance. Its broad appeal and applicability is an important attribute as the majority of enterprises in the Asia Pacific Economic Region are held by small and medium-sized enterprises (SMEs).

It is essential to ensure that SMEs are successful for the good of the region's economic health and wealth. Their ability to benefit from the power and simplicity of GP is especially important to the member economies of the APO. Nations in other economic regions do have the same potential to benefit by innovating environmental protection and enhancing community development. However, with the support of the APO and other regional stakeholders such as the National Productivity Organizations, a concerted effort to adopt GP could bring a multiplier effect. By fostering competitive advantage in individual firms, GP can help local and national economic development and provide the Asia Pacific Economic Region with better opportunity in a growing green global marketplace. It all starts with you. Are you ready?

Design

How does this handbook work?

It's a Learning Tool

The chapters of this handbook are grouped to reflect the six steps of Green Productivity. This enables you to understand the full benefit embodied under the Green Productivity umbrella.

It's a Reference Guide

The Table of Contents allows you to quickly find a specific tool, technique or methodology, giving you convenient direct access to information on a specific topic.

It's a Record of your Success

On the outer margin of every page, there is a space for you to:

- record your own ideas and experiences;
- print points that you want to explore further or
- write questions that you want to ask someone you know.

May you have Success in Six!



Greening on the Go®: A Pocket Guide to Green Productivity

Greening on the Go is literally a pocket-sized guide. It is a companion to this handbook. It holds brief explanations on over eighty concepts, tools and techniques that you can help you to solve problems on the shop floor.

Each of these is explained by answering six questions:

What is it? Defines the concept, tool or technique

Why is it useful? Outlines its attributes

How will it help you? Aids in understanding the value of your GP effort

Where do you apply it? Shows its placement either within a location or site, or within your business system

When is it useful? Delineates either a time reference or a stage where it has particular benefit in your process to adopt GP

Who benefits? Characterizes the primary beneficiary of your GP efforts, as well as indicates to whom additional benefit may flow

Most sections include a tip or word of advice. Many include diagrams that show you the process or logic flow. At the end of every section is a Point to Ponder – notes to inspire you to think differently about your business.

We hope that you find the pocket guide a practical aid along with this Handbook.





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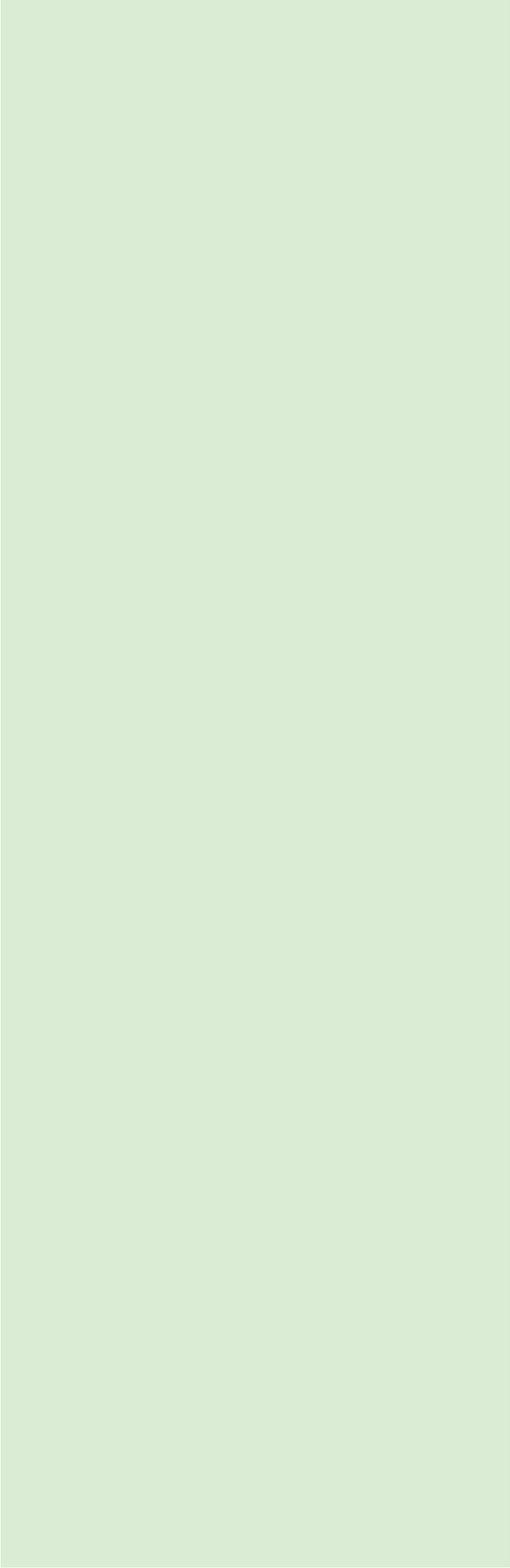
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CHAPTER 1
Green Productivity

CHAPTER 1
Green Productivity

CHAPTER I GREEN PRODUCTIVITY

1.1 Purpose of this Chapter - Introduction to Green Productivity

The new millennium is here. It is a rapidly changing world. Expectations and needs are in flux. To meet or exceed these demands from your traditional customers is a challenge. However, there are other parties who are now placing new demands on you outside your traditional business relationships. They hold you accountable for not only what you do but how you do it. It is critical to address these challenges, maintain control of your business, and remain profitable. Green Productivity offers you a logical means of excelling.

Are you ready?

This chapter will explore the concept of Green Productivity crystallized by the Asian Productivity Organization (APO) and introduce you to:

- a formal definition of Green Productivity (GP)
- the underlying principles and characteristics of Green Productivity
- its three dimensional qualities and distinguishing features
- the leadership role that the Asian Productivity Organization is taking
- early trends that show how Green Productivity can assist community development and improvements in the local quality of life
- the importance of Green Productivity to business process, especially to smaller entities and micro-enterprise
- practical information to help guide yourself to more efficient business practices including:
 - a framework for GP
 - tools and techniques
 - methodologies
 - management systems and programs

Why should you take an interest in Green Productivity?

Green Productivity recognizes the fundamental need for businesses to incorporate not just environmental concerns, but economic performance in the improvement process. This is something that previous approaches have often failed to do. GP fosters the change process to help businesses cater to customer requirements for more environmentally sound products. At the same time you need to ensure a healthy and safe work environment and a solid bottom line.

Why is there a focus on productivity?

In the simplest terms, productivity was historically defined as the ratio of output to input, where inputs included labour, material, capital and services and outputs were defined as product. Productivity was and is a measure of success or inefficiency. It is not a precise term, the ratio consists of two or more variables, the only constant being change.

Figure 1-1

What is Productivity?

As an integrated concept

$$\text{PRODUCTIVITY} = \frac{\text{Output x Satisfaction}}{\text{Input x Sacrifices}}$$

as objective \longrightarrow Social-Economic concept
 as a means \longrightarrow Technical concept

Is there something that you presently have or do that you could change to improve the productivity of your business and green it at the same time?

Look at the suggestions in Table 1.1. Is there something you see that you could do to improve? Quickly identify what you think your opportunities are. Spend 3 minutes at the most deciding where you think your risks are.

Table 1.1

Description	Needs significant improvement	Needs some improvement	Requires minor improvement	Efficient	Already green and productive
<i>Choice of raw materials</i>					
<i>Use of raw materials</i>					
<i>Use of energy</i>					
<i>Use of water</i>					
<i>Chemical content of wastewater</i>					
<i>Prevention and reduction of waste</i>					
<i>Selective separation of waste</i>					
<i>Recycling of materials to avoid waste</i>					
<i>Reuse of materials to avoid waste</i>					
<i>Dust or odours within the workplace</i>					
<i>Dust or odours outside the workplace</i>					

Description	Needs significant improvement	Needs some improvement	Requires minor improvement	Efficient	Already green and productive
<i>Storage of products</i>					
<i>Noise or vibration in the workplace</i>					
<i>Noise or vibration outside the workplace</i>					
<i>Health and safety in the workplace</i>					
<i>Mobility and transport of employees and products</i>					
<i>Prevention of environmental accidents</i>					
<i>Good emergency response plan in place</i>					
<i>Environmental information</i>					
<i>Communication with customers</i>					
<i>Communication with suppliers</i>					
<i>Planning for greener products or services</i>					
<i>Coordination with others in the community</i>					
<i>Motivation of managers</i>					
<i>Mechanisms to ensure legal compliance</i>					
<i>Confidence in management approach</i>					
<i>Need to institutionalize management of environmental issues</i>					

Table 1.1 is adapted from the Weather Map, part of the Eco-mapping© Toolkit.

Closely tied to productivity is the concept of quality. For many years, quality was also viewed very narrowly, as the absence of defects. Starting in the 1950s and into the late 1980s quality management helped to change the process of business, expanding from a more linear quantitative focus to a broader perspective, and one defined with more qualitative characteristics. No country has been more successful in capturing the essence of quality management than Japan, leveraging it to restructure its nation's industrial foundation after the Second World War.

Today, the manner in which business operates is faced with its most significant challenge – that is to balance the need to meet an exponential growth in customers with rising niche expectations for products and services, against a finite resource base held together by a single supplier.

Cradle to grave does not mean planned obsolescence. It requires that you plan for the future. Decide where you want your products to go when their productive life is over. Leaving it in someone else's hands is expensive and often contrary to your profitability.

Increasingly, business is being held accountable to a new model, which is characterized as having three-dimensional value (environment, economic and social). No longer does the marketplace accept a position of limited environmental responsibility contained to what occurs within the corporate walls, business is expected to cover all stages of an organization's activities: the input, throughput and the output. The marketplace is not only concerned with the utility and quality of the product or service you offer, it is as concerned with how you produce a product or service, and with how the product or service's life cycle ends – in a landfill or returned to some state of value. In the 1980s and 1990s the push for accountability was coined by the phrase “cradle to grave”.

However, with the start of the new millennium and in recognizing the monumental challenge that remains, the scope has evolved to encompass a “cradle to cradle” imperative. Some may view this evolutionary shift as arriving at lightning speed, perhaps spurred on by the response rate that customers have been programmed to expect by the computer age. Others have started to recognize that the state of the environment is at risk, threatening their quality of life, but do not know how to respond. Unfortunately, too few businesses are ready to exceed, let alone meet, the growing green expectations in the marketplace. However, your initiative to open this book and absorb its contents is a sign that you understand that there is a challenge and you are taking an important first step to address it.

Is starting Green Productivity difficult?

No. It does require new knowledge, which is the intent of this chapter – to define and delineate Green Productivity for you, and start you on the journey.

Start with an understanding of where you are in terms of your knowledge, skill and attitude.

Please indicate your current level of knowledge of Green Productivity where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of Green Productivity is at this level: 1 2 3 4 5

Please indicate your current level of skill in applying Green Productivity where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My skill level is: 1 2 3 4 5

Please assign a value to the importance of Green Productivity as a means to enhance your profitability and competitive advantage where:

1 (not important) 2 (slightly important) 3 (average importance)

4 (a core business concern) 5 (a critical business tool)

I think the level of importance to me is: 1 2 3 4 5

This chapter is intended to introduce you to Green Productivity. Subsequent chapters will delve into detail for each component.

1.2 What is Green Productivity (GP)?

Green Productivity is an umbrella concept covering a hierarchy of improvement opportunities for your business to meet or exceed the needs and expectations of the marketplace. These ever-changing expectations are now embracing good environmental management as a customer demand alongside quality, supply, delivery, technology, health and safety, and cost. Green Productivity attempts to answer society's needs for a better quality of life by increasing productivity through environmentally sound manufacturing practices and management activities.

Green Productivity was conceived on the understanding that a healthy environment and a robust, competitive economy are mutually dependent. GP fosters “smart growth” by releasing the collective creative ingenuity of people. This is a move away from “mandate, regulate and litigate” to encouraging people to act responsibly and take control of their actions to improve the quality of their own lives and profit for it.

Why is Green Productivity an important opportunity for your business?

Green Productivity is not just an idea; it is a proven concept. GP offers tried and tested methodologies to help you enhance profitability. This can enable your organization to achieve competitive advantage. GP demonstrates practical ways of reducing your impact on the environment, which can lead to cost savings and risk reduction. This can place your business on top - above the heads of competitors.

While the markets are becoming more sensitized to products and services that contain ‘green’ or ‘environmentally friendly’ attributes, there are surprisingly few companies that have been able to embrace the opportunity and meet market demand.

Why is that? Greening your business is not something that happens overnight. It is not possible to apply green paint or merely change the name of a product and be successful on a sustained basis. Such tricks have been played to lure customers under the banner of environmentalism. However, in the absence of real improvement, customers have not stayed. Those that have experienced this chicanery become leery of environmental claims; false claims are viewed as ‘greenwash’. To lose face with a customer carries a significant penalty: the least of which is cynicism. Of equal concern is the fact that these companies miss out on the real opportunity – to improve their business. Green Productivity is the logical connection between environment and economic improvement. It can lead to benefits that can be maintained and shared with those internal and external to your organization. GP's broad applicability should not be underestimated.

Green Productivity has already proven to be as effective in the boardroom as it is on the shop floor.

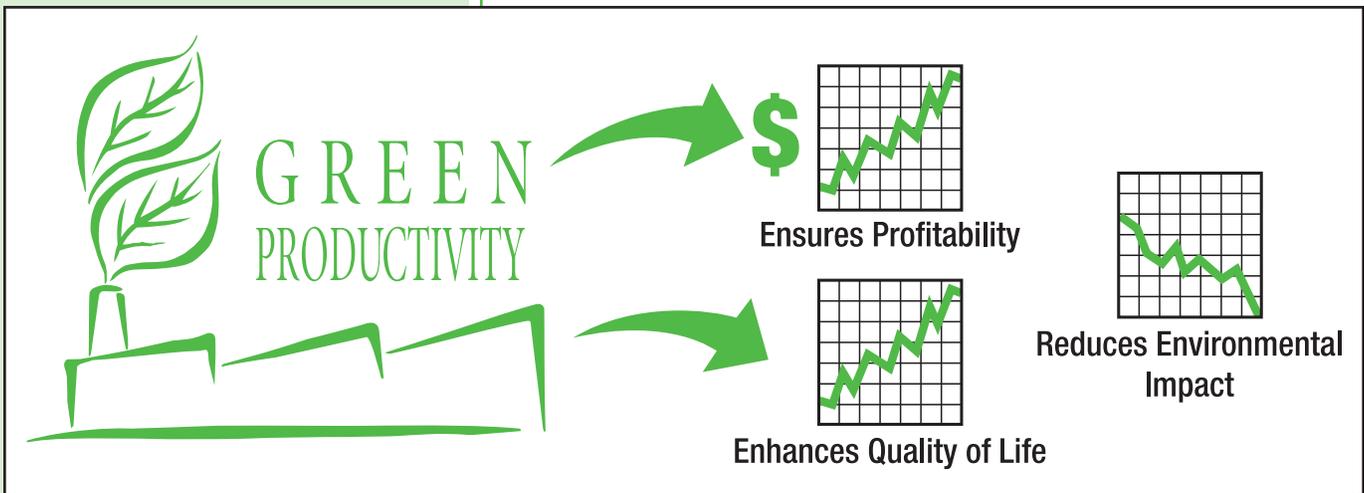
Most people are not environmental experts. This includes people that work in government, represent the public as consumers or taxpayers or are in your customer's companies. Yet most people rank the environment as an important issue. This is especially true when their health or personal safety is put at risk due to poor environmental conditions. The company that can offer better products and services based on good science conveniently and credibly will have a significant marketing advantage over a competitor. While you may not be an environmental expert, Green Productivity offers many simple ways to improve your business process by greening. Doing better by using less leads to opportunity. The power of Green Productivity to drive competitive advantage becomes a distinguishing feature.

1.2.1 Green Productivity Definition and Concept

Green Productivity is a broad strategy for enhancing productivity and environmental performance. Used effectively it can lead to positive change in socio-economic development. GP's array of productivity and environmental management tools, techniques, and technologies helps you to reduce the environmental impact of your organization's activities, goods/products and services.

Green Productivity's greatest attribute is its potential for integrating environmental protection into the operations of a business as a means of improving productivity. This can result in increased profitability, or simply better cash flow.

Figure 1-2



There are three key terms or phrases that are used in the formal definition of Green Productivity:

- strategy
- productivity, which includes economic and environmental performance
- socio-economic development

You need to understand where you are taking your business; this is not a random journey.

Strategy

The concept of Green Productivity is drawn from the integration of two important activities - productivity improvement and environmental protection.

To start with, it helps if you learn how to think differently. Consider the difference between “water logic” instead of “rock logic”¹. Water logic is described as being an excellent thinking tool for exploration. Water flows. Yet it holds onto one principle without exception. Water always moves from a position of high energy to low. Hence if you could model your business process to follow the natural flow that exists in water, you could save energy. You would be moving under the same laws of conservation dictated by physics, following natural flows. Moving in parallel requires less energy. This could result in energy savings for example, which in turn could reduce cost. Both the environment and your bottom line benefit. When you use less energy, more is available to others, a potential community advantage. In contrast, rock logic is seen as hard, unchanging, and unyielding.

It would seem that water logic would be an excellent tool for Green Productivity as it encourages innovation. Thinking differently about your business is critical to innovating new product or processes. By contrast, rock logic does not yield to its environment.

Sit back and visualize in your mind not what your business is but what Green Productivity can do to make your business unique. Just as water only needs the slightest incline to keep its momentum, Green Productivity offers the same opportunity to perpetuate a relentless search for a more competitive position that requires less energy, saves you money and effort, and helps your community. This is the essence of sustainability. The process required to maintain the strategy, which is responsive to the changing marketplace, is cyclical by nature. Think of it as an annual renewal; an opportunity to rejuvenate. Green Productivity is a multi-dimensional, comprehensive strategy that aims at improving the overall quality of life and at the same time leads to sustainability.

What does the term sustainability mean and where did it come from?

Sustainability refers to the concept of environmentally sustainable economic development. It was first conceived when one hundred and thirteen nations gathered in 1972 for the Stockholm Conference on the Human Environment. A formal definition for sustainable development emerged in the 1987 landmark report “Our Common Future“, as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Initially its purpose was to drive national policy towards sustainability as a worldwide business plan.

How is sustainability relevant to your business?

Overall, sustainability is the vision or driving force for Green Productivity. It is about finding a way to produce efficiently, perform effectively and share equitably, and show a profitable bottom line. It is about operating profitably indefinitely without drowning in your own wastes or dumping them on your neighbour. For business, sustainability has been a laudable idea, but was reserved for polite discussions outside of real core business. In six steps, Green Productivity brings the concept of sustainability from rhetoric to reality.

Productivity is essentially a marathon without a finishing line. Greening Productivity enables an organization to optimize its efficiency. By using the natural flow of energy – going with the flow you can save money, and reduce negative impacts associated with your business processes and products.

Vision is about the future you choose to create for your organization. The future is not out there waiting to happen to you. You have to create it yourself. If you don't create your own future, then you are always at the mercy of somebody else's future. Vision can be a uniting force within the organization and gives guidance to what the organization should do and how it should do it. It seems obvious to me that environmental responsibility must be a part of this vision of the future for all organizations. - Gary Fread

In today's marketplace where new "toys" emerge almost daily, there is too often a tendency to buy an engineered solution, rather than improve productivity by applying 'profound knowledge'. Dr. W. Edwards Deming, a famous quality guru, emphasized the real power behind profound knowledge through four system conditions, which are explained in Chapter 5.

Consumers and customers view poor use of resources and materials, especially generation of pollution, as evidence of lower productivity as well as poor environmental performance. With the understanding that Green Productivity brings, these conditions are now regarded by business as manufacturing defects that need to be consistently corrected. Environmental stewardship becomes an asset and an opportunity for increasing efficiency and profitability. The view that it is a cost or a responsibility held by someone external to your organization is no longer accurate. The power of this shift in outlook is not to be underestimated. A business strategy based on Green Productivity can meet the needs and expectations of the marketplace by constantly addressing both the supply side and the demand side management. As consumers have more disposable income, they want products with better environmental performance; from coffee, paper stock with high recycled content, to cars with lower emissions and improved fuel performance - such as the new hybrids. As markets demand greener products and services, Green Productivity helps to push the supply side by providing a logical process, with practical tools and techniques to accomplish this change. By using a 'life cycle' approach, covering upstream and downstream elements, your organization can establish better control to meet today's expectations. This can also help you to influence society's needs in a more sustainable direction. It's a win-win situation.

Productivity and Environmental Performance

Keeping your eye on what the future will be while you operate your business today is called vision. Visioning does not happen on its own. Think back to water logic and GP strategy. Productivity provides the context for continuous improvement. It is a description of the current state of affairs and incorporates past efforts. To improve you need to establish your objectives and targets to meet your GP goals. You also need to assign a value establishing where you are today and what measures or indices you want to use to judge progress or improvement.

Why is the opportunity for greening your business important to integrate with productivity and continual improvement?

Environmental protection is not a passive process. It requires you to focus on the sources or root cause of environmental problems rather than the symptoms. Here is where another fundamental connection to productivity emerges. Quality management, central to the improvement of productivity, seeks to eliminate unwanted variance or mistakes. You do so by analyzing the cause or causes and eliminating them. In a business process, it is cheaper to increase productivity by improving quality than it is to automate.

Nature runs the most massive chemical operation on the planet. Photosynthesis, critical for mankind's food supply, produces 300 billion tons of sugar a year; and it is produced in each leaf, no matter how small. Nothing mankind has can replace or duplicate this production facility, and without it we are in utter peril. Our next industrial revolution will come when we learn to emulate nature, using it as model and measure. This will require collaboration between engineers and biologists. This realization is not fantastical forecasting.

The turning point is now, as much of [last] century's infrastructure is in need of replacement, including outmoded highways, energy and communication networks, water treatment facilities, factories – even economic models.

Source: Janine M. Benyus, *Biomimicry: Innovation Inspired by Nature*, New York: Quill, 1997.

In the context of the environment, it is critical to eliminate the root cause of damage. Masking the problem often adds more cost; and it tends to push the problem into another area. This can lead to it becoming a bigger problem. Quite frankly there are no alternatives where resources are misused. The total amounts of resources in the world are fixed. All the supplies you use in your business to create products or services come from one place, the Earth. All the Earth's energy supplies come from one supplier – the Sun. There is no other option. The Sun cannot be replaced. That's the bottom line. While some may find these facts daunting, armed with the power of Green Productivity you can start a positive chain reaction. There are socio-economic benefits that can fall to people outside your traditional supply chain.

Socio-economic Development

What is your role in socio-economic development?

Within any community that is focused on achieving prosperity there are two key players. There are those that drive economic growth and those that support it. Green Productivity is a proven methodology to evolve the traditional ideas about growth into sustained growth, which enhances community prosperity.

Green Productivity developers are 'new wealth' generators; these are businesses that bring new and environmentally sound wealth into the community by providing innovated goods and services. This attracts new customers from other regions including international markets, thereby creating an export-oriented opportunity. Tourism is included as a wealth generator. The new wealth that Green Productivity developers bring increases the money available in the community. It is shared with:

- other businesses, as suppliers and by working to strengthen the spending capacity of local residents
- residents, as they receive wages and have job security, which in turn can make them champions of Green Productivity developers and they are promoters of sustainable business
- organizations that provide public services and amenities that are able to do so through increased public funding due to a better tax base

Everybody in the supply chain can win with Green Productivity.

Green Productivity 'supporters' are businesses that circulate money within the community, either from the sale of goods and services to residents or as suppliers to the Green Productivity developers. The retail and construction industry are two examples. Organizations that provide public service and amenities such as schools are also considered Green Productivity supporters as they provide the infrastructure and services that add to the quality of life. These services also attract a more skilled workforce that the GP developers need to keep innovating. Note that innovation is the primary driver of economic growth, which in concert with Green Productivity opens

A Single Supplier?



Ultimately the one source from which all supply chains flow is the Sun. There is no alternate. There are no substitutes. Anything that impedes your ability to connect with this source is a serious risk to your business.

the door to a sustainable future. Thus, both types of businesses, GP developers and GP supporters have a role to play in greening socio-economic development, as they are interdependent. By understanding this relationship of mutual benefit, you can use the value of Green Productivity to enhance your community's prosperity. Regardless of your role, the important issue is that you start.

Figure 1-3

GP Community Vision

Green Productivity for socio-economic growth that is sustainable.

GP Economic Supporters

...opportunities for residents, reduces poverty and crime, and generates income for consumer spending and revenues for excellent schools, quality public services and public facilities which results in...



GP Economic Drivers

...attracts and provides a base for diverse, value-adding businesses that provide jobs which creates...

The next point is to understand how to start. This is where quality comes in. A critical component of the quality movement is a customer focus. There is no substitute for truly understanding the needs and expectations of your customers. However, your customers' needs and wants are not formed in a vacuum. They do not live their lives in isolation of the events that shape the world. Think for example, of the socio-economic impacts of events like Chernobyl, Bhopal and the Exxon Valdez. All were major environmental events that caused severe social impact. All are indelibly etched into the worldwide memory. This connectivity demonstrates the fact that the world is a small place, and an error or disaster in one part of the world is no longer contained to the economic region in which it occurs.

Many developing countries in Asia and the Pacific are situated in the world's hazard belt. They are subject to floods, droughts, cyclones, earthquakes, windstorms, tidal waves and landslides, etc. These regions have suffered fifty percent of the world's major natural disasters (ESCAP, 1995a). Since the International Decade for Natural Disaster Reduction began in 1990, the total number of deaths due to natural disasters in the region has exceeded 200,000 and the estimated damage to property over this period has been estimated at US\$ 100 billion (ESCAP, 1995a). Vulnerability to disasters has increased due to the increased aggregation of people in urban centres, environmental degradation, and a lack of planning and preparedness.

Source: www.eapap.unep.org/apeo/Chp1h-nathazards.html

Unquestionably, at least one of your suppliers or customers has had personal experience with some type of environmental disaster. How did the forest fires in Indonesia affect them? Do you know how they were affected? Do you understand the changes the incident forced onto their business? Do you know what their plans are to minimize future impacts from similar events?

What about the positive side?

Think of Anita Roddick, founder of the Body Shop who popularized the phrase “trade not aid”. Her latest challenge to people is “Take it Personally”; she graphically explains in a book on making conscious choices to change the world. Her message “never feel too small or powerless to make a difference” is accurate.

To position your business to take advantage of the opportunity that exists, it will require thinking creatively.

“The significant problems we face cannot be solved at the same level of thinking we were at when we created them.” Albert Einstein

You need to understand how to increase the wealth of your business by building on a sustainable foundation. A triple focus will include economic, environmental and social criteria as cornerstones of the triangle, or as the three legs of a stool. Green Productivity’s framework facilitates this change.

1.2.1.1 Triple Focus of Green Productivity

The triple focus of Green Productivity is not a frivolous activity. According to the investment analysts at Dow Jones, there is mounting evidence that businesses that manage the standard economic factors and the ecological 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.”³

Recognition of the interdependency of economic, social, and environmental systems is important to the development of successful strategies for business plans built on Green Productivity.

There are several supportive arguments from various experts:

- the triple bottom line concept articulated by John Elkington⁴
- the Natural Step led by Dr. Karl-Henrick Robert⁵
- Natural Capital brought forward by Paul Hawken and Amory Lovins⁶

In a recent publication, “The Sustainability Advantage”, author Bob Willard has introduced spreadsheets that enable the user to input real numbers to seven business case benefits of a triple bottom line. These spreadsheets are available from the publisher, New Society Publishers⁷.

Green Productivity brings these positions into focus by ensuring that environmental protection can occur while you make your business more profitable. Development without profit will not be sustained. Neither environmental protection nor economic development can occur at the expense of the other.

Figure 1-4



Figure 1-5



Green Productivity recognizes that the environment and development are two sides of the same coin, with quality defined by your customer. Green Productivity brings together three elements seen as part of the triple focus:

- the environment, represented by sustainable development,
- profitability, defined by factor inputs, and
- quality, voiced by the customer.

Quality plays an equally important role in the process of building wealth. Quality is dictated by the voice of the customer for both goods and services. It is important to listen not only to what your customer is saying, but to understand why certain beliefs are held. Remember the concept of rock logic? How do your customers perceive your quality? Seeing beyond the black and white numbers quantified on a specifications page is important, as that is where you can exceed your customers' expectations.

“Don’t give the people what they want; give them what they never have thought possible.” Oscar Wilde

Green Productivity uses the benefits of quality by promoting the use of (perhaps) newer and safer materials, increasing processing and production efficiency and improving working conditions. It is quite probable that you are already comfortable with many of the tools and techniques in the quality toolbox. Green Productivity builds on your confidence to enable you to provide your customer with higher performance and better value by using fewer resources, including less energy, and by reducing waste. Essentially the practice of Green Productivity results in using material resources and energy more efficiently and sustainably. Productivity is improved by “doing better with less”.

This makes sense both for business and in terms of the environment. Natural resources are conserved thereby reducing environmental degradation. Reducing the amount of material and energy used to make or supply goods and services can directly cut the cost of doing business. The savings may come from lower production and waste management costs or may take the form of avoiding the cost of potential environmental liabilities. Either outcome is beneficial.

Green Productivity thus works towards attaining higher levels of productivity, while protecting and enhancing the quality of environment – both locally and worldwide. Green Productivity also fosters the greening of innovation and production enhancements. Combined, this supports continual improvement in your business. The bottom line result is improved profitability.

How critical is this to your business?

In ecosystems and in the economy, survival is the reward of efficiency. Inefficiency in the extreme is punished by extinction. At a minimum it results in a less competitive position, leaving the species or the company open to attack by a stronger more efficient entity. In an effort to escape scarcity, species as well as industry fragments into ever more specialized units. By adapting to the particular characteristics of a niche, ecological and economic units become more efficient at

reproduction/production and offspring/products. Today's continuing trend for large companies to downsize and operate in smaller business units is part of this adaptive process. It would be a mistake to assume that all organizations would operate better if reduced in size. The more one understands about the nature and dynamics of the business system in which they operate, the greater the chance for "right-sizing".

Lacking any grand design other than the urge to escape threats to their continued existence, genes and technology spontaneously weave living webs of increasingly intricate patterns. The future details of these stunningly complex systems are unknowable, but their basic architecture and historical direction are quite clear and similar.⁶

Natural selection and economic competition follow surprisingly similar patterns. But until recently, it was impossible to develop a meaningful comparison. The great bulk of thorough ecological research is a product of the last thirty years. In the absence of solid information about the facts of ecological competition, any attempt to draw a compelling comparison to economic competition was futile. However, Green Productivity has addressed this challenge by recognizing four important characteristics.

1.2.1.2 Distinguishing Characteristics of Green Productivity

The practice of Green Productivity is characterized by four distinguishing criteria.

Integrated people-based approach: *One of the strengths of Green Productivity is its worker involvement and team-based approach. Improved working environment, worker health and safety, non-discrimination and related social welfare issues increase trust between workers and management. This enables a methodical step-by-step approach for the generation of options and solutions. Thus all members in an organization can contribute to the Green Productivity process. The involvement of people also promotes trust, simplicity and accountability. It makes each person employed by your company a potential ambassador for your business.*

Productivity Improvement: *The condition of continuous improvement achieved by KAIZEN® or by adopting the premise that underlies the PDCA (Plan, Do, Check and Act) cycle is aimed at ensuring productivity improvement. However, unlike classical productivity improvement programs, Green Productivity includes environmental improvement. This is a dynamic and iterative process.*

Information-driven improvement: *Documentation and reporting under Green Productivity is drawn from management systems that exist for quality and the environment (QMS and EMS respectively). The adage "What gets measured gets done" embodies one of the driving forces of Green Productivity. After establishing a Green Productivity program, performance of an organization would be continuously measured and evaluated using a set of defined GP performance indicators. The integration between what is conventionally termed productivity improvement concepts and environmental protection concepts is most evident here. Note that Green Productivity does not dictate how much documentation you require.*

While legal compliance is often the first step for larger companies, small business needs to understand what its environmental and business risks are first. An entry-level position for SMEs is aided by the use of Eco-mapping®, a tool that will be described in detail in Chapter 4.

Eco-mapping is a shareware tool created by Heinz-Werner Engel of Belgium for mapping where the location of environmental problems and inefficiencies lie. All references to Eco-mapping and Eco-maps are covered by copyright.

Your documentation needs may include:

- Notes or minutes of a meeting
- Data records, including graphs and charts
- Results of customer surveys
- Reports summarizing your team's progress and achievements, and areas where more attention is required.

It is important that the form style and level of documentation meets your needs and suits your corporate culture. Too much documentation merely wastes paper, time and money. Too little may result in error, defects, or failures.

Environmental Compliance: Environmental protection, which is the purpose of legal instruments¹⁰, traditionally positions compliance as the first step. Legal compliance is one of the most challenging tasks facing industry. The practice of Green Productivity assists through the use of tools and techniques for pollution prevention and source reduction. Residues still require management and can be addressed by using end-of-pipe treatment measures. While environmental compliance can be achieved, it is the unique characteristic of Green Productivity that productivity will also improve.

What is the value of legal compliance?

When do you need to check to see if you are in compliance?

The more that you focus on greening innovation using Green Productivity, the greater the chance that you will move beyond the law, so that your customers benefit and you find new opportunities in a growing green global marketplace and profit accordingly.

To achieve this integration, organizations may need to adopt innovative or advanced management systems. Adoption of green design, practices and green production strategies (whether for agricultural or industrial application) help to integrate productivity improvements with enhancements in environmental performance.

'Advanced systems' do not necessarily mean cutting edge technology or capital intensive equipment, but it does mean a blend of technological and organizational changes within the company. Remember, the adoption of the philosophy and practice of quality usually brings better returns than automation. These typically include self-directed work teams, worker rotation and continuous process improvement. Such a system is characterized by close and interdependent relationships across the production chain. This includes a connection between the producers and consumers. This signals the increased pressure for corporations to be more socially responsible. Green Productivity helps your company make the changes needed while getting the job done, whether that is producing product or providing service.

Businesses have responded in the past to increasing competition with effective strategies to transform the very nature of competition by overcoming traditional trade-offs. They can adapt to changing market conditions. Green Productivity is a strategy that helps business to retain their competitive advantage while ensuring environmental protection. The primary goal of GP is to integrate environmental protection into the same arena that productivity improvements are seen. It helps you see the marketplace like a split screen on your computer - with one eye on profitability and bottom line needs and the other on prosperity for the community in which you operate.

1.2.1.3 Guiding Principles of Green Productivity

The guiding principles of Green Productivity have been drawn from both productivity and traditional environmental domains. The principles incorporated in its conceptual development lead to a more positive image that will become apparent as you evolve your new strategy.

Many of the principles used to initiate Green Productivity are guiding environmental management and productivity improvement practices today. However, they are being implemented in a compartmentalized or segregated manner. Productivity improvements are managed by one department and the environment in another. In the development of Green Productivity, care was taken to select the relevant principles that were complementary in nature and that would strengthen the integration of environmental protection and productivity improvement.

To meet the goal of environmental protection, three ecological principles were addressed:

Accountability

Polluter Pays¹¹

Precautionary Approach¹²

The complementary productivity principles that guide Green Productivity include:

Profitability

Competitive Advantage

People-Building

To put Green Productivity into operation, a step-by-step methodology was developed. These six principles were integrated into a methodology to make the practice of Green Productivity understandable by those with a background in environmental policy. Something happens when you merge environmental protection with productivity. It is positive. To fully comprehend the benefit from greening your productivity it is important to understand the roots of environmental protection.

An Integrated Strategy

Ecological Principles

Ecological principles of accountability, polluter pays and the precautionary approach bring in the element of responsibility. They place the onus for environmental restoration on the polluter, as do the laws of most nations. This generally reflects the position held by the public and increasingly by those controlling and influencing access to capital.

'Accountability' is a guiding principle that stresses the need for you to take responsibility for actions taken and decisions made. The principle prescribes the need for businesses to be accountable to various groups of people, and not just traditional shareholders. Typically, law holds polluters accountable to the courts. Regulators decide when this level of scrutiny should occur. However, other business groups like suppliers, customers, consumers and the public at large are all increasingly seeking accountability for the actions and impacts of business activities. The way people are interpreting corporate responsibility is changing.

In practice, the principle of accountability has spawned voluntary initiatives such as Corporate Environmental Reporting, product stewardship programs as well as voluntary used product “take back” schemes by the producer. When these voluntary actions are properly designed and implemented they lead to environmental improvements, reduced cost and lower risk. Businesses are increasingly subscribing to voluntary initiatives as proof of their willingness to be accountable. It improves their market image, increases credibility with regulators and consumers, and perhaps most importantly, allows them to retain control of their business. The Responsible Care® program developed by the chemical industry is an early example of this kind of initiative. The principle of accountability is captured in part of the definition of Green Productivity, in the phrase “for overall socio-economic development”.

The concept of the ‘polluter pays’ reflects responsibility by placing the onus of the cost incurred for environmental clean-up on the polluter. The entity creating the damage is made responsible for remediation of the damaged environment. This principle forms the basis of financial and other penalties and pollution taxation systems. The cost of clean-up may be in the form of end-of-pipe treatment systems, new technology to enable source reduction, etc.

The term ‘polluter pays’ is one that some have a problem with in that it is difficult to accept the stigma of blame or inference of wrongdoing. Yet every person does have an impact on the environment with every breath they draw and expel. However, not everything you do is bad. You can have a positive impact on the environment if you plant a tree; pick up litter; or if you stop a spill from occurring. As you implement Green Productivity, you can show leadership to others. Your actions can influence others to take responsibility and accentuate the positive, focusing on opportunities to minimize negative environmental impacts.

How can you avoid negative consequences? The ‘precautionary’ principle advocates a cautious, positive and anticipatory approach. It is typical in situations when the impact of an event is long-term and difficult to reverse. Pollution prevention, cleaner production and source reduction are all based on this precautionary approach for environmental protection.

Productivity Principles

Productivity principles that guide the practice of Green Productivity aim at cost effectiveness. Why? Profitability is the cornerstone of any business. It advocates the need to generate profits be it through savings on raw materials by practicing resource efficiency, improved productivity, increased quality, higher sales, etc.

Green Productivity recognizes that profitability is an essential ingredient for any form of economic activity to be sustainable.

Competitive advantage is a must for businesses to establish and maintain a market position. This also translates into profitability. This principle advocates competitiveness in pricing, quality and, in the case of Green Productivity, in ‘eco-friendliness’. As you practice Green Productivity, you will find that the integration of environmental and productivity improvements will create new business opportunities. It will provide competitive advantage in a market where “quality” has been the focus. Extending this concept to include environmental quality is not difficult; it is logical.

As the history of the quality revolution demonstrated, businesses eventually realized that quality could increase profitability in addition to reducing costs. Similarly the advantages of integrating environmental protection into business strategies will be realized as you become more familiar with the practice of Green Productivity.

People are crucial at two levels. One, you need to motivate staff or build up people's confidence ("people building"). Two, you need management's commitment that may require executive coaching. The commitment of your top management is critical. These are the people responsible for setting priorities for the company, allocating resources, motivating and encouraging employees. They need to understand the benefits and costs of moving forward with GP as well as the cost and risk of inaction. For Green Productivity to be successfully adopted in business, top management must commit to adopting "green" as a value-adding foundation.

Just as crucial is worker involvement in the practice of Green Productivity. Without involvement and commitment of the line workers, effective implementation of Green Productivity is not possible.

1.2.1.4 The Green Productivity Framework

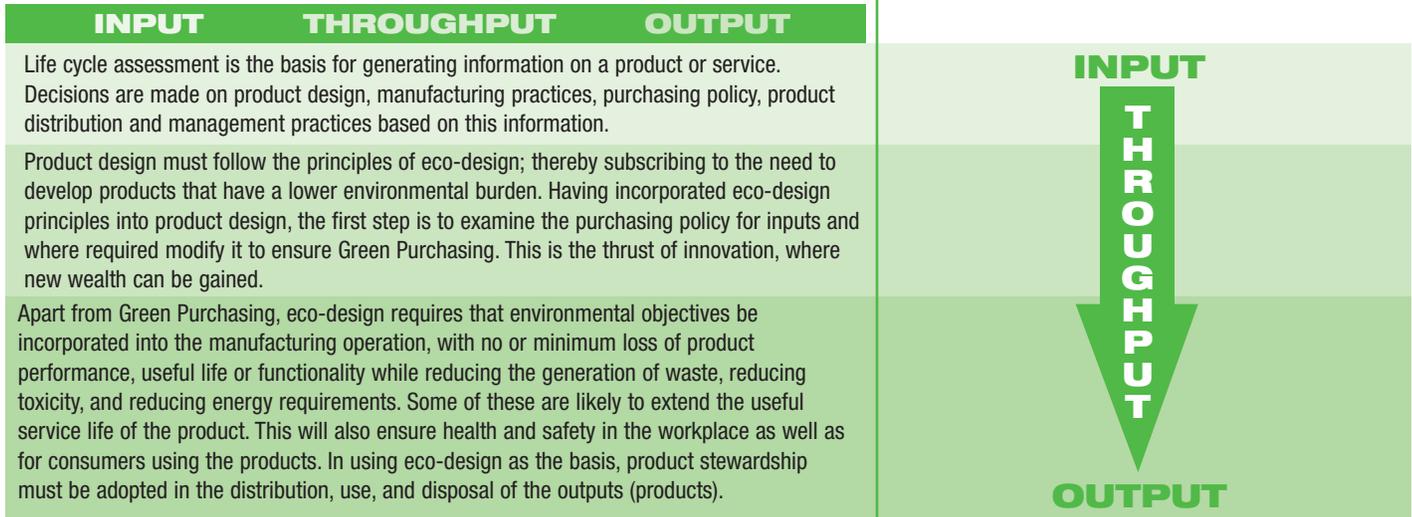
Green Productivity has an open framework to combine several of the existing, proven approaches to eco-efficiency, cleaner production, and pollution prevention, amongst others.

The framework is based on two key components:

- a set of tools used to rationalize the input-throughput-output focus, and
- a set of defined sustainable practices that will guide the practitioner in the integration of Green Productivity.

The emphasis of the framework however is not on terminology or systems. It is based on evolving the strategy of sustainability through prosperity in economic development and environmental protection.

In a small business top management may be the owner.



The benefits in adopting this framework must be measurable. After all, it will be difficult to prove to yourself and others the value in what you have accomplished unless you measure your own progress. Metrics used to measure an organization's performance based on the impact of Green Productivity are Multifactor Productivity (MFP) and Profitability Analysis. These are measurements that are commonly used in business. Details of these measurement approaches will be discussed in Chapter 3.

1.2.2 Green Productivity Tools and Techniques

What is a tool for Green Productivity? It is an aid that can assist you in drawing quantitative and qualitative conclusions. Many of the tools used in Green Productivity come from quality management, with which you may already be familiar. Many of these tools are used to support the generation of new ideas. Green Productivity spurs ideas and innovation.

What is a Green Productivity technique? It is a method of performance or work improvement, applicable to people, processes, equipment, material/energy, products and waste. These techniques are focused on the generation of options to support your Green Productivity strategy. Figure 1-6 shows the relationship of strategy, management systems and programs, methodologies, tools and techniques under the Green Productivity umbrella. Chapter 3 explores these aids in detail.

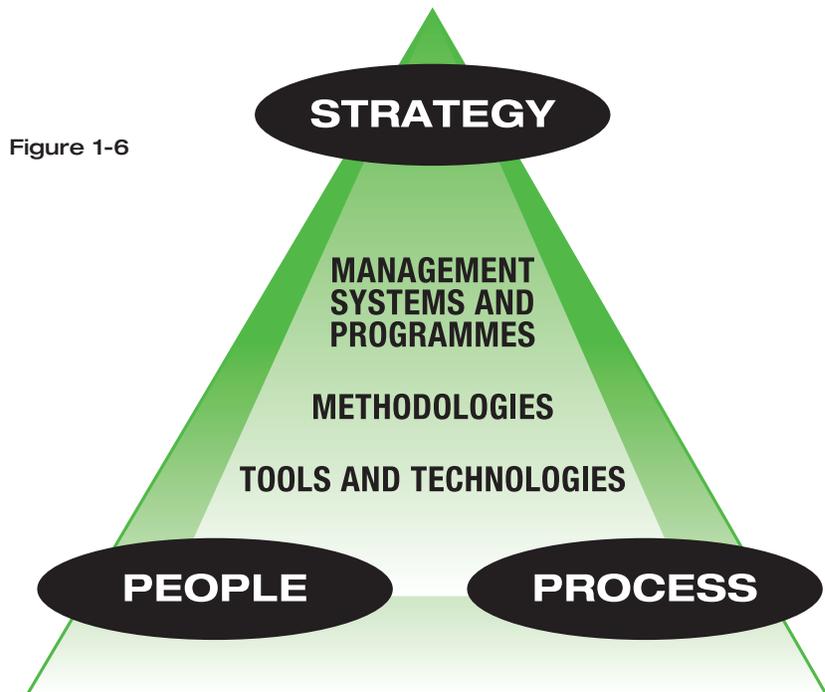


Figure 1-6

1.2.3 Green Productivity Methodology - An Overview

A methodology to support Green Productivity was developed originally to solve environmental and technical problems in the manufacturing industry. It adopted and evolved some of the proven methods used in process engineering and quality control. The concept of continuous improvement - steady incremental and systematic improvement inherent in the Green Productivity method owes much to Deming's PDCA cycle¹³ and KAIZEN¹⁴ commonly used in quality improvements in factories.

In the early days of GP implementation, the projects were mainly in small to medium-sized enterprises (SMEs) involved in electroplating, textiles, food processing and papermaking. As such, there was a very strong emphasis on the manufacturing process.

Subsequently, the application of Green Productivity was extended to farms and also to solving problems in village communities. The methodology had to be modified and made more general so that it could be applied to other areas related to productivity and the environment.

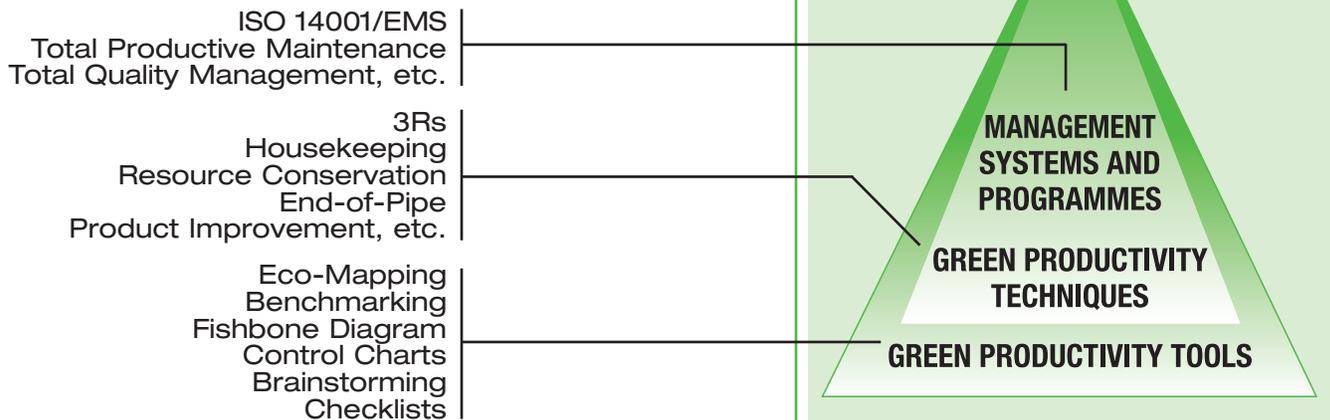
It became evident that Green Productivity can be broken down into three components. These are:

1. the step by step problem solving framework - Success in Six.
2. the set of tools, techniques and the methodology used in conjunction with the frame work.
3. the social, economic, environmental and cultural principles and values that govern the choice of tools, techniques and technologies and the design of the Green Productivity process.

Details of these components are explained in later chapters.

1.2.4 Green Productivity and Management Systems

Once your GP strategy has been formed, the most powerful means to drive the changes needed throughout your organization is a management system. It includes specific programs on areas needing improvement as shown in Figure 1-7.



These include:

- Cleaner Production
- Environmental Management Systems meeting the requirements of the international standard called ISO 14001
- Total Productive Maintenance
- Total Quality Management
- Total Quality Environmental Management and
- other elements that encompass a variety of Green Productivity tools and techniques

Green Productivity, in concert with a management system that uses the ideas in ISO 14001, can help you organize your change management process using an internationally accepted model.

The organization that initiated the genesis of Green Productivity and continues to provide leadership is the Asian Productivity Organization (the APO).

1.3 Importance of Business

The respective roles of business: Multi-nationals, small-to-medium sized enterprise and micro-enterprise.

The shift to sustainable development is both necessary and within reach. It will require substantial shifts in how businesses and the business of government and society operate. It is a race - a marathon. People seem to forget, are unaware or oblivious to the fact that the human economy is embedded in and dependent on the natural systems of this planet. Until recently, the scale of human economic activity relative to the scale of the activity in the planet's ecosystems has been insignificant. It was small enough that, in economic theory and practice, humans could 'afford' to ignore this fundamental relationship. At what point does the human economy become insolvent? Increasingly, there are people who believe that there are so many humans that their collective 'ecological footprint' or impact on the environment is causing significant change to the surface of this planet.

Suppose that an organization has a pond on their property. On the pond is a water lily, which is growing. The lily plant doubles in size each day. If the plant were allowed to grow unchecked, it would completely cover the pond in 30 days, choking off other life forms in the water. For a long time the lily pad seems small, so you decide not to worry about it until it covers half the pond. On what day will that be? (Go to the end of Section 1.6 to find the answer.)

The shift to a sustainable business culture will be nothing short of the magnitude of change experienced in the first and second industrial revolution. The third industrial revolution is moving from a situation based on many individual national economies to a global economy. One societal world, one marketplace, one planet – the change is expected to be more turbulent than the first two transitions, which were from local to national.

In the twentieth century as national economies overtook local ones, national governments gained power. However, in the transition from national economies to a worldwide market, this process is reversed and the power shifts. There are a few multi-nationals whose annual revenues exceed the budgets of single countries. The power of one company can make a difference, if daring enough to embrace Green Productivity and in so doing, benefit from new wealth.

The opportunity for new wealth is not restricted to big business. There are an estimated 152 million legally constituted business in the world today. Approximately 144 million of these are defined as small-to-medium enterprise, companies with less than 100 people. Most of these are micro-enterprise, business entities that are typically owner-operated or family firms with 10 people or less. There are approximately 91 million such entities.

The importance and dynamism of small-to-medium enterprises (SMEs) is one of the distinguishing features of the industrial sector in Asia. They are an important source of employment for low-income earners. As such they provide an important function in alleviating the effects of poverty and are key players in the development of a nation's sustainable future. They are politically, socially and economically central to the health and wealth of each nation.

SMEs are flexible, quick to react to the needs and demands of customers, and close to the core of their community. Critical to change, they have a talent for developing new ideas, which is paramount for innovation that in turn leads to socio-economic development.

In some countries where fundamental changes in industrial sector reforms are underway, such as India and parts of China, SMEs are the most dynamic industrial sub-sector. SMEs account for more than 50% of the total industrial output in China and India, and for 10% to 25% in most other Asian countries.

In 1995, the 40 million SMEs throughout APEC¹⁵ economies accounted for over 90% of all companies, which amounted to 55% of the world's combined gross domestic product (GDP) of about US\$29 trillion. SMEs in APEC economies employed from 32% to 84% of the work force, contributing 30% to 60% of the GDP and accounting for 35% of exports in the region.

Most of the SMEs in the Asian region employ less than 100 people with capital less than US \$1,000,000. SMEs in Asia play a crucial role in the production-consumption cycle. Their presence and contribution is increasingly becoming significant in the trade-environment and supply chain linkages. They are the lifeblood of communities and collectively of nations.

A common myth held by SMEs is captured in the thought that "I am so small that what I do is not important". However, there is not just one SME, there are literally millions and the impact they collectively have on the health and wealth of Asia and other regional economies is impressive.

Even the tight focus on cash flow that keeps the one-person shop operating can see the value in Greening Productivity.

Table 1-2 The Role of SMEs in APEC Member Economies¹⁶**(Data years vary)**

Economy	SMEs (%)	Employment in SMEs (%)
Australia*	96.8 (1977)	50.2 (1997)
Brunei Darussalam	98.0 (1997)	92.0 (1997)
Canada	98.0 (1996)	94.0 (1996)
Chile	15.7 (1993)	36.5 (1993)
People's Republic of China	99.0 (1993)	78.8 (1993)
Hong Kong, China	98.2 (1995)	60.7 (1995)
Indonesia	98.0 (1996)	88.3 (1996)
Japan	98.8 (1996)	77.6 (1996)
Republic of Korea	99.0 (1993)	69.0 (1993)
Malaysia	84.0 (1997)	12.3 (1997)
Mexico	98.7 (1994)	77.7 (1994)
New Zealand**	98.9 (1997)	52.3 (1994)
Papua New Guinea	N.A.	52.9 (1997)
Peru	N.A.	N.A.
Philippines	99.5 (1988)	66.2 (1996)
Russia	85.6 (1993)	33.5 (1993)
Singapore	91.5 (1995)	51.8 (1995)
Chinese Taipei	97.8 (1997)	78.4 (1997)
Thailand	95.8 (1997)	18.1 (1996)
USA	96.0 (1993)	69.0 (1993)
Vietnam	N.A.	85.0 (1998)

Table 1-2 is sourced from the report "SME Guide 2000" by the Asia-Pacific Economic Cooperation.

* Small business only

** New Zealand does not have a definition for SMEs, figures relate to firms with 0-49 full-time equivalent employees.

Grouped together as one business category, SMEs pose a measurable pollution abatement problem. As individuals, they are not the major polluters in most sub-sectors. Far larger entities are still the entities generating the more critical single point sources of pollution. However, the collective of SMEs, when they have not attended to the impacts that their operations have on the environment, are thought to pollute more when measured on a 'per unit of output' when compared to larger firms operating in the same sector. Moreover, the environmental problems that remain (habitat destruction, biodiversity, climate change) are of a different nature. They are more complex. The solutions require a shift away from a relatively easy task – identification and remediation of a source point of pollution – to the more difficult task of changing the behaviour of those controlling diffuse, non-point sources. It is difficult for small business owners to accept the stigma that goes with the ecological principle of polluter pay. It can also pose practical problems as well.

SMEs have limited resources at their disposal, be it technical, financial, time or human resources. Many of the services tied to environmental protection have been created for large clients. The service providers are not as interested in small business as a client. Understandably, small business owners often find themselves unable to afford these higher costs.

The cost of change necessary to meet environmental regulations, product controls, and international standards for environmental management, is onerous for SMEs. Even when the facts prove the contrary, the idea that an SME is the cause of local pollution is hard for the business owner to accept. They are closely tied to their community and often are seen as being local champions.

Despite the adversity of initiating change, it is something that will have to occur. SMEs are at greater risk from the implications and expectations that surround globalization (a point that will be discussed further in Chapter 2). National governments will ignore SMEs at their own peril.

However, the developers of Green Productivity recognized the risk that SMEs face. It became imperative that efforts were taken to overcome the barriers faced by SMEs¹⁷. That is why Green Productivity is especially attuned to the needs and resource limitations of SMEs. Its universality makes it as applicable to large companies as it is for micro-enterprise. Chapter 3 will explore these GP tools in detail. One particular mechanism, Eco-mapping^{®18}, which is discussed in Chapter 4, can demonstrate the value of Green Productivity to the smallest of entities, including the one-person shop. In as little time as a few hours an owner-operator can see where environmental problems lead to unnecessary costs caused by inefficiencies. This makes Green Productivity very practical at any level. It brings the concept of sustainability 'down-to-earth'.

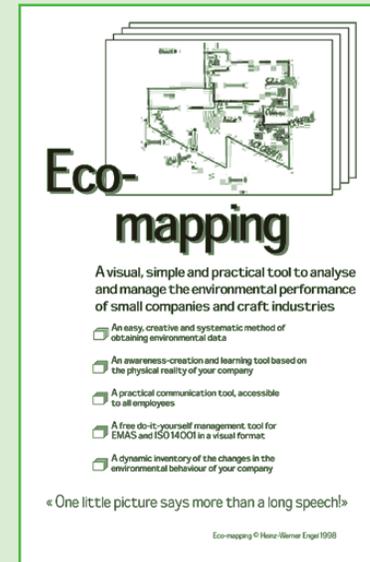
1.3.1 Multi-sector Coverage

A fact worth repeating is Green Productivity's applicability to all sectors: agriculture, transportation, retail and service establishments, government and schools, as well as industry. Green Productivity offers multiple levels of benefit concurrently. GP's flexibility can serve the needs of communities leading to higher productivity. The results address the economic needs of the society. It enables you to protect and enhance the quality of the environment in which you operate. By improving locally it can lead to opportunities to trade worldwide. Within the context of national or regional policy, Green Productivity can improve competitiveness and promote industrial development by enabling a fair distribution of the new wealth. This leads to improved quality of life. At the same time, Green Productivity can lead to gains in profitability through improvements in productivity and environmental performance for individual businesses. Increasingly, the marketplace is rewarding businesses that can demonstrate improved overall performance based on sound environmental management. *Are you ready?*

1.4 Summary of Chapter

Success comes to those who begin with the end in mind. The objective of Chapter 1 was to provide an introduction to Green Productivity and share its methodology.

While no one is expected to be an instant expert as a result of reading this first chapter, the information shared demonstrates an opportunity to improve your business through Green Productivity.



Where are you in your understanding of Green Productivity?

Please indicate your new level of knowledge of Green Productivity where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of Green Productivity is at this level: 1 2 3 4 5

Please indicate your new level of skill in applying Green Productivity where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My skill level is: 1 2 3 4 5

Please assign a value to the importance of Green Productivity as a means to enhancing your profitability and competitive advantage where:

1 (not important) 2 (slightly important) 3 (average importance)

4 (a core business concern) 5 (a critical business tool)

I think the level of importance to me is: 1 2 3 4 5

Has it changed since the beginning of the chapter?

1.5 Questions

1. Is the concept of Green Productivity clear to you?
2. After thinking about how your business would operate if it were sustainable, what qualities would you use to describe it?
3. How would you initiate a discussion on the concept of Green Productivity within your organization?
4. Do you see yourself as a GP developer or supporter? Explain your rationale.
5. Is there a customer that you think might be interested in Green Productivity?
6. Would that customer be willing to share in the cost and gains of success?
7. Do you see how learning more about Green Productivity could help you manage your concerns, lower your costs and reduce your risk?

1.6 Point to Ponder

The Paradox of Growth

Human activity has significantly changed the planet's capability for absorption of pollutants and wastes. Air pollution from factory emissions, motor vehicles, and utilities has led to changes in air quality. These changes have brought diseases to European forests and to crops in Africa, damage to the ozone layer, and loaded the atmosphere with greenhouse gases. This is the air that we draw from for our own personal needs.

The estimated global emission of carbon from fossil fuels alone has tripled since 1950. Global warming can be seen to be the unwanted output of energy use in the first world. Japan, Western Europe and the former Soviet republics are credited with accounting for about 35% of the carbon emitted into the atmosphere¹⁹. With only 5%

of the world's population, the US accounts for another 25%. As the balance between developed and developing countries is shifting as living conditions in some developing economies rises, so too are the energy and resource use. At what point will the paradox emerge: when human progress degrades the quality of the environment to the point where it increases human suffering?²⁰

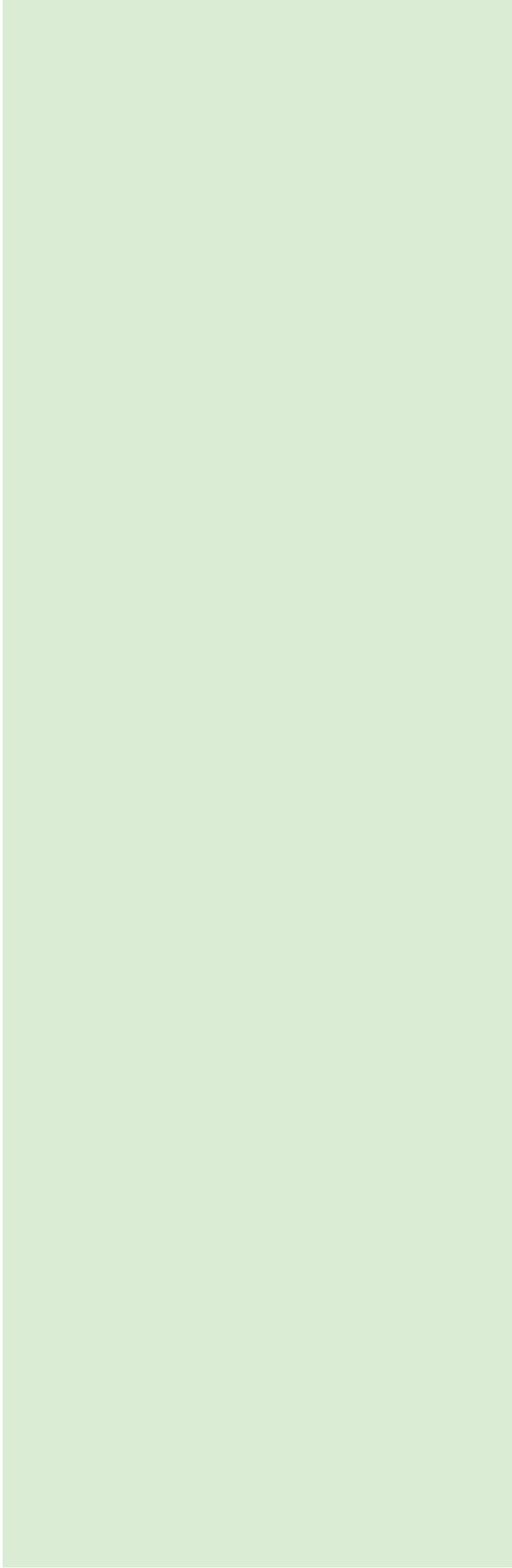
Greening the Zebra: The Role of Financial Institutions in Promoting GP for Sustainability

What does 'greening the zebra' have to do with sustainability and financial institutions?

The relationship between the tsetse fly and the zebra provides an interesting analogy, whereby both creatures take on a role from players from the financial sector. The only animal that eludes the tsetse fly is the zebra. A tsetse fly could conceivably starve to death amidst a herd of zebras as the eye of the fly cannot register the black and white pattern of the zebra's hide. Hence zebras are 'invisible' to the tsetse fly. As a zebra in West Africa, you have a genetically ingrained risk avoidance strategy, a position which financial institutions also favour. Technically, the tsetse fly itself is not the problem, just as the operations of financial institutions are not big polluters. But just as the tsetse fly carries malaria around, earning its living by sucking blood and laying eggs, financial institutions can loan money to businesses that have poor environmental performance and invest in projects without proper environmental assessments. However, changing the colour of the zebra (i.e. financial institutions), greening its hide would potentially expose it, leaving it prey to the problems carried by the tsetse fly. Similarly, money held by the banks in trust for its depositors would be exposed to higher levels of risk. Rather than increase risk to depositors, financial institutions should promote the adoption of sustainable practices by investing in those companies that have adopted Green Productivity. Hence, financial institutions can play an important role in promoting GP.

Answer to the French Riddle: On the 29th day. If you took action on the first day, there would be no issue and the cost of removal would be negligible. By day 29, only half the pond would be covered. However, if you ignored the lily pad until the morning of the 30th, there could be considerable costs involved with removal. Some issues are time critical, especially when growth patterns of some environmental issues are exponential; a concept that has proven most challenging for many.





CHAPTER 2
Green Productivity Strategy

CHAPTER 2
Green Productivity Strategy

CHAPTER 2 GREEN PRODUCTIVITY STRATEGY

2.1 Purpose of this Chapter - Understanding the winds of change and how they bring change to your business

Astronomers believe that some 12 to 20 billion years ago, a 'primeval atom' exploded with a big bang sending the entire Universe flying out at incredible speeds. Eventually, matter cooled and condensed into galaxies and stars, with planets forming around at least one star, the Sun. Eons after life began to develop on Earth, humans appeared.

If all the major events along this continuum were squeezed into twenty-four hours, the Planet Earth wouldn't form until late afternoon. Humans would have existed only for two seconds.

Yet in a span of time *much less than those two seconds*, humans have caused profound changes on the face of this planet.

Changes on the Earth's landscape have included:

- The desertification of Lake Chad, Africa
- Soil Erosion – for example on Java, Indonesia and the Magat Watershed, the Philippines
- Flooding such as that seen in Manila

Modern humans appeared on the planet thirty thousand years ago.

By 10,000 B.C., about 4 million people lived on the planet.

In between then and 1950 the number of people increased to 2.5 billion.

By 1990, a span of forty years, the number climbed to 5.2 billion.

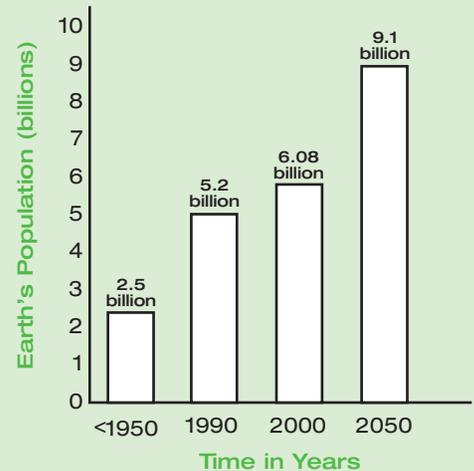
By 2000, it had increased to 6.08 billion.

By 2050, it is expected that there will be 9.1 billion people. Depending on your age, you may be retired by this time. Put aside your own personal agenda for the moment. How could you service this many clients? Given the existing quality of life, your current rate of productivity, the economic status of your supply chain, how would you be able to meet the demands of clients using the same space you currently have?

Between 1950 and 1990 the human population doubled from 2.5 billion to 5.2 billion. If the number of humans doubles again, a five-to-tenfold increase in economic activity would be required just to meet their basic needs and aspirations. As you know, the aspirations or expectations of customers are just as important to them as their needs. The imperative to grow to meet these needs and aspirations would be absolute; a never-ending story.

The challenge is not just about demand-side management. In the period between 1950 and 1990 against this unqualified growth, there was a rise in per capita energy and material consumption, which soared faster than the human population. *More people using much more to produce, not less.*

Population Increase on Earth Between 1950 and Projected to 2050



Not only has the amount of pollution caused by human activities over the same time period increased, it has done so faster than the rise in population and the level of industrialization. Moreover, its nature has changed since 1945¹ with the increasing production of unique synthetic products, often toxic in minute quantities, and which cannot be broken down by natural systems.

What does this mean to you?

If you are the owner of a small company, you can still cause environmental damage by not taking appropriate action. Being small does not mean you are incapable of doing better. If you are employed as part of a large or multi-national enterprise, your company is a bigger target for a concerned public; a deep pocket for a very dissatisfied customer or an easy target for an articulate, well-organized special interest group seeking the attention of the press and public on a specific environmental issue. If dissatisfied, consumers may boycott your products or pressure the government to legislate action. Government bodies are not immune to pressure that comes from public opinion. Governments are also responsible for the impacts of their operations on the environment just like any other sector.

Is this scenario sensational? No. All of it has happened.

Is this information presented to alarm you? No.

It is shared to let you see the need for change today, and by your own hand. Despite the challenge, the future need not be bleak. In fact, if you choose to take action, this period can be an era of excitement, prosperity and opportunity.

Why?

Your business is part of a changing landscape. Focus on how to do better with less. Align your business process with natural systems. Cooperating with nature is logical – humans and human activities are a part of nature. Green Productivity can help you to enhance your business, improve the environment in which you live and work, and demonstrate the results of your responsible actions to others.

How do you start the process of change?

In Chapter 1, Table 1.1, you identified some activities you believed could be improved. While Green Productivity emphasizes strategic thinking as the basis of value-added change, part of the change process includes learning enough about what went wrong or what was done incorrectly to prevent repeat mistakes. Its purpose is *not* to find fault. A mistake made a second time adds cost, increases frustration, and takes away from your productivity. This is a direction contrary to your future success.

Start with a baseline understanding of the history of the environmental movement and public concerns. What is your level of comfort to negotiate the drivers of change and your attitude towards positioning yourself to prosper in a future designed to achieve sustainability?

Please indicate your current level of knowledge and comfort concerning the history of environmental concerns where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of the history of environmental concerns is at this level:

1 2 3 4 5

Please indicate your current level of skill in negotiating with the drivers of change where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My level of skill at negotiating drivers of change: 1 2 3 4 5

Please assign a value to the importance of you being able to position yourself to prosper in a future designed to achieve sustainability where:

1 (not important) 2 (slightly important) 3 (average importance)
4 (a core business concern) 5 (a critical business tool)

I think the importance of sustainability to my future is: 1 2 3 4 5

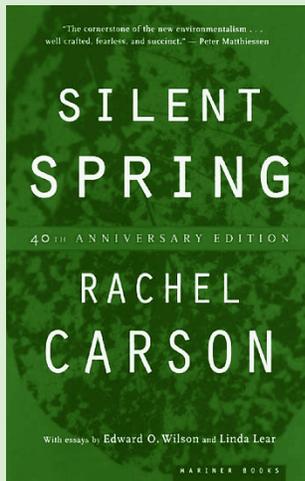
This chapter outlines the history of environmental concerns, including the drivers pushing local and global change. It includes how these drivers can affect your business and how to position yourself successfully to move towards a sustainable future. This chapter will give you the big picture in a series of snapshots as if you were looking at satellite images of the Earth from space. While you may feel distant from these global issues and their drivers, understanding what they are and how they affect you will help you decide what you need to do next.

2.1.1. The Seeds of Discontent

Environmental Trends

Conflict between humans and the environment is not new. The first great transition in human history, from a nomadic lifestyle to agricultural settlements, signalled the start of conflict between human activity and the environment. No longer nomadic, a fixed location lifestyle allowed more people to be fed. Populations began to grow. Granted, humans were still exposed to the vagaries of weather. Given the lack of ‘sophisticated technology’, when the capacity limits of local agricultural systems were breached, it led to famine and malnutrition. This acted as a temporary checking mechanism that brought the population back into balance with the resources of the land.

The second great transition in human history – the use of fossil fuel for energy and the spread of industrialization – marked the crossover, around 1800. More power fuelled the ability to simulate the environmental conditions necessary to foster more people. Humans acted on the belief that they could rule nature.



Silent Spring, Rachel Carson

By the 1980s the earth had to support about 90 million extra people every year – an increment the same size as the total population only 2,500 years ago.

It has been estimated that the marginal productivity (extra industrial output produced) in the world each decade after 1950 is equal to the whole industrial output of the world before 1950. This has led to significant changes in the last fifty years.

By the 1960s, the first warning that something was amiss started to appear. In the spring of 1962, Rachel Carson's book *Silent Spring* was published after several years of research. Her intent was to alert the public and stir people to action against the abuse of chemical pesticides. In the book, Carson explained the nature of poisons and the error of not studying their potential harm. Carson concluded that more research on the effects of pesticides on all life forms was required. This included the application of alternate methods of pest control. Although she did not approve of any use of the long-lasting chlorinated hydrocarbon insecticides², Carson did not object to all use of chemical pesticides. She believed that shorter-lived pesticides could be used responsibly. Even before its publication, *Silent Spring* caused an uproar. The chemical industry and a government official attacked Carson professionally and personally. Their reaction was emotional. The ensuing industry tirade fuelled publicity and the public pressure to react rose. Mainly due to *Silent Spring*, over forty legislative bills were introduced to regulate pesticide use in various states by the end of 1962³. Carson's book is considered an epiphany – the start of the public's vocalization of their concern for the environment.

The late 1960s and early 1970s witnessed continuing recognition of environmental concerns by the public in the west (see Table 2.1). This pattern, which started in Europe, mirrors the shift to industrialization that led the second transition, following the sun's path across North America and on to Japan. In the 1970s, industrial production was rapidly rising with a 7% annual growth in manufacturing. Environmental problems such as toxic waste contamination, smog, air and water pollution started to rise. The negative environmental impacts associated with this boom were viewed as localized problems of air, water and land pollution. Keep in mind that global trade was still in its early days.

In the 1980s the fallout of industrial growth from the 1970s began to be reflected in regional level problems. Political boundaries were crossed. These problems were based on an increasing global population with consumption patterns becoming more demanding on resources. There was recognition of the regional and global impacts of development, with acid rain, global warming, and ozone layer depletion being recognized as serious issues. For example, the broader impact of industrial emissions from the US started to appear outside the country, leading to acid rain in Canada, forest destruction in Germany and acidification of lakes and rivers in Scandinavia. Clearly, human activity had unwittingly forced the need to look at the issue of environmental quality as a global priority.

Table 2.1 Legendary Disasters

The late 1970s and 1980s hosted a period of man-made disasters that caught the eye of the public and led to the genesis of a number of reactionary activities and entities.

Seveso

Around midday on Saturday July 10th, 1976, an explosion occurred in a TCP (2,4,5-trichlorophenol) reactor of the ICMESA chemical plant on the outskirts of Meda, a small town about 20 kilometres north of Milan, Italy. A toxic cloud containing TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin) was accidentally released into the atmosphere. It was widely believed to be one of the most toxic man-made chemicals (Mocarelli et al. 1991). The dioxin cloud contaminated a densely populated area about six kilometres long and one kilometre wide, lying downwind from the site. This event became known internationally as the Seveso disaster, after the name of a neighbouring municipality that was most severely affected.

The Seveso disaster had a particularly traumatic effect on exposed local populations because its seriousness was recognized only gradually. The community was divided by bitter conflicts. People in other countries also experienced much heightened concern about industrial risks. The need for tighter regulation of hazardous chemical installations was recognized.

Amoco Cadiz

On March 16, 1978, the Amoco Cadiz ran aground on Portsall Rocks, three miles off the coast of Brittany. This was due to failure of the steering mechanism. The vessel had been en route from the Arabian Gulf to Le Havre, France when it encountered stormy weather. This contributed to the grounding. The entire cargo of 1,619,048 barrels, spilled into the sea. A slick eighteen miles wide and eighty miles long polluted approximately two hundred miles of Brittany coastline. Beaches of seventy-six different Breton communities were coated in oil.

The isolated location of the grounding and rough seas restricted cleanup efforts for the two weeks following the incident. Severe weather resulted in the complete break up of the ship before any oil could be pumped out of the wreck. As mandated in the "Polmar Plan", the French Navy was responsible for all offshore operations while the Civil Safety Service was responsible for shore cleanup activities. Although the total quantity of collected oil and water reached one hundred thousand tons, less than twenty thousand tons of oil was recovered from this liquid after treatment in refining plants⁴.

Bhopal

In the early hours of December 3, 1984, gas leaked from a tank of methyl isocyanate (MIC) at a plant in Bhopal, India, owned and operated by Union Carbide India Limited (UCIL).

The state government of Madhya Pradesh reported that approximately thirty-eight hundred persons died, forty persons experienced permanent total disability, and twenty-six hundred and eighty persons experienced permanent partial disability. Studies by India's Council of Medical Research indicate that severe injury to the lung was limited to a small percentage of the population and there was no serious residual eye disease. Medical studies have shown that massive, one-time exposure to MIC has not caused cancer, birth defects, or other delayed manifestations of medical effects.

Chernobyl

Between April 25th and 26th, 1986, the World's worst nuclear power accident occurred at Chernobyl in the former USSR (now Ukraine). The Chernobyl nuclear power plant is located eighty miles north of Kiev. It had four reactors. Whilst testing reactor number four, numerous safety procedures were disregarded. At 1:23 am the reactor went critical, creating explosions and a fireball that blew off the reactor's heavy steel and concrete lid.

The Chernobyl accident killed more than thirty people immediately, and as a result of the high radiation levels in the surrounding twenty-mile radius, one hundred and thirty thousand people had to be evacuated.

Seveso (1976) resembled Bhopal (1984) and Chernobyl (1986) in that they have come to be regarded as international symbols of industrial pathology⁵.

Exxon Valdez

On March 24, 1989, shortly after midnight, the oil tanker Exxon Valdez struck Bligh Reef in Prince William Sound, Alaska, spilling more than eleven million gallons of crude oil. The spill was the largest in U.S. history. It tested the abilities of local, national, and industrial organizations to prepare for, and respond to, a disaster of such magnitude. Many factors complicated the cleanup efforts following the spill. The size of the spill and its remote location, accessible only by helicopter and boat, made government and industry efforts difficult. It tested existing plans for dealing with such an event.

The spill posed threats to the delicate food chain that supports Prince William Sound's commercial fishing industry. Also in danger were ten million migratory shore birds and waterfowl, hundreds of sea otters, dozens of other species, such as harbour porpoises and sea lions, and several varieties of whales.

These are by no means the only 'famous' cases. They demonstrate that crisis events are recorded in indelible ink in the global consciousness.

However, a more fundamental issue was surfacing. The real environmental challenges appearing were not borne of crises; they developed in the course of everyone's normal business. The move to a global economy did not help.

Developed countries began to depend increasingly on developing countries for renewable resources (fuel and mineral). This trade boosted growth of developing economies but at the same time led to degradation of their natural resources.

In the push to sell to survive, and as barriers to trade fell away, developing countries sold their futures. In selling their natural resources and undermining the environment to put food on the tables in their nations, deep cuts were made into their natural capital⁶. The impact of environmental degradation began crossing local and regional boundaries. While increased industrialization and energy consumption led to regional problems in the developing economies, global warming and ozone layer depletion became issues of international concern.

A critical realization surfaced from the 1980s – environmental damage was not bound by political boundaries.

The 1990s saw the emergence of environmental issues in international fora and sustainable development became the need of the hour. Environmental issues being discussed at technical seminars and debates emerged as diplomatic issues, and became an integral part of international trade. The need to make production and consumption patterns sustainable evolved to become a political and diplomatic issue influencing business to take action on its relationship with the environment as a core business issue. Sustainable development, environmental and social soundness began to be recognized as issues of governance. The role of environment and development in international trade were entrenched as issues of international policy and diplomacy.

The feedback in the 1960s and 1970s was sporadic and often linked to crisis events. By the end of the 1990s, in less than a second of humankind's history, the environmental issue evolved to be a constant concern. When we started the new millennium it has become a core business and government agenda item.

While Carson's exposé on the dangers of pesticides in Silent Spring started the public's awareness of non-sustainable development, other publications followed to feed the public's concern.

In 1968, Dr. Paul Ehrlich's⁷ "The Population Bomb" theory addressed the linkages between population and environment.

In 1972 the Club of Rome⁸ released their report on "The Limits to Growth". The concept of the "limits to growth" addressed issues of population vis-à-vis the finiteness of resources and pollution due to overexploitation of these resources. A decade later the Club would acknowledge that the original concept was superseded by an inverse phenomenon, with a 'growth of limits'.

In 1980 "The Global 2000 Report"⁹ was published, presenting the global State of the Environment report.

Natural capital can be viewed as the sum total of ecological systems that support life. It cannot be produced by humans. Natural capital is the most highly organized chain of productivity upon which all human capital is based.

Figure 2-1

LANDMARK MILESTONES FROM 1960s to 1990s	
1990s	International Factor 10 Club
	Earth Summit at Rio and the Agenda 21
1980s	WCED's Report "Our Common Future"
	The Global 2000 Report 1980
1970s	United Nations Conferences on Environment, Population and Human Settlements
	The Population Bomb Theory by Ehrlich & Ehrlich
	Origin of the concept of "Limits of Growth"
1960s	Rachel Carson's book "Silent Spring"

Sustainability is not a “29th day solution” as in the lily pond story shared in Chapter 1. The reality is that humans have no way of predicting the 30th day. You need to take action early on. Now would be a good time.

In 1987, The World Council on Environment and Development (WCED) also referred to as the Brundtland Commission¹⁰ released its report called “Our Common Future”. It provided a formal definition for sustainable development. The report was the culmination of four years of intensive input and information gathering from around the world.

In 1992, the Earth Summit was held in Rio¹¹. It led to the emergence of Agenda 21, an action plan for sustainable development. The Earth Summit was a landmark event. Delegations from one hundred and seventy-eight countries, heads of state of more than one hundred countries, and representatives of more than one thousand non-governmental organizations or NGOs attended the meetings. Warning on environmental degradation and non-sustainability of current development trends in 1992 was sounded by sixteen hundred and seventy scientists and one hundred and seven Nobel Laureates. Their concern was that the global environment was worse [now] than it was two decades ago--not one major environmental issued debated in Stockholm¹² has been solved.

Agenda 21 is a guide for individuals, businesses and governments in making choices for development that help society and the environment. If you do not tackle the issues it concerns, all of humanity faces higher and higher levels of human suffering and damage to the world that you and others live in. Note that Agenda 21 goes further than just looking at the environment - social factors are seen as very important as well.

Economic Activity and Environment

While conflict between mankind and the environment is not new, it currently manifests itself in conflict. People fight for a finite area with limited resources that they want at a reasonable cost. Technology and human behaviour have not evolved at the speed of the ‘relatively recent’ explosion in population. The challenge is global, but the distribution of problems is neither even nor consistent. Twenty percent of the world’s population enjoys unprecedented material well-being, while another twenty percent lives in abject poverty. The top twenty percent of income earners take home over sixty times more than the poorest twenty percent. This gap has doubled over the last thirty years¹³.

What do the issues of poverty and regional economic disparity have to do with the history of environmental issues?

Poverty, as the Brundtland Commission determined, is the primary cause of unsustainable practices. These are actions that drain the Earth of resources. Therefore, developed economies must trade with developing countries to eliminate poverty. All trading partners must promote environmental improvement as a condition of trade, without it being imposed as a potential trade barrier.

Today it is recognized globally that production and consumption patterns have become unsustainable. Recent human history is full of examples of severe and

Production Patterns

Production activities that provide essential goods and services for consumption include industry, agriculture and services. Industry is central to the economies of modern societies and an indispensable vehicle of growth. Clearly, industry has an impact on the natural resource base throughout the entire cycle, from raw material exploration and extraction to product use and disposal. These impacts may be positive, but there is more concern right now with the negative impacts. These result from pollution and depletion or degradation of resources during the manufacturing of goods and services, as well as during their use and ultimate disposal.

What is the existing situation in Asia?

In Asia, both growth and density effects are contributing to heavier pollution loads. Trends have shown that pollution intensive, resource-based industries such as metal products, industrial farming, and chemical manufacturing are growing very fast in Asian developing countries. This results in extensive environmental degradation and depletion of natural resources.

Agriculture is a mainstay of economic development in a number of Asian countries. In recent times, there has been a shift in agricultural practices towards more chemical intensive, high yielding varieties. New hybrid varieties of seeds are being planted that require increased use of pesticides and fertilizers. New is not always better, when sustainability is not part of the design features (see Table 2.3).

Table 2.3

Case Studies of Unsustainable Agricultural Practices

In Warangal, Andhra Pradesh (around 157 km northeast of Hyderabad, India) farmers traditionally grew pulses, millets and paddy rice. Seed companies offered hybrid cotton seeds referred to as “white gold”. Their native seeds were displaced with new hybrids, which cannot produce new seed. Instead, it required an annual purchase of new seeds at a premium. Furthermore, hybrids are also very vulnerable to pest attacks. Spending on pesticides in Warangal increased 2,000% from \$2.5 million in the 1980s to \$75 million in 1997. In despair from the permanent debt cycle they found themselves, farmers who were unable to keep up with payments, committed suicide by ingesting the pesticides.¹⁴

The growth of the services sector in East Asia and the Pacific was three times the world average in the 1990s. In fact, the export of services from developing countries grew at an annual rate of 12% in the 1990s, twice as fast as those from industrial regions.

Increasing awareness and growing public concern about the negative impacts of agriculture, industry and service on natural resources is forcing a rethinking of the strategy for growth and economic development by policy makers. This rethinking will have impacts on your business.

Figure 2-2

Production Patterns

Some facts about Asian economic growth.

- Between 1990 and 1996, average annual growth for east Asia and the Pacific was 14.5%.
- Between 1965 and 1996, industry in East Asia has increased its share of total output from 32% to 45% and in South Asia from 21% to 28%.
- In South Asia the value added (as a % of GDP) through agriculture fell from 38% in 1980 to 28% in 1996 while industrial output increased from 25% to 28% in the same period.
- Export of services from developing countries grew at an average annual rate of 12% in the 1990s, twice as fast as those from industrial regions.

Production



Agriculture

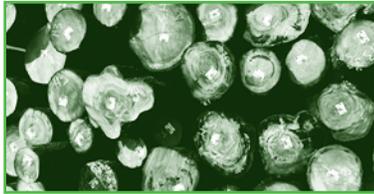
Industry

Service

Of all human activities, industry still has the most impact on the environment at every stage of the life cycle of goods and services produced. (Tracking and evaluating the cradle-to-cradle impact of good and services is referred to as life cycle assessment, details will be discussed in Chapter 3.) Consideration of these impacts begins at the stage of raw material exploration and extraction, moving through transformation into products and finally the use and disposal of products by consumers.

Figure 2-3

Industry and Environmental Degradation



Resource extraction of raw materials through mining, logging, water extraction and energy extraction.



Resource utilization during manufacturing leading to emissions, wastewater and solid waste generation.



Resource demand during distribution, use and disposal of goods and services.



What is happening now? There are three general types of primary causes and effects or impacts (as shown in Figure 2-3).

Raw material extraction through mining and other extractive processes leads to degradation of soil, vegetation, and contamination of air and water bodies. Manufacturing processes result in air emissions, wastewater and solid waste generation. This leads to pollution of air, water, land and associated biota (plants and wildlife). Distribution of goods and services demand resources such as energy, packaging material, etc. There is also the potential for secondary environmental impacts as a result of these activities. Finally when consumers use and dispose products it again results in pollution of air, water and land; a third set of impacts.

As previously stated, the negative impacts of industrial activity in the 1950s and early 1960s were perceived to be limited to local impacts. With increasing expansion of industrial activity, globalization of trade, etc. the ecological footprint¹⁵ of production of goods and services has crossed national and regional boundaries.

Costs of Environmental Damage

All this environmental damage is leading to mounting costs that are large even in simple economic terms. The Asian region's costs from environmental degradation are above 5% of annual GDP¹⁶, and in China may be as high as 10%. In India, the economic cost attributable to resource degradation is more than 5% of GDP. What is important to understand is that the economic costs are a result of normal operations; they are not created in crisis. There is one school of thought that for every dollar of inefficiency, there is a corresponding dollar of environmental damage. Research in the US also indicates that most corporations have not tracked the true cost of their environmental inefficiency and are 1 to 5 orders of magnitude off. This is an astounding amount of inefficiency! Without proper management, these environmental and economic costs will escalate. Left unchecked the potential for bankrupting human and natural capital is real.

International Trade

Trade has made nations realize how dependent they are on each other for a strong economy and a healthy ecosystem. It has shown the interdependency of the environment and the economy: neither operate in isolation.

In the 1980s, the value of trade in manufactured goods grew at a faster rate than in primary products. With this shift, a growing number of developing countries emerged as major exporters of such goods. Industrialized market economies became more dependent on fuel and mineral imports from developing countries. The latter had to use non-renewable raw materials to earn foreign exchange. The dilemma was to break foreign exchange constraints on growth while also diversifying into manufactured exports. Trade liberalization resulted in remarkable growth rates in exports, manufacturing output and aggregate income for Indonesia, Thailand and Malaysia. Most striking are the high growth rates achieved in China, by far the largest of the East Asian developing countries.

Outward-looking strategies, especially in the Asian region, have dramatically reduced poverty and raised living standards for a large fraction of the world's population. It has allowed consumer expectations to rise, with some eyeing Western levels of consumption as the standard to which they aspire. While Western nations have enjoyed decades of higher per capita consumption, they have also experienced the costs first hand. There has been extensive degradation of the environment and natural resources.

As Asian nations begin to industrialize, they too experience environmental changes similar to those seen in the west. Some regions are already suffering from serious environmental change due to resource-based industries like oil extraction, coal-fired electricity generation and mining. Land-use change is considered to have caused greater ecological impact during the twentieth century than any other global factor. Yet Western nations cannot deny any other economic region the right to a higher living standard. Therefore, the need to improve environmental performance in all regional economies is paramount.

Conditions for export success are changing as producers face rising environmental expectations in key export markets. This is due to tightened regulations, new corporate practices and changes in consumer values and lifestyles. However, corresponding national policy changes have not supported this trade-led growth.

Yet, the export led growth has also provided Asia with financial resources, technological capabilities, and institutions in which environmental problems can be managed. By raising living standards and strengthening communications, it has also created social and political conditions in which people demand environmental improvements. The crucial issue is to establish supportive policies and promote strategies that ensure sustainability of trade and the environment. Global growth demands a new infrastructure, with equal force over nations in all economic regions.

What infrastructure exists now?

Starting in the 1950s, as trade started to grow after the postwar era, so did the need for dialogue. Trade negotiations developed as 'rounds'. With the completion of trade negotiations from the Uruguay Round of December 1993, there were far reaching implications on international trade for both developed and developing countries. The Uruguay Round set the course for further liberalization and is widely regarded as reinforcing a transparent, predictable, multilateral trading system, benefiting both developed and developing countries alike. The World Trade Organization (WTO) arose from the Uruguay Round in 1995, as the only global organization dealing with the rules of trade between nations. It is currently the only organization empowered by the one hundred and forty-four member nations to respond to issues relating to sustainable development, trade and the environment. These have been discussed in the General Agreement on Tariffs and Trade (GATT)¹⁷ and now through the WTO.

As trade became liberalized and evolved to one world market, there seemed to be a correlating increase in environmental degradation. This led to the hypothesis that global trade was a cause. Research conducted by the World Trade Organization (WTO)¹⁸ concluded that international trade did not cause environmental degradation. Its roots were in various market and policy failures. For example, firms have no reason to install scrubbers to clean emissions from sulphur dioxide and nitrogen oxide unless provided with the right incentive. Nor do governments have the innate inclination to reduce emissions that transcend national boundaries or have a global reach, as carbon dioxide emissions. The failure within a nation to properly establish and enforce resource management is one challenge. The other is the continuation of government subsidies that encourage overcapitalization of the industry or the perpetuation of resource depleting practices.

However, international trade can sometimes exacerbate the effects of poor environmental policies. For example, the additional demand from the world market may induce farmers to increase the usage of agro-chemicals to boost production for exports. Likewise, the demand from the world market may encourage unsustainable fishing or logging in the absence of a proper management scheme.

The country with the highest number of **trade barriers** is the US, followed by France¹⁹.

Since 1995, work has been conducted in the Committee on Trade and Environment (CTE) following a comprehensive work program. At the Fourth Ministerial Conference in Doha, Qatar, in November 2001, Ministers agreed to start negotiations on specific issues relating to the trade and its linkage to the environment.

The implications of these negotiations are being assessed in the face of policy distortions in importing countries. These range from protectionist barriers (especially for agricultural and textile imports) along with bureaucratic regulations that effectively discriminate against foreign producers.

The central issue is to find a workable balance between the sovereign right of countries to exploit their own environmental resources for economic reasons, and the necessity of increased international cooperation to tackle mounting resource and ecological degradation. The Earth Summit in 1992 drove the connection between trade and environment as “mutually supportive”. More than ten years later, there is a need to trace changing perceptions on the importance of environmental issues to society, having looked at the mutual interdependence of economic activity and the environment.

What does this mean to your business? The environment is not an issue to be ignored or taken lightly. Government policies in your own country and entities influencing trade are driving change. It is a core business issue. It can affect your ability to export.

Environmental Trends

Developing countries have raised a number of issues considered disputable by the Uruguay Round²⁰. Of importance are the rules and disciplines covering market access. Clarity is being sought particularly for exports of interest to developing countries, including agricultural and tropical products; wood and fishery products, textiles and electronics.

Why should you care about trade and the environment? What has it got to do with your business? Without the ability to demonstrate that your goods and services are environmentally sound, you may be prevented from trading. Business today is not limited to customers that exist around the corner or in a neighbouring city. It is a growing green global marketplace, connected electronically.

‘Environmentally-related trade barriers’ (ETBs) are measures introduced by the importing country to protect the health and safety of wildlife, plants, animals and humans as well as the environment. The vast majority of products in the international markets are subject to ETBs. The environment in its strictest sense only accounts for a limited number of the restrictive measures imposed. Bans for the protection of wildlife, focused on a limited number of products, carry the highest degree of trade restriction. Labelling to identify environmental attributes, eco-labelling, affects up to 1,400 products. It accounts for US\$251 billion in trade.

In addition to bans, there is a whole spectrum of ETBs that could be applied to your business. ETBs could take the form of any of the following mechanisms: customs surcharges, additional charges, internal taxes levied on imports — these are known as para-tariff measures in UNCTAD²¹; finance measures (advance payment requirements, multiple exchange rates, transfer delays, etc.); automatic licensing measures (automatic licence, prior surveillance); quantity control measures (non-automatic licensing including prior authorizations, quotas, prohibitions, export restraint arrangements, enterprise specific restrictions); monopolistic measures (single channel for imports, compulsory national services); and technical measures (technical regulations, pre-shipment inspection, special custom formalities, obligation to return used products, obligation on recycling).

Why should Asian countries pay attention to the issue of environmentally-related trade barriers? First, any country in any regional economy should pay attention to ETBs. Second, Asia has two countries that are categorized as being part of a group of the forty-nine least developed countries. These countries are significantly more exposed to ETBs than those from any other group as they must strive to compete with higher expectations and tough standards imposed by more developed economies. The poorest of the poor countries (largely in Africa) will have to face even tougher hurdles in the future as a result of the growing environmental concern worldwide. This is especially the case for agricultural products that are among the most exported products by the least developed economies²².

Environmental issues are an increasingly integral part of international trade as globalization brings the reality of a one-world market fast forward. Proof that the environment is seen as a condition of trade is growing as the number of conventions and the related negotiations led by the World Trade Organization increase.

Recognizing the global implications of environmental degradation, the international community has responded in the form of treaties and conventions: 1,200 multilateral and bilateral treaties and other agreements on environmental matters exist today. Their existence confirms that unsustainable practices and development activities are of global importance. Impacts transcend political boundaries.

Some of the landmark conventions include:

- the Basel Convention on Transboundary Movement of Hazardous Wastes (and their handling), which manages hazardous waste and their transboundary movements are regulated, 1989.
- the Montreal Protocol, which regulates manufacture, use and disposal of ozone depleting substances, 1992.
- the Climate Change Convention, which regulates the emission of green house gases (GHG) that have contributed to global warming, 1992.

- the Convention on Biodiversity, which is aimed at conserving the species diversity of biological organisms, 1992.
- the Convention to Combat Desertification, which is aimed at preventing further desertification and increased aridity by promoting sustainable land management practices and retarding the advancement of desertification, 1994.

How do these conventions affect your business?

It is unlikely that you discuss any of these conventions as part of your daily business negotiations. Yet you can be affected by their existence. The impact of these conventions has been in the form of phasing out CFCs²³ in refrigerants and hazardous materials such as PCBs, lead, asbestos, etc. On the other side, they encourage the use of renewable sources of energy. If you are part of the supply chain using an undesirable component in your product you may spark a downward trend in your earnings. If you are in a business where you supply parts used to create solar panels or other energy saving devices, you may be seeing the start of a bull market. For example, one of the outcomes of climate change is more volatile weather, with extreme changes in short periods. Consumers need a way to react positively by taking action to save energy.

Production, consumption and the associated trade activities are strongly interlinked and are driving the environment into business strategy. National and international policies are being forced to view environment as a crucial aspect of the global agenda for development.

Global Scenario

Environmental treaties and conventions have brought to light key global issues. These issues have to be managed to achieve progress. Some of the critical issues are examined in this section at the global level – others will follow in greater detail at the regional level for Asia. The various global environmental issues of concern today are:

- **Loss of crops and grazing land due to erosion**, desertification, conversion of land to non-farm uses etc., currently totalling a loss of about 20 million hectares a year.
- **Depletion of the world's tropical forests**, leading to loss of resources, soil erosion, flooding, and loss of biodiversity - currently at a rate of 10 million hectares a year.
- **Extinction of species**, primarily from the global loss of habitat, and the associated loss of genetic diversity - currently over 1000 plants and animal species becoming extinct every year.
- **Rapid population growth**, pressing the carrying capacity of land, air and water to maintain this growth.
- **Shortage of fresh water resources** due to overexploitation of surface and groundwater resources.

- **Over-fishing, habitat destruction, and pollution in the marine environment -** Twenty five of the world's most valuable fisheries are already seriously depleted due to over-fishing.
- **Threats to human health** from mismanagement of pesticides and hazardous substances, and from waterborne pathogens.
- **Climate change** related to increasing concentrations of greenhouse gases in the atmosphere.
- **Ozone layer depletion** due to indiscriminate use of chlorofluorocarbons. The active chlorine atoms strip the ozone layer preventing filtering of the sun's ultraviolet rays.

It may be difficult to see how you can respond to issues operating at the global level. This next section brings the issue closer to home. It provides a snapshot of the challenges faced by you and other Asian businesses.

Regional Scenario

For Asian business leaders to develop a relevant strategy for sustainable development, it is necessary to take stock of the environmental issues facing the Asian region. You already know what the key global issues are. Just remember every region of the world is facing these issues to some extent. What differs is how they are managed.

Environmental issues in your region can be categorized into four key areas:

- **Pollution:** Organized industrial development has led to extensive contamination of air, land, and water (surface water, groundwater and the coastal waters). How would you react to a shipment of goods that you knew to be contaminated? How would your customer base react?
- **Environmental degradation:** Land degradation has led to loss of arable land, increasing aridity and desertification. Degradation and overexploitation of water resources has led to water scarcity. How would you cope if your water supply was cut in half?
- **Resource depletion:** Overexploitation of natural capital for fuels and minerals has resulted in depletion of resources. Export-led development catering to the resource needs of the developed countries has resulted in excessive depletion of mineral and fossil fuel resources in several parts of the region. What would you do if you had no fuel for your fleet? How would you get your products to market?
- **Biodiversity:** Resource depletion in the form of species loss brings a decrease in genetic diversity in terrestrial, aquatic and marine ecosystems. What would you do if a critical raw material for your product line was no longer available? What if there was no substitute?



Every unit of waste steam emitted represents an equivalent reduction in productivity.

How did Asia's state of the environment deteriorate to this point?

Development in the Asian region has been characterized by rapid urbanization and industrialization, which have led to high levels of pollution and social stress. This section groups the issues under the four categories. An environmental issue can appear in more than one category or overlap. However, this is logical as water, land and wind are not isolated in real life.

This information is presented as a series of snapshots. Each description gives you a quick image of the challenges faced under each category.

Pollution

Air pollution is a problem that has accompanied economic growth and high-energy consumption. Urban air pollution is a serious problem in many major cities of the region. Significant health threats also arise from indoor air pollution. These result from the use of low-quality solid fuels, such as coal, wood, crop residues, and dung for cooking and heating in lower-income urban households and in rural areas throughout the region.

Fly ash generated from the mining of coal is also a significant problem in the region. India is particularly challenged with the problem of fly ash - it is as serious as acid rain is elsewhere.

Acid Rain/Acidification

The effects of coal burning tend to spread over a large area, resulting in acid deposition. The problem of acidification has also started to emerge in parts of Asia and the Pacific region. It is not unusual to see black clouds descend upon Hong Kong's shining silver skies. It is not the start of a thunderstorm; it is merely the arrival of winds laden with 'normal' coal-generated pollutants.

Slash-and-burn agricultural practices lead to haze problems that extend beyond national boundaries. The Indonesian fires of 1997 were the result of an economic policy that supported the overexploitation of natural resources. Most fires were deliberately set by plantation companies to clear the land. The forest fire haze of 1997 caused widespread health problems, and disrupted air, sea and road traffic. It also had a regional impact with effects spreading as far as Malaysia, Thailand, Brunei, Singapore and even the Philippines and Australia.

Coastal and marine pollution in the Asian region is mainly due to direct discharge from rivers, surface runoff, drainage from port areas, domestic and industrial effluents, and various contaminants from ships. About 70% of the waste effluent discharged into the Pacific Ocean has no prior treatment. In addition more than 40% of marine pollution in the region is derived from land-based activities through discharge to rivers. The main problems are heavy metal contamination, pesticide contamination, algal blooms (an overproduction of algae) due to nutrient build-up, industrial effluent, and dumping of land-based solid waste into the sea.

Fish farming (called aquaculture) has resulted in loss of coastal habitats that includes substantial loss of mangrove forests in South-east Asia. This has had a negative impact on commercial fisheries particularly in Thailand and the Philippines.

Toxic wastes contributed by industries and agriculture include pesticides and heavy metals predominantly. They accumulate in the food chain, and are extremely difficult to degrade. When consumers in developed countries realize this, what do you think their reaction will be? Unfortunately, extensive and reliable data on the generation of toxic and hazardous wastes in the region are not available. The 1995 estimates indicate that about 100 million tons of waste is produced annually, with as much as 90% generated in China and India. About 60% to 65% of these wastes end up in landfills. 5% to 10% are dumped in the oceans. About 25% are either incinerated or undergo physio-chemical treatment.

However, there is growing awareness in the region, especially in Japan, China, and India, about the detoxification of wastes. About seven hundred million tons of solid waste and one thousand nine hundred million tons of industrial waste are generated each year in Asia and the Pacific. Among the various sub regions, East Asia generates the largest share of municipal solid waste. In the 1990s, broad calculations indicated that this region's share would increase to 60% by the year 2000 because of the large population base and high economic growth rate. Where did these wastes end up?

The key issues regarding solid waste management are:

- the environmental health implications due to inadequate coverage of the waste collected;
- improper storage prior to collection; and
- poor standards of disposal.

It is estimated that 30% to 50% of municipal solid waste is not collected. Where does it go? Do you know? The disposal of domestic and industrial waste is given relatively low priority in many countries. Only around 70% of the waste in urban municipal areas is collected and only 5% of this is treated. Solid waste disposal is a particular problem in the small island states such as Fiji, Maldives, and Western Samoa due to their limited land area. Disposal areas have been used for land reclamation in some of these countries, resulting in contamination and pollution of surrounding coastal areas. How is this affecting the tourist industry? Given the importance of tourism to the economic status of these islands, solutions that are sustainable are critical.

Environmental Degradation

The Asian and Pacific region occupies 23% of the world's total land area. It has 58% of the world's population. In most developing countries in the region, soils are affected by varying degrees of erosion and degradation mainly due to rapid rates of deforestation, poor irrigation and drainage practices, inadequate soil conservation, steep slopes, and overgrazing. Of the world's 1.9 billion hectares affected by soil degradation, the largest area (850 million hectares) is in Asia and the Pacific. This accounts for about 24% of the land in the region.



Compounding the challenge of survival for Thailand, the Tsunami of December 2004 impacted 386 fishing villages. A population of 120,000 people lost some 4,500 fishing boats and fishing gear. Their infrastructure, including eight harbours were severely damaged. Around 15,800 fishing cages were also damaged at a cost of \$33 million. In some areas, seafood supplies have dropped by 90 per cent.

Source:
tokyo.usembassy.gov/e/p/tp-20050114-40.html



In Indonesia, the inappropriate use and over application of pesticides led to the evolution of pesticide resistant pests, and the elimination of natural predators that help control pests. In addition to these direct user costs, contamination of surface water by pesticide runoff resulted in the decline of fishing productivity and in costs to human health. Too often people only consider one problem, they forget the impact one issue has on another aspect of the environment.

In 1996 studies by United Nations Environment Program (UNEP), World Resources Institute, United Nations Development Program (UNDP) and the World Bank showed that 13% of arable land in the region is considered to be severely degraded, 41% moderately degraded, and 46% lightly degraded. There is no 'good' ground remaining.

Only 10% to 30% of natural habitats are left in many countries in the region. Only 15% of the total land area is considered arable. This land must support the growing number of people and their overseas markets. More than 50% of the world's irrigated land affected by water-logging and salinization is located in Asia and the Pacific. Increased dependence on intensive agriculture and irrigation may cause further degradation. This is a serious concern in the region, especially since irrigated lands are expected to increase significantly in the near future.

Altogether 35% of once productive land in Asia is now arid. The region has the largest population in the world affected by increasingly sterile, arid lands. The countries suffering most from desertification are China, Afghanistan, Mongolia, Pakistan, and India.

Resource Depletion

Due to industrialization, agricultural expansion, and forestry product trade, deforestation remains one of the major environmental issues in the region. Deforestation in the region increased from 2 million hectares per year during 1976-81 to 3.9 million hectares per year in 1981-90. At the current rate of harvesting, the remaining timber reserves in Asia may not last for more than forty years. This adds the increased risk in soil erosion as the ground is without roots to act as anchors. Other resources facing serious threats of depletion include water, nonrenewable fossil fuels and minerals.

The region is blessed with an abundance of water resources. However, only a part of the renewable water resources can be extracted and used. This results from the high variability of stream flow between low water and flood seasons, the inaccessibility of some watercourses, and the lack of storage sites on many catchments.

The regional demands on water for domestic and industrial uses are increasing. This is due to the rapid rise in urbanization and industrialization. The demand for water will continue to rise in parallel with population growth. Countries such as Afghanistan and Iran suffer from chronic water shortages due to aridity, while parts of China and India experience the same problem primarily due to high population density.

Agriculture accounts for 60% to 90% of the annual water withdrawal in most countries of the region, with the highest proportion in Afghanistan (99%). Water pollution in Asia-Pacific countries is mainly caused by domestic sewage, industrial effluents, and runoff from activities such as agriculture and mining.

The problem of bacterial contamination (pathogenic pollution²⁴) is severe in South Asia, South-East Asia, the Pacific Islands, and China. The main source is domestic sewage that is discharged untreated into watercourses. South Asia and China are also severely affected by pollution caused by organic matter, effluent from the pulp and paper and food industries.

Other types of pollution are caused by the discharge of mine tailings and development of industrial areas. Direct discharge of pollutants into neighboring river systems has resulted in high concentrations (hot spots) of heavy metal pollution throughout the region.

India is among the countries projected to fall into the 'water-stressed' category before 2025. Its situation is well illustrated by the case of Rajasthan, which is home to 8% of India's population but claims only 1% of the country's total water resources.

One of the important implications of economic growth in Asia and the Pacific over the last three decades has been the increased demand for energy, in the form of fossil fuel. The region, excluding Japan, Australia, and New Zealand, accounted for 21% of the world's primary commercial energy demand in 1992 as compared with 51% for members of the OECD²⁵ and 28% for the rest of the world.

The growth in energy demand for the whole region was 3.6% per year between 1990 and 1992, compared with an average 0.1% growth of the whole world. The region accounted for about 41% of world's coal consumption in 1993. Mineral and non-renewable fuel resources continue to occupy a prominent position in the exports and are one of the main sources of foreign exchange. Ensuring that Asian companies remain viable is as important as protecting the quality of resources for the long term.

Biodiversity

The rainforests of South-East Asia contain some 10% of the flora of the world. The region as a whole contains two thirds of the world's flora. Almost all the nations in the region (with the exception of Singapore and Brunei Darussalam) depend heavily on direct harvesting from nature. The flora and fauna of the region are more threatened now than ever before.

The drive for increased agricultural production has resulted in the loss of genetic diversity. Land under rice cultivation rose between 1960 and 1970 by only 25% but production rose by 77% due to the replacement of traditional varieties with higher-yielding, semi-dwarf varieties. By 2005, India is expected to produce 75% of its rice from just ten varieties compared with the thirty thousand varieties traditionally cultivated. In Indonesia, fifteen hundred varieties of rice disappeared during the period 1975 to 1990. Reliance on fewer species can be risky. If these species all succumb to a common pest or blight, the chance for widespread loss (and famine) is significantly increased.

Loss of terrestrial biodiversity in various ecosystems has been identified but has yet to be quantified. Overall habitat loss has been most acute in the Indian sub-continent, China, Vietnam, and Thailand.

**Energy is the
currency of
productivity.**

From each paycheck you get
subtract 7 cents from every
dollar. How does this affect
your personal budget?

The Indo-West Pacific is the centre of shallow-water marine biodiversity. Coastal habitat loss and degradation, combined with increased sediment, nutrient, and pollutant discharge into coastal areas, are a major cause of concern, particularly in the insular countries of the region. Loss of keystone species²⁶, extensive deforestation and habitat loss, increased trafficking in animals and animal body parts, large-scale conversion of land for agriculture, and the construction of large-scale dams has also contributed to loss of biodiversity.

It should be clear to you now that there is an urgent need to develop a strategy that will lead Asia's economy towards sustainability. Equally important is an understanding of the costs of the environmental damage.

Cost of Environmental Damage

Asia's emphasis on rapid economic growth without equal attention to the environment has resulted in widespread environmental damage. That fact has already been demonstrated. Environmental damage is leading to mounting costs that are large even in simple economic terms. Environmental damage is like compound interest. The Asian region's costs from environmental degradation are above 5% of annual Gross Domestic Product (GDP). In China it may be as high as 10%. In India, economic costs attributable to resource degradation are more than 5% of GDP. If a regional average were assumed to be 7%, how does this affect you?

Seven cents from every dollar you earn is being spent on fixing past problems, whether:

- you do so as a conscious business decision,
- you pay it in health costs or
- it is captured as part of your national debt.

Consider this as your portion of the national debt incurred on natural capital. If left unmanaged, these costs will rise.

In 1992, the World Bank estimated that East Asian countries would spend up to US\$20 billion a year during the 1990s to clean up environmental damage brought about by rapid industrialization and population growth.

If East Asian countries were paying this level of cost, how did it compare to other economic regions with which these countries traded? In 1992, the global environmental debt amounted to at least one trillion dollars. In the US, the value of environmental risks was estimated between \$26 and \$213 billion, depending on the scenario. Canadian industries faced an environmental burden estimate of \$20 billion²⁷. Oil companies earmarked at least \$2 billion to clean up former service stations. The investment required by the mining industry was placed between \$3 and \$6 billion.

These are substantial dollars being spent, which do not improve productivity. Wouldn't it be far wiser to improve future activities in order to eliminate these costly mistakes?

Table 2.4 Ecological Balance Sheet

Germany summarized an Ecological Balance Sheet²⁸ to show the true cost of daily mismanagement of the environment (listed in deutschmarks - DM). Again these are not costs borne from crises, these costs are the culmination of everyday inefficiency.

Damage Category	Cost (in thousand million DM per year)
Atmospheric Pollution	Approximately 48.0*
Health damage	Over 2.3 – 5.8
Material damage	Over 2.3
Damage to crops in the open	Over 1.0
Woodland and forest damage	Over 5.5 – 8.8
Water Pollution	Well in excess of 17.6
Damage to rivers and lakes	Over 14.3
Damage to North Sea and Baltic Sea	Well over 0.3
Damage groundwater	Over 3.0
Soil Damage	Well in excess of 5.2
Chernobyl and “Chernobyl prevention costs”	Over 2.4
Disposal of “inherited pollution”	Over 1.7
Habitat and species conservation costs	Over 1.0
Token entry: miscellaneous soil contamination	Well in excess of 0.1
Noise	In excess of 32.7
Loss of residential value	Over 29.3
Loss of productivity	Over 3.0
Noise-induced welfare payments (including invalidity pensions)	Over 0.4
Total Damage	Well in excess of 103.5

* These DM 48 thousand million are obviously not the sum of the individual items in the atmospheric pollution category. The figure is in fact the result of a representative household survey conducted in Berlin to ascertain willingness to pay for purer air, and grossed up to the FRG [West Germany] population. This willingness to pay can be seen as a measure of “loss of enjoyment caused by air pollution.” It goes well beyond the directly ascertainable costs, including such intangible factors as “impaired well-being”.

This means that the overall figure of DM 103 500 million cited in the ecological balance sheet (something like 6% of Gross National Product (GNP) in West Germany in 1984) represents a minimum figure, and that the actual amount of damage is much higher. Practically all the items in the balance sheet were quantified on the principle "if in doubt, underestimate rather than over-estimate".

At a 1979 OECD environment ministers' conference, the group announced that annual environmental damage in the OECD Member States represented between 3 and 5 per cent of GNP. Note this was qualified as being no more than a 'rough and ready' estimate. It is a conservative estimate.

Public Concern

Public concern stems largely from the effect of environmental degradation on health and the quality of life.²⁹ This concern should not be dismissed or ignored, even when the basis of public concern may be the perception of risk versus facts supported by good science. Perhaps you know someone with an "environmental illness" or condition cause by pollution. The increasing costs of environmental damage also reflect rising health costs and the deteriorating quality of life. In industrialized countries public concern over environmentally unsound practices began in the 1960s. In the US, incidents such as poisoning due to toxic wastes, for example the Love Canal³⁰ episode, triggered public outcry and protests. Awareness of mercury poisoning in Minamata, Japan, the Bhopal Gas tragedy in India and the recent arsenic poisoning of well waters in Bangladesh has led to a higher levels of public concern. Their concern is justified. Research has shown that the public has zero tolerance for environmental risk resulting from human error.

Over three thousand victims have been recognized as having had "Minamata Disease". People lost their lives, suffered from physical deformities, or have had to live with the physical and emotional pain of "Minamata Disease". This suffering was attributed to the mercury that was dumped into the seawater by the Chisso Corporation. In 1993, nearly forty years later, the Japanese courts were still resolving suitable compensation for the victims.

Bangladesh is one of the poorest and most densely populated countries in the world. At the best of times it has suffered from floods, tidal storms, famine and disease. Now it is confronting the accidental poisoning of as many as eighty-five million of its one hundred and twenty-five million people with arsenic-contaminated drinking water.³¹ According to the World Health Organization in 2000, the scale of disaster in Bangladesh is beyond that of the accidents in Bhopal and Chernobyl. While not the result of a specific act of negligence, the environment has become toxic as a consequence of population pressures. How? Arsenic is naturally occurring in pyrite bedrock underlying much of West Bengal. The poisoning began to occur as millions of kiloliters of water were being pumped out from deep within underground reservoirs. As a result, the water level dropped and exposed the arsenic-bearing pyrite to air leading to oxidization, a reaction that flushed arsenic into the receiving water.

Asia is home to six of the top sixteen largest rivers in the world. Each one of them is at risk from human activity. Public concern is mounting due to the progressive pollution of rivers like Yangtze, Bramaputra, Irrawaddy, Ganges, and Yamuna, etc. The pollution is due to industrial wastewater and domestic sewage discharge. It is measured by biochemical oxygen demand (BOD), an indicator of bacterial contamination.

Fresh-water availability below 1,000 cubic meters per capita per year indicates water scarcity. Overexploitation of groundwater has led to saline water entry in Thailand, and parts of India. Further loss of groundwater is a result of extensive contamination by industrial pollution. In countries like Bangladesh, salinity and sedimentation are occurring largely as a result of upstream water withdrawal.

Rank in the World's Top Sixteen Rivers	Countries in the River Basin ³²	Average Annual Discharge at Mouth (m ³ /sec)
Yangtze (3)	Tibet, China	28,000
Bramaputra (5)	Tibet, India, Bangladesh	19,000
Mekong (7)	China, Laos, Burma, Thailand, Cambodia, Vietnam	18,300
Irrawaddy (11)	Burma	13,000
Ganges (13)	Nepal, India, Bangladesh	11,600
Amur (14)	China, Russia	11,000

The **Brahmaputra** is in the top five of the world's largest rivers. Beyond the urban fringe, the expanding development of rural land is also cutting into the availability of renewable fresh water. Deforestation and the degradation of agricultural soil can alter the water cycle, threatening the river flow and groundwater recharge. Rapid population growth has contributed to unsustainable farming practices and deforestation in countries like Nepal and India. It has severely reduced the water-absorbing capacity of the land in the Himalayan watershed to the point where floods are devastating Bangladesh downstream on the Ganges and Brahmaputra rivers, with increasing frequency.³³ Flooding can wash away topsoil and slowly choke rivers, dams and reservoirs with deposited sediment.

The **Yangtze** River, the third largest river in the world and the longest in China, has long been polluted by industrial and domestic waste. In addition, human activities have overloaded the waterway, which has led to increased soil erosion, making it vulnerable to floods. The economic toll is on the rise. One prime example was in 1998 when the river generated one of the worst flood disasters in the nation, involving 160 billion yuan (US\$19.3 billion) in economic losses.



Ganga River



Yamuna River

Experts have warned that the growing pollution and water-related disasters may put a dent on economic growth in business epicentres such as Shanghai, which sits right at the estuary of the Yangtze River. China has mapped out an ambitious program to clean up the pollution-plagued Yangtze River. If successful, it is expected to improve water quality for two-fifths of the nation's inhabitants by 2010.

It is an aggressive plan. Authorities intend to substantially reduce water pollution in the Yangtze River area within an eight year period. They want most of the water sources for drinking to greatly improve.³⁴

The **Ganga** is associated through myth and reality with the people of India, as well as neighbouring countries like Bangladesh. The major polluting industries on the Ganga are the leather industries, especially near Kanpur. They use large amounts of chromium and other chemicals. Much of these chemicals find their way into the meagre flow of the Ganga.

When the market for leather is strong, the environmental problems also grow, as the industry is still dependent on older technology. In the absence of sound environmental management and strong supporting environmental legislation, a boom presents the conflict between environmental challenge and economic opportunity.³⁵ However, it is easier to progress an industry that is making money than one that is in an economic downturn. Industry is not the only source of pollution. Sheer volume of waste, estimated at nearly one billion litres per day of mostly untreated raw sewage, is a significant factor. Inadequate cremation procedures are also believed to increase water contamination (adding to the BOD).

The **Yamuna** originates at the Yamunotri glacier 6,387 metres above mean sea level, in Uttarkashi district of Uttaranchal state. The river then meanders into the plains, at the Tajewala barrage. Here almost all its waters are diverted into the Western Yamuna Canal and the Eastern Yamuna Canal for irrigation, urban and industrial usage. This 172 km stretch is referred to as the Himalayan segment.

Of the 2,547 million litres a day (mld) of sewage generated in the metropolis, only 885 mld (or 35 percent) is treated before being released back into the Yamuna. The decision to construct twelve small treatment plants in the Indian capital of New Delhi is a big step forward. But the saga of the 1,376 km river remains murky. A lifeline to some sixty million people, a mere 2% of its length accounts for the bulk of pollution. 71% of the wastewater problem is introduced here. Sources in New Delhi release 55% of the biochemical oxygen demand (BOD) into the river daily.

The ultimate devastation, however, occurs elsewhere. Raw water treatment plants in New Delhi require 15 kgs of chlorine to treat one million gallons (mlg), but their counterparts 200 km downstream at Agra require 54 kgs chlorine per mlg. The good citizens of Agra are thus forced to drink water with high levels of chlorine to counteract the high BOD created by New Delhi's outflows.³⁶

Public concern over the environmentally unsound practices of industry in Asia has increased. There is no reason for it to continue. In India, thousands of industries that did not comply with environmental regulations have been forced to close down. They were closed through public interest litigation or through judicial intervention based on public concern.

Public protests are focusing on:

- demands for better health and living conditions targeted primarily against industrial degradation of air, land and water.
- loss of habitat due to acquisition of resources for industrial and other developmental activity.
- globalization of environmental standards and social ethics in industrial production, consumption and trade.

Public concern is expressed not only as protests but also in the form of consumer boycotts of products. Special interests groups like Greenpeace have not only encouraged consumers to join a running boycott against Exxon²⁷, they have solicited the assistance of the Body Shop²⁸. The Body Shop's own reputation is based on producing and selling consumer products ethically and sustainably. It is quite profitable in its own rights. Anita Roddick, Founder of the Body Shop, is reported in the press as encouraging her customers and her staff to join the boycott.

Underscoring this discussion on public concern is the obvious need to consider the impact of your products and services on the environment. This does not mean that everything you do must be subject to a detailed life cycle assessment. A start today can be as easy as understanding the source of people's concern. This can help you learn more about environmental issues and establish priorities for action. What follows are tips for managing discussions surrounding environmental conflict.

1. The environment is not an issue to be taken lightly or dismissed. Your customers, and in turn their consumers, take it very seriously.
2. Emotional or defensive responses to concerned citizens are not in your best interest. At the very least, conflict can absorb vast amounts of time, causing you to lose face, reduce your productivity and affect your profitability. In the extreme it can cost you business. When a concern is voiced, it is often prefaced with anger. It is important to calm them without patronizing them. A simple approach can to start with: "I am sorry that you're upset. Can you explain your concern to me?" Once you have diffused their temper, you can learn the source of their concern. Then the real problem can be addressed.
3. Manage your existing products and services by educating your customer on the proper use of your goods and services. A small company can create a big problem in a local context. Demonstrating that you care about the environment is a signal to your customer that you are concerned with their future too. It's simply good business.

Now you understand the scope of the challenge. A detailed discussion follows on what some regions and business sectors are doing to manage these concerns.



Blue Angel logo
(Shown in green due to print limitations)

2.1.2 The Seeds of Change

In the 1960s and 1970s, the public was accustomed to merely voicing their objections to companies that polluted. The public in the 1980s and 1990s started to show a growing willingness to buy green, and even a willingness to pay a premium for eco-friendly products. This started the trend referred to as green consumerism.

Green Consumerism

Governments set criteria by which the public could identify products and services with green attributes. Europe is credited with the start of the movement to buy green, with Germany as its hub. Germany's "Blue Angel"³⁹ started in 1977. Canada started in the mid 1980s and by the late 1980s had developed its Environmental Choice program, identifying environmentally – 'friendly' products with its 'EcoLogo'. Studies taken as early as 1985 showed that consumer demand for eco-friendly products was about 37.6%, a two-fold increase over 1977 figures.

Due to a proliferation of false claims of eco-friendliness in the 1990s there has been a decline in the willingness to pay a premium unless the claims can be proven genuine. Eurobarometer⁴⁰ surveys report that consumers require proof, but are still willing to buy green. Active demand exists for organic produce, fair trade bananas, coffee and tea as well as organic cotton. Consumers are willing to pay a premium for these products.

Now, consumers are beginning to favour manufacturers who take responsibility for the disposal of their goods after the consumer has finished with it. Examples include durables such as fridges, computers, batteries and cars.

Organic Spice Trade Helps Rural Empowerment in India

This project uses Export Production Villages to organize smallholder spice producers. It builds partnerships with local NGOs and ultimately provides access for rural villages to higher-value export markets for organic products. Out of a total project area of around 764 acres, 40% was certified by the end of August 2001. The remainder was to be completed by the same time in 2002.⁴¹

Japan's rapid transition to consumer affluence has made it a special role model for emerging economies in Asia fostering the shift to sustainable consumption. In response, the ECO ASIA initiative was launched by the Government of Japan to support a long-term perspective for sustainable development for the Asia-Pacific region up to 2025. The stress is on values and the traditional frugal Asian lifestyles. However, this effort is being threatened by mass consumption. To their credit, surveys have shown that the patterns of consumption are generally more energy efficient, with more equitable and less excessive consumption than in Europe and North America.

Green consumerism is thus forcing producers to recognize the environment as a competitive advantage. Producers must ensure that their claims are verifiable and authentic.

What is most important about green consumerism is the existence of market demand. Until industry received a clear signal that customers and consumers were willing to pay, it was difficult to convince management that the changes required in process, product or service would be saleable. In the early 1990s some businesses did take a leadership position, realizing that they had to educate their own people. They also had to educate the marketplace as well. An overview of these leadership activities follows.

Sustainable Development, Sustainability and Agenda 21

The 1987 release of the Brundtland Commission's report, "Our Common Future", as with the publication of Carson's "Silent Spring", changed world thinking to recognize that sustainability was critical to the survival of human activity.

In April 1991, the International Chamber of Commerce (ICC) held the Second World Industry Conference on Environmental Management (WICEM II). It was well attended by CEOs and senior management from multi-nationals from developed countries around the world. In a three-day period the investment of senior executives' time alone was conservatively the equivalent of US\$7 million⁴². This event launched several multi-nationals on the way to embrace corporate led environmental management and voluntary action. Many of the CEOs present signed the International Chamber of Commerce's (ICC) Business Charter for Environmental Management. It was an articulation of leadership for environmental management contained in sixteen principles. CEOs started to involve themselves in complex issues that were traditionally considered by business to belong to the realm of government, aid agencies and environmental groups. This was a fundamental change in the mindset of business: adopt sustainability or become extinct.

Industry Initiatives

In preparation for the 1992 Earth Summit in Rio, about fifty business leaders from both developed and developing countries met in The Hague in 1991, just after WICEM II to form the Business Council of Sustainable Development (BCSD). The BCSD did not speak for global business but as a small group of business leaders led by Stephan Schmidheiny, then Chairman of UNOTEC⁴³. By definition BCSD was a small minority. One of the accomplishments of BCSD was the publication of a book, "Changing Course". It signified the beginning of a process that drew other business leaders to the inescapable logic of sustainable development. "Conservation of the environment and successful business development should be opposite sides of the same coin – the coin being the measure of the progress of human civilization. The degree to which these two halves can be joined in the world of human activity, and the speed of this process, will determine the rate at which sustainable development will turn from a vision into reality."⁴⁴ A new vocabulary started to evolve in support of the purposeful decision by businesses to move towards sustainable development.

Coming out of the Earth Summit, the BCSD expanded to become the World Business Council of Sustainable Development (WBCSD). This is a coalition of one hundred and twenty international companies united by a shared commitment to the environment and to the principles of economic growth and sustainable development. Its members

are drawn from thirty-three countries and more than twenty major industrial sectors. The WBCSD also benefits from a thriving global network of nine national and regional business councils and four partner organizations.

The Malaysian Business Council of Sustainable Development (MBCSD) was also created in 1992 to join this global network. Similarly Indonesia joined the network with its Indonesian Business Council of Sustainable Development (IBCSD).

The WBCSD provides a powerful and unified business voice on sustainable development issues. It plays an important role in developing closer cooperation between business, governments and others, and in encouraging high standards of environmental management in business itself.

Voluntary initiatives were started. These refer to industry action that goes beyond applicable environmental laws and regulations. A voluntary initiative may nevertheless be:

- legally binding (in the case of a signed contract),
- mandatory (if it becomes a condition for membership in an industry association such as Responsible Care®),
- compulsory (if it becomes a de facto marketing requirement, such as the international management systems standard ISO 14001 or the Eco-Management Audit Scheme (EMAS) in the European Union) and
- used to encourage compliance with existing laws.

Responsible Care® is the worldwide chemical industry program for continuous improvement of safety, health and environmental performance. It was started in Canada⁴⁵ in 1984, was adopted in the United States in late 1988 and in Western Europe and Australia in 1989/90. Today, Responsible Care® is now being implemented in forty countries. In the Asia-Pacific region it is being implemented in Australia, New Zealand, Philippines, Hong Kong, Malaysia, Singapore, Taiwan, Japan and India. An important premise that Responsible Care® has is that its process will only be as strong as its weakest link. While the major chemical companies and some of the major petrochemical companies are involved, the majority of the smaller companies have not participated. This is the industry's weakest link.

One of the concepts fostered by the Responsible Care® process was the idea of accountability for their products beyond the traditional boundaries of the corporate walls. Product Stewardship is a principle that directs all entities in the life cycle of a product to minimize the impacts of that product on the environment. What is unique about Product Stewardship is that it emphasizes making the entire product system environmentally sustainable. All participants in the product life cycle - designers, suppliers, manufacturers, distributors, retailers, consumers, recyclers and disposers - share responsibility for the environmental effects of products.

The concept of stewardship has been embraced in various ways:

- Environmental Stewardship addresses proper use and disposal of products in the market.
- Marine Stewardship for the food-processing sector addresses responsible fish harvesting practices.
- Forest Stewardship for pulp and paper sector addresses promotion of sustainable forestry practices.

One of the landmark stewardship initiatives is the Extended Product Responsibility (EPR). Important features of EPR include structuring production processes so that the waste of one industry is a valued input to another⁴⁶. Another design opportunity is to focus on products that avoid the use of hazardous materials so that they can easily be remanufactured or the materials in them recovered.

EPR had its origins in Western Europe where policy makers focused primarily on the last stage of the product cycle, particularly the take-back of used materials. In Germany the concept has been applied to a packaging ordinance. Since then, many other European countries and Japan have followed suit with "producer responsibility" laws covering:

- packaging
- electronics
- vehicles
- batteries
- paints
- household hazardous wastes
- building materials and
- others.

Producer Responsibility is implemented in many different ways. The approaches range from placing full responsibility for collection and recovery on producers to sharing costs to voluntary programs with backdrop governmental authority to mandate responsibility if necessary. By shifting the cost of managing these products from municipalities to producers, these laws are intended to send an economic signal to manufacturers to reduce waste associated with their products. In Asia, consumers, retailers and packaging manufacturers share the responsibility with the financial burden for waste management formally falling on the retailers and packaging manufacturers.

Learn from the mistakes of others – A Twist on the Concept of Cradle to Grave

In Canada, the province of Ontario introduced a new regulation two days before Christmas in 2003 with the intent to increase landfill diversion. Early assessments of the program forewarned policy makers of the commercial disruption inherent in the way the regulation was written. Rather than focus on the unwanted behaviour of waste generation, it penalizes those materials with a proven history of recycling. Perversely, the plan financially discourages more recycling. It forces industry to pay for the half costs of municipal programs with no accountability and no overall strategy for optimization of the recycling system. Time will tell whether or not this program causes the recycling system to fail resulting in more waste going to landfill, or if supporters of recycling are able to assert proper system controls to ensure that the system becomes productive and green.

Corporate Environmental Policy (CEP) is the commitment of a business to environmental excellence as a part of its corporate mission and vision. The key guiding principles of precautionary approach, polluter pays and accountability are integrated into a policy statement. A CEP enables adoption of practical measures, ensures transparency and includes environment in corporate training schemes. Training is a requirement of most voluntary initiatives, codes of conduct and international voluntary standards such as Responsible Care®, ISO 14001, etc.

Closely linked to Corporate Environmental Policy is Corporate Environmental Reporting (CER), a voluntary disclosure of environmental performance by companies. Presently CER serves as a vehicle for greater accountability to stakeholders and as a benchmarking tool. It also serves as a catalyst for the evolution of internal management systems, improvement of performance, and the emergence of new forms of accountability. Two specific examples of CER include the Dow Jones Sustainability Index (DJSI) and the Global Reporting Initiative (GRI).

How important is corporate environmental reporting?

According to the economic index, the Dow Jones, there is mounting evidence that companies that manage the standard economic factors and the ecological 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.”

The Index addresses the performance of blue chip companies. “Increasingly investors are diversifying their portfolios by investing in companies committed to corporate sustainability. This business approach creates long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments.”

“A company's pursuit and management of sustainability opportunities and the reduction and avoidance of sustainability risks and costs also facilitates the financial quantification of corporate sustainability performance. Sustainability leaders can be identified and ranked for investment purposes according to their management of sustainability opportunities and risks. These opportunities and risks are directly

related to a company's commitment to the five corporate sustainability performance principles:

Innovation: Investing in product and service innovation which focus on technologies and systems that use financial, natural and social resources in an efficient, effective and economic manner over the long-term.

Governance: Setting the highest standards of corporate governance, including management quality and responsibility, organizational capability and corporate culture.

Shareholders: Meeting shareholders' demands for sound financial returns, long-term economic growth, long-term productivity increases, sharpened global competitiveness and contributions to intellectual capital.

Leadership: Leading the industry toward sustainability by setting standards for best practice and maintaining superior performance.

Society: Encouraging long lasting social well being in communities where they operate, interacting with different stakeholders (e.g. clients, suppliers, employees, government, local communities and NGOs) and responding to their specific and evolving needs thereby securing a long term 'license to operate', superior customer and employee loyalty and ultimately superior financial returns.

Corporate sustainability performance is an investable concept. This relationship is crucial in driving interest and investments in sustainability to the mutual benefit of the companies and investors. As this benefit circle strengthens, it will have a positive effect on the societies and economies of both the developed and developing world.⁴⁷

Not everyone in this world is part of a blue chip company. The challenge of how to bring consistency to corporate environmental reporting was tackled by the Global Reporting Initiative (GRI), which was established in late 1997. Its mission was to develop globally applicable guidelines for reporting on the economic, environmental, and social performance, initially for corporations and eventually for any business, governmental, or non-governmental organization (NGO).

Convened by the Coalition for Environmentally Responsible Economies (CERES) in partnership with the United Nations Environment Program (UNEP), the GRI incorporates the active participation of corporations, NGOs, accountancy organizations, business associations, and other stakeholders from around the world.

"Timely, credible, and consistent information on an organization's economic, environmental, and social performance is a key element in building sustainable societies. Communities, investors, governments, and businesses need reliable information to effectively address the development challenges of the 21st century."

However, the Global Reporting Initiative (GRI) is perceived as too complex for small business. Small business are usually privately held entities and do not have reporting requirements outside of tax returns. Given the importance of small business in most

ISO 14001 and ISO 14004 were revised as of 2004, with some changes. While one of the revision criteria was to make the standards more user friendly for small business, it is arguable whether this objective was met.

An international survey of small to medium-sized enterprise was published in May 2005 articulating some of the outstanding challenges ISO needs to address to attract more small business as users of its standard.

national economies and their cumulative impact on the environment, CERs will have to be rethought and designed for small business, not merely scaled down.

While all these are voluntary initiatives that an organization may choose to adopt depending on its business priorities, conforming to the international standard for environmental management systems, ISO 14001 is the preferred tool.

The ISO 14000 series of standards -- a set of voluntary environmental standards-- have been designed to help organizations of any size, sector, be it for or not-for profit from any regional economy, manage their activities, products and services to reduce the associated environmental impacts. ISO 14001 is the requirements standard, and as such it gets most of the attention. This standard, and its companion guide ISO 14004, were developed between 1993 and 1996 through a process of international consensus. The consensus process operates under the umbrella of the International Organization for Standardization (ISO). The standards outline the key elements of a management system that will help an organization address the environmental issues it faces systematically. The management system includes:

- (i) setting of policy, supporting goals and priorities
- (ii) assignment of responsibility for accomplishing them
- (iii) measuring and reporting on results and
- (iv) verification of results.

ISO 14001 was designed on the Deming concept of Plan Do Check and Act, referred to in Chapter 1. ISO 14001 does not set performance expectations save for the organization's commitment to compliance, prevention of pollution and continual improvement. It provides a way of systematically setting and managing performance requirements set by the adoptive organization. Chapter 4 will discuss this tool in more detail.

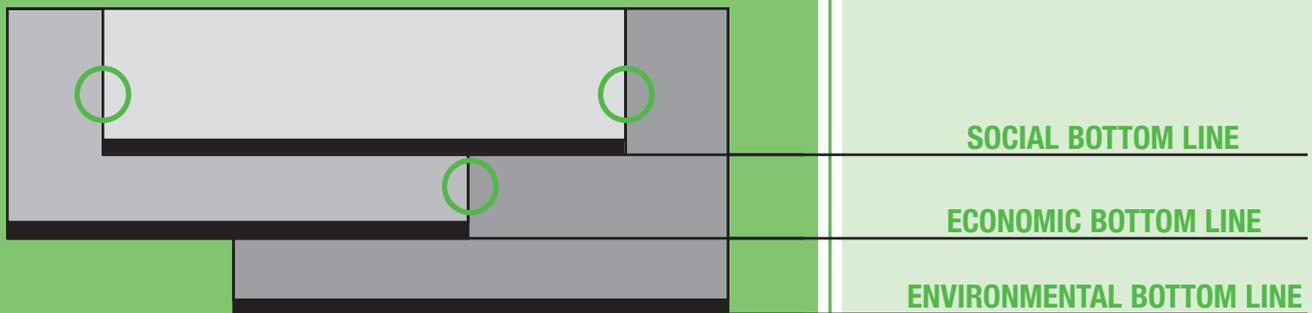
Perhaps the most important point to remember about ISO 14001 is that it is the tool of choice for business as a stepping-stone to sustainability and as a passport to trade. Whether you adopt it or not, your business will be judged against it.

Today as the world moves towards sustainable development, the bottom line is not just economic and environmental performance but also social performance. Consumers, investors, shareholders and other stakeholders, are starting to demand environmentally and socially sound business practices – a 'triple bottom' line. In response to the growing demand for credible information, the Council of Economic Priorities established standards for Social Accountability (SA) 8000⁴⁸. The Council of Economic Priorities Accreditation Agency (CEPAA) provides certification.

SA 8000 provides transparent, measurable, verifiable standards for certifying the performance of companies in nine essential areas:

- Child Labour Forced Labour;
- Health & Safety;
- Freedom of Association;
- Discrimination;
- Disciplinary Practices;
- Working Hours;
- Compensation and Management of the implementation and review of SA 8000 compliance.

The term 'triple bottom line' is often associated with author/consultant John Elkington. It is one that is used by a number of organizations in their annual report. The term focuses on economic prosperity, environmental quality and social justice. The last component being the one with the least amount of attention given to date. The initial reporting activities of enterprise have tended to focus on activities like energy efficiency. The argument is presented that this focus is not enough to warrant labelling the effort as sustainable. The triple bottom line distinguishes environment, economic and social as distinct, non-stable activities. The suggestion is to view them as three continental plates, each with the ability to move independently, although each move has consequences on the other two.



What is the message that you should take from the involvement of the investment and corporate reporting activities? People are serious about sustainability. What does this mean to your business? There are growing external drivers for change. There are internal benefits to change when properly managed. You must become more efficient - eco-efficient.

In 1992, the term "eco-efficiency" in production was coined by the Business Council for Sustainable Development (BCSD, which is now the WBCSD). As a corporate strategy, eco-efficiency emphasizes economics, in addition to environmental improvement. This is not just about reducing the use of material and minimizing the creation of waste. Rather, it is concerned with resource productivity, which is,

Given Einstein's oft quoted position that new thinking is required to solve existing problems, how would you apply water logic to establish a fluid solution to one of the environmental and economic challenges your region is experiencing?

Many small businesses may think that, as their operations are so small, what they do is not important. Individuals think the same way. This is a myth. The real problem is that it is the cumulation of seemingly trivial contributions by each and every person, all six billion of us that are loading the environment with impacts it simply cannot absorb. You cannot wait until the 29th day to change. We cannot afford this. And our population is growing.

maximizing the value added per unit of resource input. The WBCSD believes that by applying the principles of eco-efficiency increased value for customers can be created through the sustainable use of resources.

Efficiency in resource productivity is also reflected in the term 'Factor 4', which was coined by the Wuppertal Institute for Climate, Environment and Energy when it chronicled fifty examples of **quadrupling** resource productivity. Most of the examples exist today as widely available technologies. They include energy efficient homes, office buildings, kitchen appliances, lighting, farming systems, and motors and are widely available, off-the-shelf, competitively priced technologies. Others are well-reasoned technical arguments of possibility, poised for implementation. Improvements of this magnitude would be impressive.

A higher aim has already surpassed the improvements intended by Factor 4. The 'Factor 10 Club' is researching and promoting reductions of 90% in resource use. The Factor 10 Club is an international body (mostly Europeans) of senior government, non-government, industry, and academic leaders working out of Germany's Wuppertal Institute, since 1994. The Club believes that within one generation, nations can achieve a ten-fold increase in the efficiency with which they use energy, natural resources and other materials. Such a goal is within the reach of technology and with appropriate policy and institutional changes, could be made economically viable and politically acceptable. A leap in energy and resource productivity of this magnitude would strengthen the basis for sustainable social, economic and environmental progress.

How has the attitude of business changed the approach to problem solving related to the environment?

In the 1950s, a common response to environmental pollution problems was to ignore them. This was possible when the problems were relatively small, localized. This was accepted as the understanding and awareness of the health and environmental impacts and linkages were not well developed.

In the 1960s, a common approach to pollution was to dilute and disperse concentration of pollutants. Examples include constructing taller smokestacks for broader dispersion into the atmosphere and extending pipelines into the sea to dilute water pollutants. The motto of the decade was "the solution to pollution is dilution."

It was soon realized that this approach did not solve problems. There is no place to send wastes 'away'. There is no 'away'. Many pollutants have been found to be toxic even in the smallest concentrations. Some chemicals retain their toxicity for very long periods. They accumulate in soil and water and eventually find their way in the food chain.

Experts will refer to the assimilative capacity of the environment. This refers to the limits of tolerance the Earth has to absorb pollutants. When these limits began to be exceeded, efforts were taken to establish environmental standards to regulate the discharge of pollutants. By the 1970s people started to recognize that the volumes

were far too large for dilution and exceeded the assimilative capacities of receiving bodies. This resulted in the use of treatment systems to ensure the discharge from industries and other enterprises met stipulated environmental quality standards. Installation of such treatment systems was termed as an 'end-of-pipe' approach. As discharge standards became more stringent, the cost of such end-of-pipe treatment became more expensive and affected the economic viability of some industries. Treatment costs rose reaching 1% and as high as 2% of gross national product in some industrial countries by the late 1970s. Despite the high costs, an "end-of-pipe" treatment approach was proven inadequate. Some of these industries in fact relocated to countries where they did not have stringent environmental standards. However, with the end-of-pipe approach, pollutants were not eliminated but merely transferred from one medium to another, exacerbating the problem in another region.

The high cost and poor returns associated with end-of-pipe treatment in the late 1970s and early 1980s led businesses to re-examine their manufacturing practices. Industry began to explore technological options to reduce pollution at source i.e., pollution prevention through practices such as Cleaner Production.

What is Cleaner Production?

Cleaner Production (CP) is the continuous application of an integrated preventive environmental strategy applied to processes, products and services. It embodies the better efficient use of natural resources and thereby minimizes waste and pollution as well as risks to human health and safety. Unlike waste minimization, pollution prevention or source reduction, which focuses on reducing the amount of waste produced by the manufacturing process, the scope of CP extends across production processes, to product and services. A life-cycle perspective is thus included in its definition. Compared to conventional end-of-pipe treatment alone, pollution prevention is usually more cost-effective, often resulting in reduced energy and material usage and lower treatment costs. It can produce significant environmental benefits such as reduced environmental impacts from lower energy and material usage. You can do better with less.

As pollution prevention and source reduction of pollution began to be actively adopted it was realized that they reduce the conflict between environmental protection and industrial competitiveness. But the tendency was still to apply these approaches vis-à-vis end-of-pipe treatment. However, for development to be sustainable, both environmental protection and profitability need to be addressed simultaneously.

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.

Having the support of policy makers behind you, Cleaner Production efforts can reduce the wait to get permits where necessary.

Who supports Cleaner Production?

The UNEP Industry and Environment Office launched the Cleaner Production Program in 1989. Pollution Prevention and Cleaner Production were promoted extensively through programs both in the developed and developing countries by UNEP, UNIDO, USEPA and national governments.

Governments, international organizations and associations also began to work on developing policies and initiatives to tackle mounting costs. The 1990s saw the advent of the need to ensure pollution prevention through efficient resource utilization. Concepts of sustainable development and Green Productivity, eco-design, product life cycle and eco-sustainability emerged as interface areas with the concept of pollution prevention and cleaner production.

The US Congress, Office of Technology in its report "Industry, Technology and the Environment - Competitive Challenges and Business Opportunities", recognized that for a program to be effective it must operate synergistically and integrate pollution prevention with the manufacturing needs of an industry. This is captured in the following statement extracted from the report.

To enable sustainable development, businesses will have to go beyond pollution prevention.

Unfortunately, end-of-pipe approaches are still being used. In some cases the reason is lack of alternatives. There is no choice. In others it is perpetuated by a lack of understanding of where the real savings are. Here again is where Green Productivity can help your business to improve from using end-of-pipe as a means of handling the waste generated to a focus on source reduction.

The wisdom in considering pollution prevention in tandem with manufacturing needs also arises from the fact that in principle, there are a lot of similarities between pollution prevention and improvement of manufacturing efficiency.

In both cases, the production process is examined in greater detail and the focus is on continually improving the process to improve quality, productivity and reduce pollution. Businesses, governments and international agencies are increasingly beginning to recognize that sustainable development requires influencing both consumption and production patterns. A move towards an integrated approach that enables resource efficiency both in consumption and production is needed, and this need has been recognized.

The 1990s saw a transition from compartmentalized approaches to profitability and environmental protection towards a more integrated approach of resource efficiency. This could not be achieved by technological change alone. Goals, assumptions and the very philosophy of business had to change.

Moving towards sustainability

What will it look like? Will you know it when you see it? Any vision of sustainability must be dynamic, and must be open to revision as soon as it is realized.

Why is there a need for constant revision? Your environment and the world markets are not static.

From environmental protection to eco-sustainability

The shift to a sustainable future is still at a nascent stage in developing countries where increasing population and uncontrolled industrial growth are putting enormous pressure on natural resources. You will live through interesting yet challenging times. However, you need not meet these challenges alone. There are some conceptual guidelines, which follow. These concepts have emerged to support the transition towards a more sustainable pattern of development. Their intent is to emphasize the need for considering environmental or ecological aspects, which have been ignored previously.

Eco-efficiency: Efficiency in resource utilization to produce the same level of goods and/or services. It reflects the issue of sustainability through resource utilization in manufacturing. "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."⁴⁹

Eco-sustainability: The principle of eco-sustainability like eco-efficiency recognizes the finiteness of natural resources and the need to utilize them efficiently.

The core concepts of eco-sustainability are:

- no adverse long term effects on ecosystem;
- rate of use of natural resources is less than the rate of renewal of the resources;
- growth is within the carrying capacity of the environment.

Eco-design: This is a design process in which environmental attributes are treated as a design objective rather than a constraint. The environmental attributes are added to the regular design objectives. One of the most well-known eco-design programs is called Design for Environment (DfE). It seeks to incorporate environmental objectives with no or minimum loss of product performance. This applies to its useful life or functionality.

Differences occur as to which environmental attributes and general goals should be included, leading to differences in terminology like 'Sustainable Product Development', 'Life Cycle Design', 'Green Product Design', etc. DfE guidelines vary between different countries, which reflect the need to adapt to the local cultural, economic and ecological factors. The focus here is on eco-friendly product design.

The Netherlands as a Case Study

The Dutch Manual for Environment Oriented Product Development probably contains the most detailed elaboration of the environmental objectives for product development. A distinction is made between:

- Design for Alternative Need Fulfillment.
- Design for Product Lifetime Extension.
- Design for Minimal Materials Use and Selection of Most Environmentally Compatible Materials.
- Design for Closure of Materials Cycles.
- Design for Energy Conservation.
- Design for Cleaner Production.
- Design for Efficient Distribution and Logistics.

Product Life-Cycle: The entire life-cycle of the product from extraction, through manufacturing to product use and disposal is considered while evaluating the environmental burden of a product. This approach originated in Europe and is considered as the most holistic approach to eco-friendly product development.

Conventionally, productivity improvement focused on cost effectiveness through cost reduction. Therefore, to improve profitability or organizational effectiveness the approach used was cost reduction. With the advent of “the quality” drive, productivity had to be measured by comparing the benefits accrued from a quality program (output) with the resources used within the programs (inputs).

How would
*Design for
Environment*
change your
product or
service?

The need for a viable strategy that integrates “environment” into productivity improvement for industrial, agricultural and service activities has never been higher, particularly in Asia.

In an attempt to improve productivity by influencing the internal organization of an industry, a number of programs emerged. The most popular ones have been:

- Total Quality Management (TQM), which is founded on Deming’s concept of quality.
- In the 1990s this program evolved to highlight the environment (TQEM), recognizing the inherent connection between quality and environment.
- Total Productive Maintenance (TPM) addresses equipment maintenance.
- 5S Technique (Seiri, Seiton, Seiso, Seiketsu and Shitsuke) that ensures structured and systematic housekeeping in an enterprise.
- KAIZEN, which is a philosophy, committed to continual improvement.

Productivity practices like Preventive Maintenance, Good Housekeeping, etc. reduce the environmental burden. For total environment management, there is a need to integrate these productivity improvement programs into your day-to-day procedures to optimize the return to you for your efforts invested.

The transition requires careful management. Balance during this period must be maintained. On one hand, there are external drivers pushing rapid change:

- (i) for rapid industrial growth (from a limited resource base) while ensuring that there is no further deterioration of natural resources;
- (ii) from the international marketplace to include the environment as a strategic business factor and
- (iii) from the increasing public awareness and concern for the environment as well as improving environmental regulation and enforcement.

In contrast, there is the impact from the lingering effects of the East Asia economic crisis. During the stabilization stage in an economy following a crisis, there is a need for tight fiscal discipline. In such a situation, amongst other things, public expenditures on environmental protection and the administrative costs of regulatory agencies are usually affected. Why? Many people still do not understand the inherent link between environment and economy. They believe in the myth that management of the environment can wait until tomorrow. The same thing can happen in business. When enterprises have limited financial resources, they tend to fall back on history. They tighten spending to eliminate any ‘non-essential’ costs. This is especially the case where there is pressure to compete in the international market. However, walking away from the environment does not stop the fact that the world is moving closer to the economic crisis that will foreshadow or parallel the collapse of ecosystem failure. However, the turn around process that business is renowned for could also be used as an opportunity by industry, agriculture, the service sector, as well as policy makers, to steer the Asian economy towards a sustainably developing economy.

Given this economic instability, it is even more critical for development in Asia to be guided in a sustainable manner.

Why? It is clear that there are close links between the concepts of productivity and sustainable development. It is internationally recognized that enhancing productivity will not be possible without protection of environment. The ultimate objective of productivity improvement is to achieve a better quality of life for everyone.

Why? Productivity improvement also creates wealth, improves national wealth and enables the society to invest more in environmental protection and rehabilitation measures. Whereas, a degraded environment has been proven to be a direct threat to the quality of life, and therefore poses a challenge to productivity activities. Workers who are ill or experience an absence of good health cannot be as productive.

Why? Productivity in a broad sense is a measure of how efficiently and effectively resources are used as inputs to produce products and services needed by the society. Green Productivity by definition is a logical strategy forward. This was touched upon in Chapter 1. A deeper discussion is warranted.

2.2 Driving Forces of Green Productivity

In its formal definition Green Productivity uses three key terms or phrases:

- strategy,
- productivity and environmental performance, and
- socio-economic development.

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

It is a cyclical process of continuous improvement. This parallels natural process.

Nature manufactures materials with far less energy. Nature's products offer more value with fewer resources. Through resource efficiency you can work towards retaining the natural resource "capital" thereby ensuring a form of savings for the environment too.

The first step in this process is to avoid the problem. Identify ways to prevent pollution or waste at its source. Reduce the level of resource inputs through the process of rationalization and optimization. This optimizes cost reductions and minimizes environmental impacts. If wastes are generated, the possibilities of reuse, recovery and recycle are looked at to salvage the outstanding resources.

Next, explore opportunities for substituting toxic or hazardous substances to reduce the life-cycle impact of the product. At this stage, examine the product itself including packaging within the framework of Design for Environment (DfE).

The evolution of keen to lean, keen and green.

Finally, treat the wastes in its residual forms adequately by suitable end-of-pipe options to:

- a) further reduce your impact on the receiving environment and
- b) meet the regulatory requirements both from the perspectives of the workspace and the receiving environment. Green Productivity incorporates a systematic approach and methodology to ensure continuous improvement in productivity as well as in the level of environmental protection.

From productivity to Green Productivity

How do you 'green' productivity? Productivity by its very definition involves resource utilization. Any form of resource utilization will have an impact on the environment. All forms of economic activity, be it industry, agriculture or services, utilize resources in response to societal needs and thus impact the environment. A detailed examination of productivity will help you create your own mind map that you can use to think through the change process and link to Green Productivity.

What is Productivity as a Technical Concept? Defining productivity is not an easy task when the answer is needed in precise terms. The term productivity is a broad concept that involves two major aspects. Conventionally, productivity has been defined as the relationship between the ratio of two important elements, namely: output and input as shown in Chapter 1. Output represents the product of an operation, or result, of special interest. Input refers to the resources consumed in the production or delivery of output.

A technical or production concept of productivity is very useful in the measurement of productivity. It measures one's ability to efficiently utilize available resources to produce desired output and thus reflects the changes in productivity. However, a very narrow understanding of productivity may pose some problem if input and output are viewed in quantitative terms, neglecting the qualitative aspect of both input and output. As such, efforts to raise productivity may result in an increase in output with deteriorating quality. In some cases, it may even result in labor-management conflict due to a reduction in labor force in an effort to increase labor productivity. Neither of these outcomes are desirable. To overcome this problem, the concept of productivity has been broadened to include a wider social concept.

What is Productivity as a Social Concept? This concept is captured in the following statement. "Productivity is, above all, an attitude of mind. It seeks to continually improve what already exists. It is based on the belief that one can do things better today than yesterday and better tomorrow than today."

In August 26, 1958, a similar statement was released in Paris by the secretariat of the Productivity Agency Organization, under the title of "The Concept of Productivity and the Aims of the National Centers."

It is human nature to want to make tomorrow better than today. It is an innate wish of everyone. Hence, productivity can be a common objective of everybody. It aims to

achieve a better quality of life for all. Sustainability is about making a better world. The aims coincide.

What is Productivity as an Economic Concept? Productivity may also refer to your ability to create more value for your customers. Value creation is an economic goal. It provides the basis for the existence of many business organizations. Economic gains for all (employees, management, government and other stakeholders) are measured in terms of value added, which may come from increases in inputs or improvements in productivity. In most cases, increases in value added are attained through expansion in capital and labor. However, a productivity driven growth model reflects resource efficiency and output superiority in the market since it drives the creation of more value to customers. Hence, a long-term sustainable growth in the economy cannot solely depend on expansion strategy alone. One of Deming's Deadly Diseases (causes of failure) is over-dependence on visible numbers where the reason for success is a valued quality or attribute. A healthy environment is not defined numerically. Yet it is doubtful that any of your customers would be willing to forgo it.

What is Productivity as a Management Concept? From a management perspective, productivity has been equated with efficiency and effectiveness. As previously illustrated, efficiency and effectiveness are both management concerns to ensure that desired products and services are provided in the right manner all the time. This concept of productivity provides a working definition to manage and improve productivity at micro or organization levels.

What is Productivity as an Integrated Concept? As an integrated concept, productivity can be viewed in two ways; as an objective and as a means. Productivity as an objective is explained by the social concept of productivity. As a means, productivity pertains to the technical, economic and management concepts of productivity.

Experience has shown that companies and economies face competition from other countries offering similar or even better products and services. A better option as a long-term strategy would be to strive for productivity-driven economic growth involving the expansion of labor and capital inputs and the qualitative improvements of these inputs. Among these, the qualitative aspects of capital and workforce improvement would be of greater concern.

The Three Guiding Principles of the Productivity Movement

With an understanding of what productivity is all about, it is important to also understand the following principles as guides for productivity improvement:

Principle of Increase in Employment: In the long run, improvement in productivity will increase employment. However, during transition or before the results of improved productivity are realized, the government and the people must cooperate to generate suitable measures to transfer surplus labor to areas where it is needed and thus prevent possible unemployment. Sustainability is not about jobs versus the quality of the environment. It does impact where the jobs need to be.

Principle of Labor-Management Cooperation: In developing concrete measures to increase productivity, labor and management must cooperate in discussing, studying and deliberating measures that conform to the conditions existing in the respective enterprises. Workers on a production line are key to implementing environmentally sound management practices required by management.

Principle of Fair Distribution: The fruits of productivity improvement must be distributed fairly among management, labor and the consumers. History is riddled with the consequences where equity was not present.

What happens next? Having looked at the various components in the productivity continuum, evolving your business to operate under a Green Productivity framework requires that you steer production and consumption towards sustainable practices. As you do so it is very important for you to be able to measure these efforts to enable continuous improvement. The Green Productivity framework proposes to draw from the productivity domain to achieve that goal.

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\text{Value of goods or services}}{\text{Cost of resources consumed}}$$

There are a number of different inputs associated with any output from an industrial or commercial organization i.e., labor, capital and materials. However it can also include energy, water and sector specific factors. For example, it could include dyes and other chemicals for the textile-manufacturing sector. In a metal finishing operation it could include metal salts, acids and complexing agents.

While the concept of Green Productivity is simple enough, the logic of improved productivity alone is not always a strong enough motivator for change. There are forces both external and internal to the organization that will drive Green Productivity.

External Drivers

External forces typically include pressure from regulations, be they local, regional, national or international. Demands from various stakeholders such as consumers and suppliers may drive your GP efforts. Regulations may be in the form of increasingly stricter and more complex regulations and standards, or fiscal instruments such as taxes and penalties or judicial directives. Many national regulations are a reflection of the international regulatory developments in environmental and natural resource protection. Keeping an eye on what transpires in your end market is prudent.

Evolving global agreements, such as international conventions, industry standards as well as codes of conduct for environmental and social responsibility, are all driving forces in the move towards Green Productivity.

These trends have much greater implications for businesses in developing economies due to their technological and resource constraints. Opening up of world markets and increased globalization has further intensified the pressures on these businesses, as they have to meet international expectations. Trade is not yet an equitable process.

Customer requirements usually focus on quality, cost, reliability, and promptness of delivery. However, as environmental requirements become an integral part of business strategy, pressure from customers particularly in industrialized countries will increase. Suppliers need to be able to provide environmentally sound goods and services. The need to demonstrate credibility using standards such as ISO 14001 and SA 8000 will continue to pressure suppliers to improve their environmental and social performance.

The trend towards greening of the supply chain is favoured by a number of multi-nationals. Their purchasing policies are changing to incorporate the environment as a criterion alongside other more traditional risk assessment criteria. To stay in the market, suppliers have to modify their business practice to meet or exceed these evolving expectations. Are you ready for these new requirements? Greening of the supply chain by corporations is forcing SMEs, which are an integral part both upstream and downstream in the supply chain, to re-think their business practices. Those organizations that take advantage of these trends now, modifying their business practices to make them more resource efficient will find themselves with a competitive edge in the marketplace. Those that don't improve run the risk of losing a key customer or business closure.

Another dimension of this pattern of development has been the increasing, albeit slow, shift among consumers towards sustainable consumption. This was already discussed. It has led to a demand for more eco-friendly products such as:

- garments manufactured without azo dyes,
- vegetable tanned leather products,
- organically grown produce,
- coffee that has been obtained through fair trade practices,
- cosmetics manufactured through fair trade practices, etc.

This trend is prominent particularly among consumers in North America, Europe, and Japan. Green consumerism is becoming an important driver of change. However, it can be difficult for business to make the appropriate corrections – knowledge of environmental science within organizations is uncommon. Waiting until the last minute to respond may lead to change that is contrary to your productivity, adding cost and causing environmental damage. It must be done without compromising the quality of the products while answering the consumer's needs.

An important issue pertaining to sustainability of consumption and production is resource pricing and availability. Policies favoring realistic resource pricing are an essential economic instrument to drive production towards resource conservation and efficiency. Availability of a resource would typically govern its pricing and this in turn would be indicative of the priority placed on its conservation. Governments must be willing to adopt the instruments you need to make these changes. Informing them of your need is prudent.

International Conventions

- the Montreal Protocol, Climate Change Convention

Industry Standards

- Responsible Care® for the chemical industry
- Marine Stewardship Council for the food processing sector
- Forest Stewardship for pulp and paper sector

Codes of Conduct

- ICC Business Charter for Sustainable Development
- SA 8000

All these trends are also creating new market opportunities for goods and services produced in a more sustainable manner and which promote a sustainable lifestyle. These trends are serving to drive businesses towards Green Productivity while systematically strengthening their market position. It can help your business too.

Internal Drivers

Internal forces that affect Green Productivity are integral to the enterprise, such as worker health and safety, and internal efficiency.

The establishment of standards such as SA 8000, adoption of the International Labour Organization's standards for social welfare, and social codes of conduct adopted by corporations and retail chains are driving businesses to recognize worker health and safety as a crucial issue in business today. Can you think of a company that neglected to include these and what their customers' and the public's response was?

The advantages of ensuring worker health and safety include reduced health and insurance costs, reduced absenteeism, lower liabilities and an increase in the morale of the workers. This is reflected effectively as improved labor productivity, which is a strong driver for the adoption of Green Productivity. Internal efficiency in processes and operations in an organization primarily involves resource efficiency. Typical benefits include:

- reduction of waste by improving process conversion efficiency, equipment efficiency, and recycling and recovering useful raw materials and by-products, thereby reducing off-spec product formation;
- improvement in quality of products by increasing the proportion of 'Right First Time', using better and safer raw materials and reducing defects;
- cost reduction as a result of the above measures.

2.3 Positioning Green Productivity in the Market - Determining where you are

Green Productivity aims eventually at shaping business to answer societal demands for "quality of life" through supply of goods and services produced in a sustainable manner. GP has a strong small-to-medium sized enterprise focus. SMEs form the backbone of Asian businesses. They are also key to economic development as a whole in Asia.

Business also shapes society's demands through market maneuvers. Markets evolve according to a "push-pull" process. In this situation, businesses or the producers (supply side) offer products, which push demand in a particular direction. Green Productivity can help this push to be in the direction of sustainable consumption.

Societal demands help shape business practices via consumer pressure. Consumer needs (demand side) evolve exerting a pull on the market. An active interface is created in this push-pull situation, which is the position occupied by the product. Environmental protection and economic benefits are judged by the form and type of product and the service it provides.

Any changes made to benefit society have to be made in the marketplace. This means one has to develop strategy aimed to change consumption by pushing products and services so that societal economics are not compromised. At the same time the natural environment, on which society depends, is not degraded. GP enables this change.

2.3.1 Triple Focus

Green Productivity focuses on making the links between the environment (for a sustainable future), quality (representing the voice of the customer) and profitability (considering factor inputs) practical. It is especially important to recognize not only the strength in the triad, but to understand the power in each corner of the triad (refer back to Chapter 1 – Quality, Environment, Profitability, Figure 1-4, page 1.12).

Environmental Concerns

The bottom line for environmental concerns is that the rate at which resources are extracted or impacted must be slower than the rate at which they are replenished by natural processes. This is the core or essence of a sustainable environment.

Economic Concerns

Reducing the amount of material and energy used to make or supply goods and services can directly cut the cost of doing business, thereby enhancing profitability. The savings may come from lower product and waste management costs or take the form of avoiding the cost of potential environmental liabilities. This makes good business sense. There is also the potential for moving ahead and helping customers understand what is good for their bottom line, is good for the quality of their environment as well. This reinforces the traditional bottom line.

Social Concerns

Green Productivity attempts to answer society's needs by increasing productivity through environmentally sound manufacturing and business practices. In doing so, GP caters to customer requirements for more environmentally sound products while ensuring a healthy and safe environment. This extends the bottom line from mere profitability to address prosperity, a more stable condition.

This process is iterative. Strategically, Green Productivity addresses not just the supply side, it includes demand side management. This way the needs of society can be used to influence progress in a sustainable direction.

2.3.2 Prioritizing Concerns

How do you know where to put your effort and energy?

Productivity improvement means improvement in QCDMS:

- Q = Quality** Higher Quality that meets or exceeds customer requirements
- C = Cost** Lower Cost
- D = Delivery** Timely Delivery as desired by the customer
- M = Morale** Boosting morale of all concerned
- S = Safety** Thinking and improving safety of each and every aspect of the product and process

Outputs are divided into two groups: desired outputs and undesired outputs. Undesired outputs are often called “waste”. The productivity of a system is determined by its desired outputs, which are usually regarded as final products. The aim of a substantial part of all productivity improvement is to increase the ratio of desired outputs to total outputs. Starting with an idea of where your current productivity is may be useful, as it will establish a baseline on which you can improve.

Using one or more of the various productivity ratios previously introduced, determine what your current state is.

Your Current Level of Productivity is:

2.4 Summary of Chapter

This chapter covered a great deal of material that may seem distant to you in terms of your daily business needs. It was an intensive chapter. You may wish to review some of the sections and make additional notes. You may decide to further investigate some of the topics through the Asian Productivity Organization, a national productivity office, or through the Internet.

However, there should be no doubt of the need to evolve your business towards sustainability as a bottom line priority, a requirement of a global social contract and an imperative for survival. The planet is not at risk, but many believe that humans are, and that impacts your business. The evidence is in the air you breathe, the littered streets you walk, and the water you drink with care.

Implementation of Green Productivity has both immediate and long-term benefits. The benefits accrue to producers, as well as consumers. They include increased efficiency gains in resource use, lower costs of production, and decreased costs for waste treatment and disposal.

Green Productivity benefits business by lowering its operational and environmental compliance costs. Its implementation prevents the generation of waste through efficient resource utilization. This can also reduce or eliminate long-term liabilities and clean-up costs. Furthermore, disposal costs are reduced when the volume of waste is decreased.

Adoption and practice of Green Productivity provides businesses with a competitive advantage. It increases productivity growth rates in businesses, and as a result of which market share and profitability should increase.

This shift towards integrating “environment” and “productivity” enabled by Green Productivity has far greater implications for businesses in developing economies due to their technological and resource constraints. The opening of world markets and increased globalization has intensified the pressures on these businesses. They will have to meet international expectations. The implications for SMEs are critical. SMEs cannot be overlooked, as the wealth of almost all national economies is based on a sizable involvement from the existence of small business. As shown in Chapter 1 their presence is around 95% or higher in most national economies.

Workers will benefit from Green Productivity because it justifies wage increases, improves health and safety in the workplace. Policy makers, economists and environmentalists will care because this form of growth will accelerate economic expansion in a sustainable manner. Green Productivity thus forms an integral part of the broader sustainable development agenda, moves society towards sustainable production and consumption and makes business sense.

By improving productivity and environmental performance for overall socio-economic development, Green Productivity enhances quality of life. Green Productivity achieves this through its multi-sector focus and its potential role in the community as a whole.

In this chapter, you have learned about the history of the environmental movement, the correspondence with public concerns, and the drivers forcing change. Are you comfortable with the idea of negotiating with the drivers of change? Has your attitude towards positioning yourself to prosper in a future designed to achieve sustainability changed?

Please indicate your new level of knowledge concerning the history of environmental concerns where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of the history of environmental concerns is at this level:

1 2 3 4 5

Please indicate your current level of skill in negotiating with the drivers of change where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My level of skill at negotiating drivers of change: 1 2 3 4 5

Please assign a value to the importance of you being able to position yourself to prosper in a future designed to achieve sustainability where:

1 (not important) 2 (slightly important) 3 (average importance)
4 (a core business concern) 5 (a critical business tool)

I think the importance of sustainability to my future is: 1 2 3 4 5

2.5 Questions

1. Do you understand the extent of the impact that mankind has had on the Earth?
2. Have you experienced first hand an environmental disaster? If so, how did it affect you?
3. Is there a particular environmental management issue introduced in Chapter 2 that concerns you?
4. Do you believe that the environmental concerns of your receiving markets have affected your business? How has this appeared?
5. Has there been a specific environmental concern tabled by your customers in export markets?
6. Have you been able to address these concerns effectively and manage these to your advantage?
7. Do you feel that Asia will have a disadvantage or an advantage in meeting the growing green concerns of the west over the next five years? Can you provide any evidence to support this?

2.6 Point to Ponder

History without GP

The issue of environment quality is not a new phenomenon. A look back at the history of the world can show you where problems have existed and how people have reacted.

Rome was at one time considered the center of western civilization. The Roman Empire built incredible bridges, aqueducts, and other engineering feats that even today stand as monuments to their achievements. Yet, the Roman Empire fell and all of the Emperor's centurions and gladiators could not put it back together again. What happened? A combination of factors caused its downfall. There were two environmental factors.

One was the presence of lead in the pipes that supplied their drinking water. The second was the overloading of the swamps around Ostia with sewage, creating a haven for disease vectors, particularly mosquitoes. Parasites transmitted by mosquitoes brought an army to its knees, and outbreaks of malaria to the population. An unhealthy populace cannot defend itself.

King James of England had an interesting challenge to deal with. Admiral Sir Robert Mansell had concerns for the future of British shipbuilding as the charcoal burners were decimating the forests. In 1615, he persuaded King James I to forbid glass furnaces to be fired by wood. This was probably not a difficult decision as due to the burning of coal and local wind patterns, air pollution had become so severe that lung

disease was epidemic. The solution? King James decreed that anyone caught burning coal within the city limits would be beheaded. Cleaner air conditions returned. The incidence of lung disease dropped. This case study, although somewhat abrasive, was a highly effective anti-pollution law. It is unlikely that this approach would be accepted by current society.

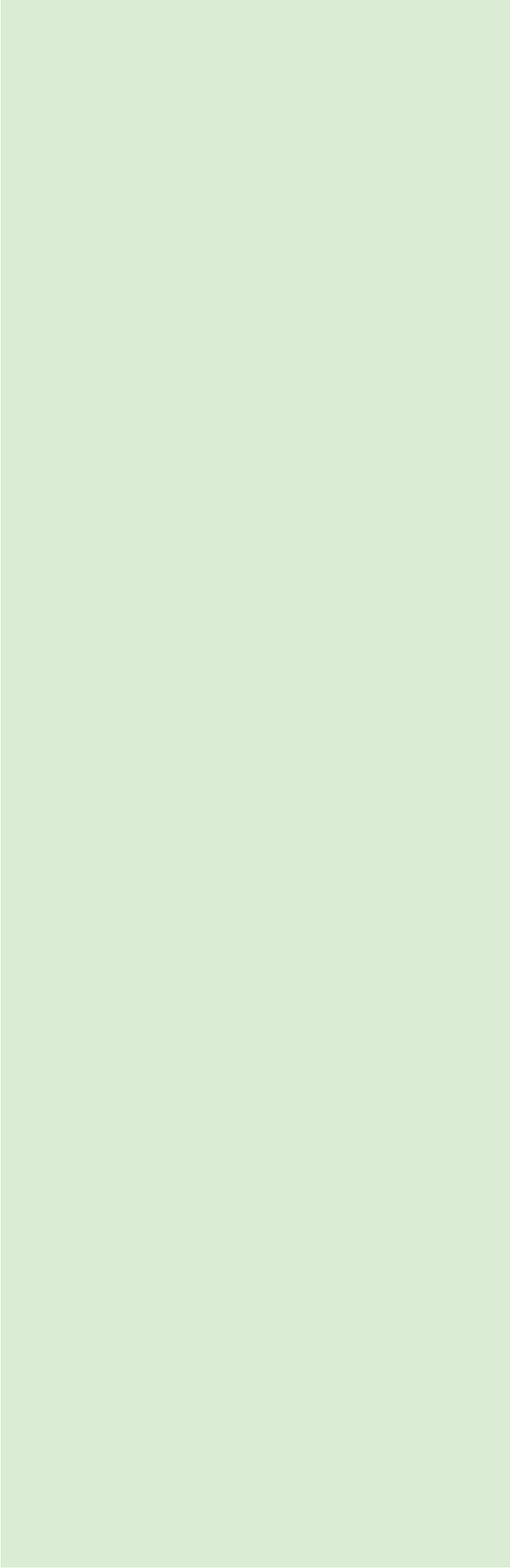
At the height of power of the Bourbon Kings, the Palace of Versailles was the cultural centre of France. At its peak, over 40,000 courtesans lived on and around the Palace. A pretentious man, King Louis XIV broke a history of royal traditions and aligned himself with Greek gods, challenging nature. Previous kings chose animals as their icons. Louis' self-declared analogy to Greek gods antagonized royalty across Europe.

With the intense court population, and with limited water reserves from the reversal of flow from the river Seine, it proved to be impossible to bathe with water. Consequently, alcohol was used to wash one's face. Obviously this practice resulted in the drying out of the bather's skin. Blotchy red faces emerged, evidence of psoriasis. The art of the period shows how the French responded. Powder was used to coat faces, worn so thickly that their faces appear white in paintings. Wigs of all kinds were worn to hide their unwashed heads. The perfume business of course flourished as people dosed their bodies with scents so as to continue to please the nose of the Grand King and others in such close quarters. Each summer the Palace court was plagued with illness because of water pollution. Yet the response from nature exacted a price for each challenge that remains with the French to this day. To this day, Paris all but empties during August, the month when water flow is at its lowest.

What cultural adaptations do you know about that have emerged in response to a stressed environment? History is riddled with them.



Palace of Versailles



CHAPTER 3

Green Productivity Tools and Techniques

CHAPTER 3

Green Productivity Tools and Techniques

CHAPTER 3 GREEN PRODUCTIVITY TOOLS AND TECHNIQUES

3.1 Purpose of this Chapter - Implementing Green Productivity Practices

Can you imagine a material twice as tough as the highest-tech ceramic?

How valuable would it be to your business if you had the rights to produce a thread that was thinner than any other available on the market, yet five times stronger than the best steel?

Or to produce an adhesive that sticks to anything without using a primer, even underwater?

How would you like to be the exclusive manufacturer of any of these goods in today's global market? They all do exist. The abalone, the spider and the zebra mussel, respectively, currently hold the manufacturing rights to each of these innovations. Nature has perfected the manufacture of incredibly efficient products and services, using much less energy and dramatically fewer resources. Nature makes current human productivity pale in comparison. Imagine what the market opportunity would be if you could mimic the efficiency and simplicity inherent in natural design and construction. Green Productivity enables you to start this transformation to parallel nature's efficiency.

This chapter will explore the tools and techniques held under the umbrella of Green Productivity and introduce you to:

- ways to determine your productivity improvements against an appropriate measuring stick.
- tools that show you what you can do to help your business evolve towards sustainability.
- techniques that will outline how you can use these tools to your advantage.
- case studies where businesses have already made progress in specific areas by using one or more of the tools and techniques.

Build on your knowledge of productivity, your confidence in using tools and techniques to enhance your productivity and your attitude towards making Green Productivity a business priority.

Please indicate your current level of knowledge concerning productivity measures where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of productivity measures is at this level: 1 2 3 4 5

Please indicate your current level of skill in using tools and techniques to enhance your productivity where: 1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My level of skill at applying these tools is: 1 2 3 4 5

Please assign a value to the importance of your being able to leverage Green Productivity to enhance your profitability and environmental performance where:

1 (not important) 2 (slightly important) 3 (average importance) 4 (a core business concern) 5 (a critical business tool)

I think the level of importance of Green Productivity to my business is:

1 2 3 4 5

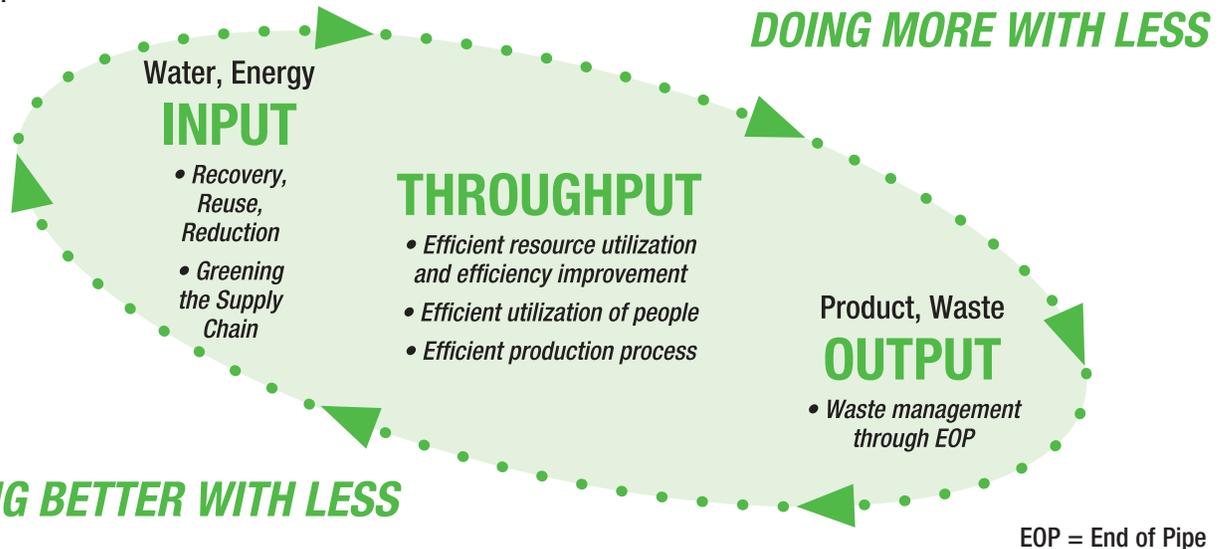
Nature hosts the most efficient producing service. Yet the value of the services Mother Nature offers does not appear on any corporate balance sheet or in any nation's annual budget. It is accepted that the human economy is based on natural capital. Calculations published in the journal Nature conservatively estimated the value of all the earth's ecosystems services to be \$33 trillion per annum. That was close to the gross world product in 1999 and it implies a capitalized book value in the order of half a quadrillion dollars. More importantly, for most of these services there is no known substitute. No alternatives at any price. However, too often the realization of the true cost of the destruction of the services provided by Mother Nature becomes apparent when the services start to break down.'

How are you going to operationalize Green Productivity? Green Productivity is not a casual activity, putting it into use means that you must design for the value-added benefits you seek.

Input-Throughput-Output Focus

Implementing Green Productivity means using fewer resources, being more efficient in the throughput of all the resources involved, and ensuring that there is a purpose for all the outputs.

Figure 3-1



You need to enhance your understanding of productivity. As a review of Chapter 1, the efficiency of a process is defined as the ratio of the output to the input. In any production process some resources are utilized to make the output occur and some of the resources are wasted, specifically as they are not retained in the product or

service. However, these wasted resources result in an equivalent amount of pollution being generated and are seen as lowering productivity. The amount of resources utilized is directly proportional to productivity. The more resources retained in the product or service, the higher the level of productivity. The efficiency of resource utilization depends upon many factors, from the type and quality of raw materials used to the technology employed. All these factors ultimately have a direct bearing on productivity and profit. As a technology becomes older, productivity typically decreases as the bar of efficiency is raised with the advent of new technology. To maintain optimum productivity, an effective system should be developed to continually improve and maintain efficient resource utilization.

Implementing Green Productivity can be better understood by extending the quantitative definition of productivity. Remember, that productivity is the ratio of output to input.

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}} = \frac{\text{Value of goods or services}}{\text{Cost of resources consumed}}$$

In evolving productivity past its traditional definition, it becomes the 'relationship between output and one or more of the associated inputs used in the production process'. To elaborate, in implementing Green Productivity, the focus is not only on the input used and the output produced, it is also on the 'throughput' needed in the conversion of input to output. With Green Productivity, the means of achievement, the how, are as important as the end.

Some of the issues that need to be considered in the process of implementing Green Productivity are outlined in these three points:

1. Inputs to be considered include water, energy, materials, technology, labour (which covers training costs, health and safety precautions), and capital for both production and environmental protection systems.
2. Adding value in terms of the reduction of inputs, such as reduced treatment costs, revenue generated due to the addition of new products and by-products, and a rise in value of saleable outputs due to improvement in quality. For example, if a new approach results in less material required to produce the same unit you can either reduce your inventory (and save money) or sell more (increasing profit).
3. Throughput to convert inputs into value added outputs is in the form of improved processes and procedures. This will enable efficient resource utilization (including humans) as well as improved functionality and reliability of products and services.

A number of initiatives have been taken by businesses around the world that have broken away from 'business as usual' towards more responsible entrepreneurship. These companies have made a commitment to incorporate an eco-sensitive

approach in their business practices. In realizing that sustainability is characterized by qualities that are hard to quantify, a broader measure of productivity is essential. This also requires a change in the qualifiers or factors in the productivity ratio.

Multi-factor Productivity

Factor productivity is a single measure of production, typically labour, sometimes capital. Multi-factor Productivity² is a productivity measure based on a composite of two or more factors. It is a more comprehensive measure of economic efficiency. It is one that is considered essential if an economy or a business is to sustain long-term economic growth.

Multi-factor Productivity (MFP) measures are useful for many purposes, such as analyzing changes in overall efficiency or of total costs. However, factor productivity measures such as labor productivity still provide insights into industry efficiency. They are useful for analyzing unit labor costs. Some industries suffer from data inadequacies that prevent the development of Multi-factor Productivity measures.

Multi-factor Productivity is an integral part of the Green Productivity framework. With the increasingly important role that environmental costs and resource efficiency are playing in businesses today, Multi-factor Productivity appears to be a more appropriate measure. Benefits to an enterprise, due to conservation of resources, improvement of health and safety in the working environment etc., would more readily be reflected in the measurement of Multi-factor Productivity rather than simple factor productivity.

Why? In the context of Green Productivity improvements, Multi-factor Productivity can be reflected in terms of a lower utilization of resources such as water, using as many renewable energy resources as possible versus non-renewables, and employing eco-friendly chemicals in processes, amongst others. In essence, apart from greater efficiency in utilization of resources you can leverage the quality of these resource characteristics. Such leverage would include an element of increased safety, a reduced toxicity and a reduced burden to the environment overall. These concepts have been integrated into the measurement of Green Productivity.

There are three overarching ecological principles that guide Green Productivity. They ensure that there will be sound ecological performance in development activities.

Principle #1. *Sustainable use of natural resources*

To be sustainable, natural resources cannot be used faster than they can be renewed or regenerated. For non-renewable resources, they cannot be used at a rate faster than the sourcing of reliable substitutes. Green Productivity aims at the efficient use of natural resources including non-renewable. The increased efficiency will result in the conservation of natural resources and lead to their sustainable use. Why is this important to you? Think.

How long would your business last without clean water? How long would your business last without any water?

Principle #2. Protection of ecological balance

Pollution that exceeds the capacity of the environment to treat or absorb wastes cannot be tolerated. Pollution disrupts the various ecological processes that provide humans with clean air and water. Pollution also contaminates the food chain upon which humans depend for survival. There is no alternate source to provide for your personal or corporate needs, or for the species upon which your survival is dependent. Green Productivity, with its objectives of preventing and reducing pollution, serves to protect the natural processes that are so essential in maintaining the ecological balance of the environment. Green Productivity provides you with the toolkit you need to reduce the amount of pollution caused by your actions. *In some cases, leading edge industries have taken this respect for the environment a step further - in the outputs from their business process, the water they return to a river is cleaner than the water they extract.*

Principle #3. Protect plant and animal species and their environment

Plants and animals, besides their inherent value, are essential for long-term survival. Their role is to help maintain the ecological balance of the planet. They are also the basis from which humans derive food and other products. The genetic composition of these plants and animals are the sources for the improvement of food crops, sources of medicine and other useful products on which humans depend. Green Productivity fosters the more efficient use of the environment and resources, and the reduction of pollution contributes to the survival of these species; *including human beings.*

Do you know how long you can survive without air? How long would your business last without an essential resource?

Now it is time to explore the tools and techniques in the Green Productivity framework, with case studies that show it is possible to protect the environment while improving the bottom line. These illustrate the three phases (Input-Throughput-Output) in Green Productivity. These case studies come from demonstration projects that were carried out in Asia by the APO and other government programs, and from voluntary initiatives carried out by industries showing both environmental protection and productivity improvements – a win-win scenario.

3.2 Tools and Techniques

3.2.1 Tools and Techniques Defined

The information in this section will explain what the Green Productivity tool or technique is, and provide an example to illustrate its practicality in business. These tools and techniques will help you redesign your business processes, evolving you and your community towards a sustainable future.

Early descriptions for Life Cycle Assessment started out with the phrase “cradle to grave” and are evolving to capture the spirit of productivity improvements to close the cycle in the new phrase “cradle to cradle”.³

Life Cycle Assessment

Life Cycle Assessment (LCA) is the process of evaluating the effects that a product has on the environment over the entire period of its life, which is described correctly as a cycle. Life Cycle Assessment sets out to provide objective answers. Its aim is to uncover information and suggest more enduring forms of production and consumption. It uses a scientific approach in which the quantification of effects plays a dominant role. A complete Life Cycle Assessment is composed of three separate but interrelated components:

- Inventory
- Impact analysis
- Improvement analysis

Life cycle inventory is an objective data based process of identifying and quantifying the environmental loading involved. This includes the energy and raw materials used, and the emissions and wastes consequently released (e.g. air emissions, liquid effluents, solid waste) throughout the life cycle of a product, process or activity.

Life cycle impact analysis entails a technical quantitative or qualitative process to characterize and assess the effects of the environmental loading identified in the inventory component. The assessment should address ecological and human health considerations as well as habitat modification, noise pollution and other such effects.

Life cycle improvement analysis refers to a systematic evaluation of the needs and opportunities to reduce the environmental burden associated with energy and raw materials use. It includes environmental releases throughout the entire life cycle of the product, process or activity. This analysis may include quantitative measures of improvements such as changes in product, process and activity design, raw material use, industrial processing, consumer use and waste management.

Using Life Cycle Assessment, the environmental impact of processes, product cycles, and economic activities can be minimized by reducing the material flow through cleaner processes, cycles, and activities. If the reduction in material flow occurs without loss of service or quality of the product as required by the consumer, then it leads to improvement in the material efficiency of those processes.

Together with information on costs, convenience, and consumer safety, the information obtained from a Life Cycle Assessment can be used by organizations to make decisions on how to develop, produce and improve products. Improvements in efficiency can occur at various points in the cycle. In production processes, improving the material efficiency could mean:

- avoiding leaks and spills,
- better materials handling,
- closing internal material loops for auxiliary materials, and
- designing and redesigning processes for improved material and energy efficiency.

It is important that material efficiency includes energy efficiency, because energy supply is either explicitly or implicitly related to material flows. *Energy is the currency of productivity.*

In terms of consumption patterns, improved material efficiency means improved utilization of products, designing products for longer service lives, and reversing the throwaway mentality of the existing consumer society.

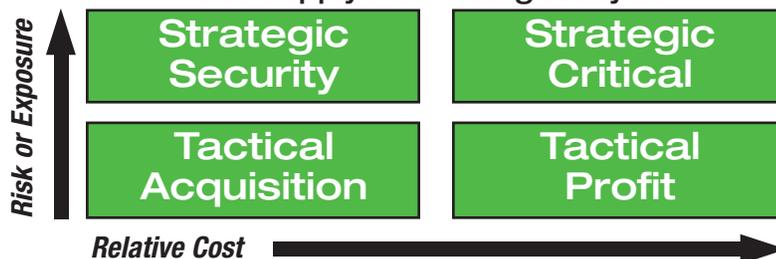
In the broadest sense, improving the material efficiency of the economy means reducing the material needs of any given service. Therefore the material requirements upon which economic welfare is based are reduced.

Green Productivity scans for opportunity upstream and downstream of a product, along the whole supply chain. This is done by adopting a life cycle approach and by focusing on efficiency of processes leading to productivity improvement. It encompasses the environmental impact of not only raw materials but also the usage of the product by the consumer, and its post-use value. Supply chain management is an inherent component of the strategy for environmental improvement, which will be discussed further on.

Applying Life Cycle Assessment to supply chain management has implications for small business today. SMEs form part of an extensive base in the supply chain for any large enterprise. As the business strategies of larger or multi-national enterprises move towards sustainability, smaller suppliers will be pressured to modify their business practices to conform to these demands. Just as the demand for quality in the supply chain swept through businesses in the 1980s and 1990s, and continues to be a procurement criterion, the demand for environmentally and socially sound practices will follow a parallel path. Volvo was the first car company to inform its suppliers globally that they must adopt a standardized environmental management system referred to as ISO 14001. In 1997, the Environmental Manager from their head office toured the globe to meet with tier one suppliers and inform them of this requirement. Other car companies followed this trend with variations in how this requirement could be met.

Few companies can afford to ignore these trends. If you operate in a market with numerous competitors you are well advised to take action now and not wait to conform to these demands. Why? When customers perform a supply position analysis (see Figure 3-2) the opportunities for streamlining suppliers is greatest in tactical profit. How will you be able to compete if you lag behind those that have already improved?

Figure 3-2 The Supply Positioning Analysis⁴



As energy is neither created nor destroyed, the energy inherent in a material means that its existence in some form continues – how are you optimizing your use of this energy in its extended presence? Is this an opportunity for forging an alliance with a customer or neighbouring business?

There is no “away” where we can throw our waste. “Away” does not exist.

Nature has no waste. Neither should you.

Small-to-medium sized enterprises or SMEs underpin most supply chains. **Competition in this quadrant is fierce.** How can you distinguish your company as a preferred supplier?

The significance of Life Cycle Assessment (LCA) in sustainable product design was recognized in Japan leading to the formation of the Life Cycle Assessment Society of Japan in 1995. The Society was established with the support of Keidanren and the Ministry of International Trade and Industry (MITI).

LCA has formed the basis for product assessment in Japan where design for recycling has begun to play a very important role, particularly in the household appliances and automobile sectors. The conceptual origin of product assessment in Japan began with the enactment of the Law for Promotion of Utilization of Recyclable Resources (Recycling Law) in 1991. In 1994, the Industrial Structure Council, a consulting council for the Ministry of International Trade and Industry, issued a guideline requiring manufacturing companies to prepare assessment manuals for product design. LCA serves as a very useful tool when conducting such an assessment. Various industry associations have developed product assessment guidelines for their industrial sector.

Using the principles of LCA, national projects were carried out in Japan between 1993 and 1998 to identify 'eco-materials', which showed for example, that the impact of recycling aluminum and glass has a much lower impact than recycling virgin copper. Such findings were very important for materials based industries. A list of 55 product categories that exert a lower burden on the environment vis-à-vis their conventional counterparts has been developed by MITI.

Life Cycle Assessment is thus being used by Japan to:

- (a) examine the contribution that products make to reducing global problems;
- (b) determine their environmental impact using eco-indicators; and
- (c) develop newer, safer and more sustainable products based on this information.

Conventional product design and development processes emphasize how reducing production costs and achieving higher performance can enhance economic value. Today, in recognizing the power of tools like LCA, Green Productivity has incorporated the principles of eco-design into its framework. Product design therefore becomes design for a cleaner, higher quality environment.

Design for Environment (DfE)

Design for Environment (DfE) is currently interpreted as a design process in which environmental attributes are treated as a design objective rather than a constraint. It is a quality to which you strive to achieve to enhance your product or service. What is important in DfE is to increase eco-efficiency i.e., lower the environmental impact and improve the quality of products. These changes in turn lead to a reduction in costs and improved profitability. This shift in perspective is key and consistent with that required for Green Productivity.

Increasingly, industry is redesigning existing products. This is being done by:

- increasing the amounts of recycled or recyclable materials used in manufacture;
- substituting toxic and hazardous materials with more suitable less toxic or non-toxic alternatives;
- reducing material intensity for a given product.

The aim is to reduce the environmental impacts of consumption. This must be done while ensuring that the quality of the product is maintained or improved.

Why is Design for Environment of interest? DfE can open the door to niche markets for revolutionary new products. It is believed that many of the products that are required to move human activity towards sustainability are currently not available. New products need to be innovated. Such changes open the door to great opportunity, as innovation is the primary engine of economic growth. The task is to make the products and services of the future green. There is great potential for new business and in doing so a community can also benefit as economic growth becomes sustainable. That is good news.

Why is Design for Environment important to you now? 70% of the cost of a product's development, manufacture and use are 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 to use the tools and techniques available through Green Productivity to eliminate negative environmental impacts in the design phase offers the potential for significant returns.

If design is under the control of the same organization as production, it can make the process of change easier to start. There is a direct bottom-line incentive. If this is the situation that your business is in, implementing Green Productivity to make design changes can result in substantial savings in cost, reductions in environmental impact, and tremendous improvements in efficiency⁵. Opportunities for substituting toxic and hazardous materials have already been taken by some in the industry and the service sectors. Some of these have regional or global consequences. These design changes have resulted in altering the life cycle of the product, leading to the manufacturing of products that are less demanding on natural resources while at the same time satisfying the needs of the customer.

Case Study - Insulation

The purpose of insulation is to retain heat during the winter and keep heat out during the summer.⁶ RTICA®, a new generation of insulation for residential and commercial applications, promises to radically change the perception of, and preference for insulations in wide use today, notably those made with older fibreglass, cellulose and rock wool technologies. The product matches or exceeds these existing insulations in thermal performance as measured by R-values. In handling, RTICA® will not cause skin irritation nor generate dust that has been attributed to respiratory ailments. The base material used to manufacture this unique insulation product is 100% recycled

plastic of the kind used widely to produce bottles (polyethylene terephthalate). As a secondary benefit, RTICA® offers a welcome solution to a growing Solid Waste Management problem.

Manufacturing here includes not only the product but also its packaging. The way in which it is used and disposed of by the consumer also impacts the environment. A number of companies worldwide are substituting conventional packaging with more environmentally benign materials, improving productivity. In some cases this has led to whole new delivery systems being created with incremental environmental and economic benefits being picked up along the product's life cycle.

Guidelines for 'Design for Environment' vary between different countries; however the focus here is on eco-friendly product design.

SONY has taken a number of initiatives to minimize environmental burden without compromising on quality by addressing various stages of a product's life cycle.

Design changes have been made in the materials used for the manufacturing of their modern TV sets. The theoretical result is that only 1% of the total weight of the product will have to be sent for disposal, the rest can be recycled. Design changes have reduced the number of materials used and all plastic parts are marked to facilitate recycling.

Air moulding technology has been used in the manufacture of the TV cabinet. As a result, the amount of plastic used has reduced drastically. An LCA to compare the air-moulded cabinet, a steel cabinet and a mixed material cabinet clearly shows advantages for the air-moulded model. It not only imposes a lower environmental burden but also has better mechanical qualities and lower production costs.

The disassembly time for this TV unit (time needed to dismantle the unit and sort components according to materials) has been drastically reduced. In fact due to snap and slide connections, the need for tools has been minimized and it can easily be opened by hand. Water based lacquers are now used in finishing the product. The remaining challenge is the sophistication of the recycling systems that exist in the receiving market. This is where the concepts of Extended Producer Responsibility affect the success of Sony's efforts.

A new line of loudspeaker cabinets has been made with recycled material (Tectan Tectan board is composed of paper (75 %), polyethylene (20 %) and aluminium (5%) - a material made from shredded and pressed Tetrapak cartons. Tetrapak is a composite package). A further benefit has been identified; this cabinet has better sound quality than that of similar boxes made of conventional material.

As part of its product stewardship initiatives, in Germany a "take back" label is part of every SONY monitor sold since March 1996. When the monitor is to be disposed of, the customer sticks the label on the product and returns it to one of the 800 take-back points. In cooperation with Rethmann Electrorecycling GmbH, SONY guarantees that the monitor will be dismantled and recycled in an environmentally sound way. Thus LCA to eco-design can be a very feasible and sound route both environmentally and business-wise.

Product manufacturers can leverage this information from LCA activities into DfE opportunities. One of the avenues for incorporating the principles of DfE is to buy safer and more environmentally benign materials. This is where Green Purchasing comes into the Green Productivity framework.

Green Purchasing

In the past you may have unwittingly increased your costs and environment risk by bringing a problem into your company at the point of purchase. It is not uncommon to overlook environmental problems that are entrenched in design. Sometimes when products with improved environmental performance are available, they are not selected due to a higher purchase price. The price is a visible number and decisions are often made in this way. It is important, however, to find out the true cost of using the product. **Price does not equal cost**, do not be fooled by a lower purchase price. You may be adding to your costs significantly without realizing it.

Green Purchasing opportunities exist at two levels:

- establish corporate procurement policies that support the use of raw materials goods and services that are more eco-friendly.
- foster consumer purchases to demand more sustainable goods and services. Green Purchasing is an important front-line tool for Green Productivity.

Why? Consider:

- 55% of all revenue goes to suppliers for goods and services;
- the range is 30% for services, as high as 90% for assembly;
- typically 41% of spending goes through purchasing BUT
- 59% are decisions made without the benefit of a purchasing professional;
- 70% of the cost, both financial and environmental, is in design.⁷

These statistics indicate two opportunities.

One – the need for a systems approach, which will be discussed in Chapter 5.

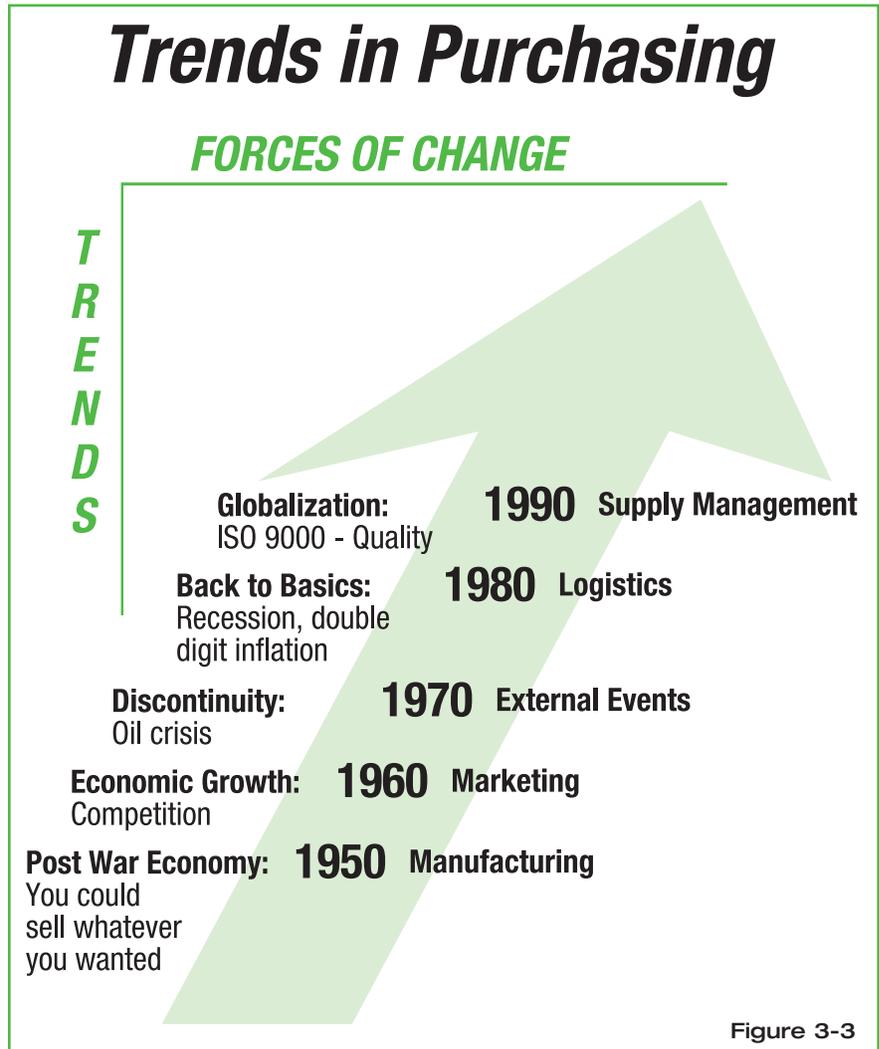
Two – the potential for significant savings when Green Productivity is applied to the purchasing process.

Using the power of Green Purchasing, priority is given to the acquisition of products and materials that reduce loading on the environment. This is in addition to the normal considerations of cost, supply, technology, quality, health & safety, and supply & delivery. As discussed in the section on Life Cycle Assessment, the impact of Green Purchasing and LCA has far reaching implications along the supply chain, especially for SMEs. If you are a small business owner, you are not excluded from this opportunity - the tools and techniques under the umbrella of Green Productivity can be applied at your level. However, it is advisable to develop your own understanding now before the pressure to provide goods and services that are environmentally friendly takes priority. It may take a smaller company longer to get switched over because of time and other resource restrictions.

Price ≠ Cost

Discussion – the World of Purchasing has undertaken a parallel change. In the 1950s, the purchaser's role was to execute requisitions in a market that was hungry to buy in a world of isolated economies, focused on rebuilding business after wartime. Decisions within an organization were made in each department; purchasing was a clerical job in a department. In the 1960s, competition for purchasing dollars began and marketing to win a customer's favour grew (so did golf). In the 1970s, 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 1980s, 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 1980s and into the 1990s there was the realization that quality was the ticket to a growing international marketplace, and a venue for managing suppliers to achieve a value-added product. Figure 3-3 shows the trends in purchasing from the '50s up to the start of the '90s.

Japan in particular has taken great strides in Green Purchasing. A Green Purchasing Network was organized in Japan in 1996. By 1998 there were one thousand firms, local governments and NGOs participating in this network. Europe and the US saw emergence of such networks in the late 1980s and 1990s. The potential benefits of Green Purchasing are still underutilized in all regions.



While isolated concerns for environmental goods and services started in the mid 1980s with the Blue Angel® process, followed by the Canadian Ecologo program, interest in Green Purchasing did not really start until the early 1990s.

GREEN PROCUREMENT CAME IN THROUGH THE BACK DOOR

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 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 program 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.⁹ However, waste diversion became the backdrop to the initial focus of Green Purchasing in governments and industry, which specifically targeted packaging, but this has a limited return despite all the valiant efforts and energies applied.

Typically a purchaser, usually a junior person, was called upon by an engineer from production assigned with the task of waste diversion. The purchaser would be asked 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 Life Cycle Assessment, 70% of the real opportunity for cost savings and the related environmental benefits come in design. Therefore, at most the purchaser could only potentially recoup 30%. Experience has shown that this is unlikely to occur except in rare situations as the package material, treated as a waste, conceptually and in practice has minimal, no or negative 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 (Elkington, 1998). Many green procurement attempts never gained momentum or returned full value as isolated policies and the environmental departments developed programs without soliciting the expertise and support of the purchasing department (OECD, 1998). These programs focused on promotional activities but outcomes showed little or no result. It was hard to determine any real value gained, as often there was no measurement of the improvement, be it qualitative or quantitative.

Green Purchasing today is still under development and faces a number of barriers. Organizations that fix on price as the key determinant of the purchasing decision, focusing their efforts for environmental improvements to end-of-pipe options, effectively limit their opportunity for real improvement. The tendency in these organizations is to apply narrowly defined environmental criteria to a selection of products or services, and label it as Green Purchasing. This is an unsophisticated approach, as it restricts the opportunity to leverage purchasing as a mechanism for attaining sustainability.

JUSCO, the largest retail chain in Japan, served as a board member on this network. JUSCO has established three major principles in Green Purchasing.

The first emphasizes the importance of the product life cycle. A product is bought only after considering its cumulative environmental load through its life cycle. The second principle is to assess adoption of Green Purchasing policies so as to select products manufactured and distributed by corporations with an active interest in environmental protection. The third is to gather and apply environmental information to evaluate products, manufacturers and distributors. These three principles form the outline of an important strategy – in essence JUSCO developed a systematic approach. It reinforces life cycle benefits, and a ready market based on common green qualities.

Green Purchasing includes business and government initiatives to make consumption patterns sustainable. Green Productivity can also trigger citizen initiatives, which will in turn, have a positive impact on greening the supply chain.

#1: In Mumbai, India over sixteen thousand households now belong to the Mumbai Grahak Panchayat, which operates a collective purchasing system. It provides good quality foods and other products at a competitive price. It provides its members with a fair and efficient system of consumption. The system also benefits local producers. It provides an incentive for sustainably produced food, traffic reductions, cutting of waste through re-use of cloth bags, and by exercising restraint in impulse buying.

#2: In Japan, the Nippon Ecology Network operates a weekly organic food home delivery service for over twenty-five thousand households. Recently the Green Purchasing Network has brought together over one thousand companies, public authorities and citizen groups to promote the choice of sustainable goods and services across Japan.

Green consumerism is a form of Green Purchasing that can create a market demand for eco-friendly products, as discussed in Chapter 2. Green consumerism can “push” producers towards eco-design, resulting in environmental improvements in manufacturing. Producers in turn push green criteria onto their suppliers in their procurement requirements. As a result the entire supply chain becomes involved. As you move up from simple housekeeping techniques to design of environmentally compatible products, the cost of implementing the technique rises correspondingly. So do the returns.

Implementing simple techniques like housekeeping, rationalization of operations, reuse, and recycling in most cases are easy tasks. Moreover, it is possible to implement these techniques in a fairly short period of time with relatively low capital investment. Each technique can bring about incremental improvements, although some increments might be more significant than the others. These techniques are applied in combination and rarely in isolation.

Sometimes moving directly to Design for Environment may result in a complete change of product lines resulting in substantial benefits. When environmental and productivity attributes are already incorporated in the product development process, the potential for environment and financial benefit has wider application. In this situation, the cost and the level of effort required for DfE would be rather high and the time schedules also could be longer. This is an example of the domino effect – one action precipitates a chain of activities. Managing this chain reaction to achieve both environmental and bottom-line improvements is worth a separate discussion.

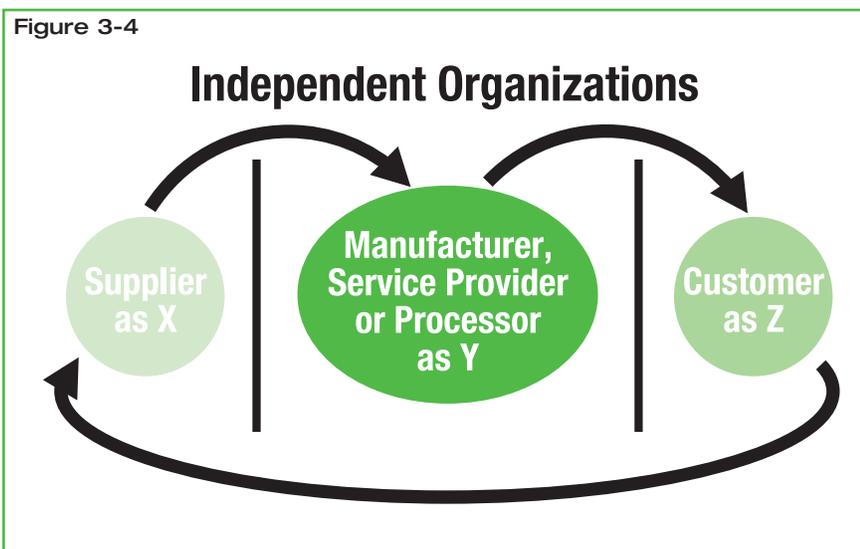
Supply Chain Management

Managing cooperatively along a supply chain offers each of the stakeholders involved the potential to occupy a unique market niche and to share in cost savings. This can include companies, consumers, the community and others. Green Productivity encourages this approach as a means to realize significant resource savings not just in one of the players but along the whole supply chain. Cooperative competition can be proven to add value and reduce costs for those involved. There is good reason to involve other organizations in your GP effort.

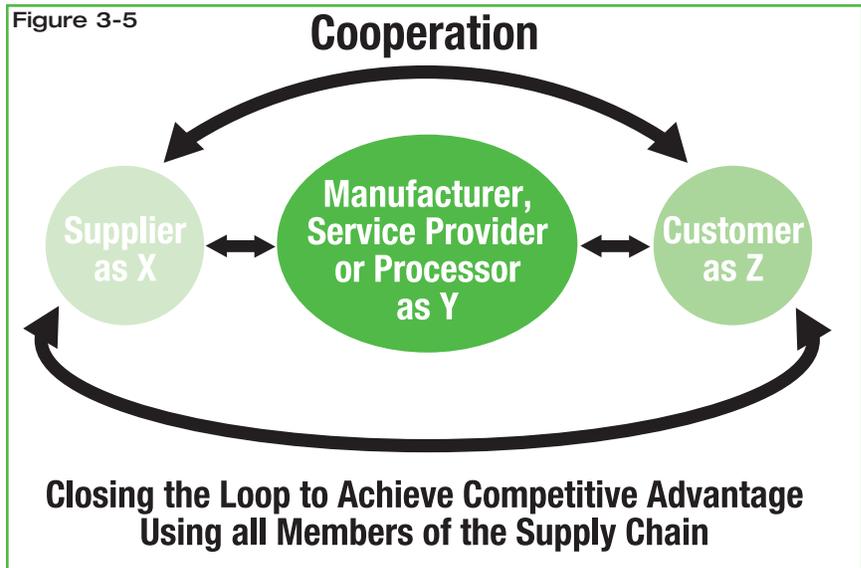
In the environment, the barriers are not limited to those within an organization. They exist along the supply chain as part of a system or closed looped process. Decisions made lead to actions required upstream and downstream of an organization. It is difficult, if not impossible, to attain the full system benefits in isolation.

Co-operation can be shown to add value mathematically. As shown in Figure 3-4, if each organization operates in isolation, the maximum benefit is the sum of three distinct efforts, as: $X + Y + Z = \text{Results}$. In the case where X, Y, and Z have the same value, 9, the total benefit is 27. In the case where the values were not the same, where $X = 5$, $Y = 7$ and $Z = 9$, the maximum benefit is 21.

Figure 3-4



However, if the three entities leverage their respective resources within the system, the results shift to provide a product or an exponential return. Co-operation does add value as shown in Figure 3-5.



XYZ, carrying the respective values of 5, 7, 9 would now result in 315. Where the entities are equal, each carrying a value of 9, it would bring a return of 729, a 231% increase. The quantitative benefits of co-operation are clear.

Despite its value, supply chain management's history has not shown as much success with its implementation as you might expect.

Why? The failures are attributable to:

- Fragmentation in the way supply chain management is understood and applied;
- Failure of companies to develop true integration of the processes used to achieve supply chain management;
- Organizational resistance to the concept;
- Lack of buy-in by many top corporate managers;
- Lack and/or slow development of needed measurement systems;
- Lack of good and sufficient information, including integrated information systems and electronic commerce linking firms in the supply chain; and
- Failure of supply management thinking to push beyond the boundaries of individual companies.

In the case of the supply chain management and the environment, the potential returns and rewards are even higher. This is especially true when they are factored in with some of the other tools and opportunities that Green Productivity offers. Probably the best example of where cooperation for resource management has been

implemented along a supply chain is in Kalundburg, Denmark. While the example focuses on the supply chain aspect, Kalundburg demonstrates the value of Green Productivity on an industrial park basis.

What are the tips that Kalundburg¹⁰ shares for creating success among the players of a supply chain?

- All contracts were negotiated on a bilateral basis.
- Each contract resulted from the conclusion by the companies involved that the project would be economically attractive.
- Opportunities not within a company's core business, no matter how environmentally attractive, were not acted upon.
- Each partner did its best to ensure that risks were minimized (and continue to do so).
- Each company evaluated their own deals independently. There was no system-wide evaluation of performance. They all seemed to feel this would be difficult to achieve.

There are several conditions that are desirable for a similar web of exchanges to develop:

- Industries must be different and yet must fit with each other.
- Arrangements must be commercially sound and profitable.
- Development must be voluntary, in close collaboration with regulatory agencies.
- A short physical distance between the partners is necessary for economy of transportation (with heat and some materials).
- At Kalundborg, the managers at different plants all knew each other.

Knowing who the partners are helps overcome any inter-company challenges that may exist. It allows the players to build trust, an essential quality in any business arrangement striving to become sustainable.

Profitability Analysis

The costs incurred and the benefits accrued to an organization in adopting the Green Productivity framework must be measurable. Profitability Analysis is a common metric used to measure performance. It is also an appropriate tool for evaluating the impacts of Green Productivity on an organization's performance.

Quantification using Multi-factor Productivity is useful in indicating changes in productivity over a given period. It is also a useful tool for analyzing these changes. The inputs provided and outputs obtained must be assessed using a common measure. Measurement of productivity is based upon separately measuring outputs and inputs to calculate the ratio. A common measure of productivity is the monetary unit or value of outputs over a given period. This measure is used as there are different types of outputs produced. Inputs can consist of labor and capital as well as intermediate inputs such as raw materials, semi-finished products, etc.

While in economic terms environmental criteria are often categorized as intangibles, there are tangibles affiliated with them. For example, when the water quality is so bad that people become ill and cannot work, or die (as in the case of Walkerton, Ontario, Canada) the results are quite tangible.

Money as a common measure is the basis for Profitability Analysis. It provides you with the bottom line. In the Green Productivity framework Profitability Analysis is useful in two ways: (i) to determine the feasibility of options to be implemented and (ii) to evaluate the effectiveness of implemented options on the overall performance of the organization.

Profitability Analysis typically uses the three financial indicators:

- Simple Payback
- Net Present Value (NPV)
- Internal Rate of Return (IRR)

Conventional Profitability Analysis does not consider environmental costs and benefits, as many of them are considered intangible.

In the GP framework, inclusion of measurable environmental costs is advocated. Use of supportive tools like Total Cost Accounting can be made to enable a comprehensive Profitability Analysis.

Total Cost Assessment

Total Cost Assessment (TCA) is used to quantify projects using environmental cost data, appropriate time horizons and standard financial indicators. TCA is a comprehensive method for analyzing costs and benefits of a program for pollution prevention or eco-design project. It includes:

- full cost accounting, which is a managerial accounting method that assigns both direct and indirect costs to specific products,
- estimates of both short and long-term direct, indirect or hidden liability and less tangible costs, and
- costs projected over a long horizon such as 10-15 years.

It is acknowledged that the time frame here is long, much longer than the horizon normally considered by SMEs.

TCA is an approach to remove potentially unwarranted and misleading financial barriers to pollution prevention and other environmental investments. It assists in developing comprehensive financial analysis of the true profitability of an investment. TCA differs from conventional project analysis methods in four ways.

1. The inventory of costs, savings, and revenues includes indirect; which are less tangible items typically omitted from project analysis (such as compliance, training, testing, liability, product and corporate image).
2. Costs and savings are directly allocated to specific processes and product lines instead of being pooled in overhead accounts.
3. Time horizons for calculating profitability are extended to capture longer-term benefits.

4. Profitability indicators capable of incorporating the time value of money and long-term costs and savings are used.

Such tools¹¹ will ensure that the inventory of costs, savings, and revenues of less tangible items typically omitted from project analysis, (compliance, training, testing, liability, product and corporate image) are also included.

Manifold Benefits of Green Productivity

Implementing Green Productivity will have both immediate and long-term benefits. The benefits accrue to producers, as well as consumers and include increased efficiency gains in resource use, lower cost of production, decreased costs of waste treatment and disposal.

Green Productivity can benefit your business by reducing your operational costs, lowering environmental compliance costs and preventing the generation of waste through efficient resource utilization. These actions can also reduce or eliminate long-term liabilities and clean-up costs. Furthermore, disposal costs are reduced when the volume of waste is decreased.

Green Productivity can also provide your business with competitive advantage. It can increase productivity growth rates, as a result of which, market share and profitability will increase.

The shift towards integrating environment and productivity enabled by Green Productivity has much greater implications for businesses in developing economies due to their technological and resource constraints. With increased globalization pushing a one-world market situation, pressures on these businesses have intensified. They have to meet international expectations, as indicated in Chapters 1 and 2. The consequences of these trends have been more intensive on SMEs. This fact is being recognized by policy organizations, but few have taken action that is appropriate to the needs of the smaller businesses. APO has a special focus and program track to assist SMEs, which is discussed in Chapter 6.

Workers will benefit from Green Productivity. It justifies wage increases, as well as improving health and safety in the workplace. In addition, there are benefits of Green Productivity that transcends normal business relationships in the form of goodwill. Just as pollution is a negative aspect of anyone's business operations that does not respect political boundaries, improvements derived from Green Productivity can spill over into the community in which you operate, creating a positive aspect. In some cultures, this action is purposefully done. The mindset that accompanies this change is considered new age thinking and signifies a transformation in how business is being conducted. This new age thinking is fundamental to the third transition referred to in Chapter 1. While some may view this recognition as an intangible, it may be the deciding factor in your favour in:

- a new business venture,
- an approval process for a government body or
- a consumer's decision to buy your product or service over a competitor.

Do not underestimate its value.

Policy makers, economists and environmentalists will start to show support for this form of growth when they believe that economic expansion can occur in a sustainable manner. While the transition is unlikely to be smooth, Green Productivity is an essential approach forming an integral part of the broader sustainable development agenda. It will help move society towards sustainable production and consumption. GP makes good business sense.

Organization of the Techniques **– the ‘how to’ of Green Productivity**

The Green Productivity Techniques have been categorized as follows:

- Training and Awareness
- Awareness Programs
- Design of Adult Learning
- Industrial Field Trips
- Waste Prevention
 - Improved Operating Procedures
 - Waste Segregation
 - Good Housekeeping
 - 5S Program
 - 7 Wastes
- Resource Conservation
 - Recycle, Reuse & Recovery
 - *Off-site recycling*
 - *On-site Recycling*
 - Energy Conservation
 - Process Modification
 - Input Material Changes
 - Process / Equipment Changes
- Management of Waste
 - Air Emission Control
 - Effluent Pollution Control
 - Solid Waste Management
- Product Improvement
 - Design for Environment

Training and Awareness

Training and awareness programs are a pre-requisite to the introduction of any new improvement program. Building awareness through training is a good vehicle to merge Green Productivity into your daily business processes with the aim of becoming more competitive. This can be in a formal process, as in structured sessions held at a recognized educational institute, it can be provided by professional trainers in a tailor made program for your organization, or provided under the auspices of a government body.¹² Alternatively, awareness training may take on a more informal approach. You may opt to take on the role of a coach, adding a discussion about Green Productivity options as part of your normal meeting process.

To start building awareness within your company it is important to know:

- why is a new program needed?
- what are its benefits?
- is it feasible and relevant for your organization?
- will it help in tackling the issues that your organization is facing in terms of productivity and environmental protection?

Learning programs to support the start of Green Productivity within an organization can start with simple pollution awareness seminars, where managers and employees are asked to identify the ways of reducing the generation of waste. Or they can be complex programs that are independently staffed by corporate personnel. In the latter case, they may be part of a worldwide corporate program.

Regardless of the venue chosen, the employee plays a vital role. A successful campaign to reduce the quantity of waste generated must incorporate an effective employee-training program. To meet the goal of waste reduction, employees need to understand not only how to detect spills, leaks, and releases of material, but to learn how to avoid creating waste in the handling process as early on as possible.

Process operators and maintenance personnel may benefit from additional training to stress Waste Prevention and reduction methods. Identify your organization's training needs to ensure that the right people get exposed to the right information.

What are your training needs? Do you want to design and conduct your own training program? These simple five steps can help you.

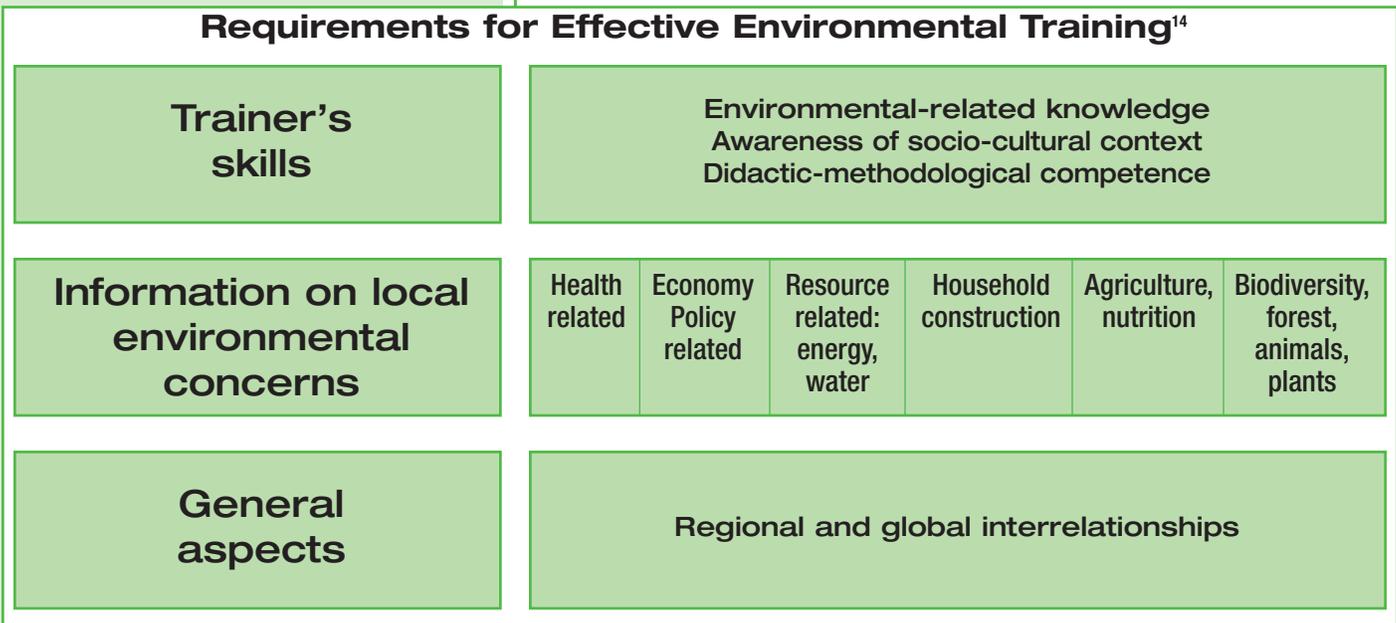
1. Conduct a needs analysis.
2. Set objectives. (Refer to what it is you are trying to accomplish for your Green Productivity option.)
3. Design the program (content, format, logistics, timing, duration, etc.).¹³
4. Implement the program.
5. Evaluate the training program against your objectives.

Awareness Programs

Environmental education has been in existence for about twenty-five years. The themes chosen for building awareness tend to reflect the predominant issues and ideas of the time. It cannot be emphasized enough that the trainers have an understanding of the culture for which the training is being developed. This may be culture on a macro scale (i.e. the culture issues affiliated with the Asian region versus those in Western countries). Or it may be the specific culture of one organization versus another. The program designer and the trainer (who may be the same person) must embed the awareness topics in the socio-cultural context, and even better, be guided by this context.

Why? The employee's interest to act more responsibly towards the environment and in support of Green Productivity will be stronger if the awareness theme corresponds to the real challenges of everyday life that he or she faces. A primary difference between the context that a person living in most Western cultures and one living in Asia is the level of risk that Asians face from natural disaster (as noted in Chapter 1). This factor changes the perspective of the person learning and often trainers from Western cultures underestimate the repercussions this has on the Asian employee's outlook.

Figure 3-6



Design of Adult Learning

Traditional teaching methods tend to be based on a one-sided flow concept. The professional trainer or professor gives information in a lecture format to transfer knowledge from the expert to the novice. However, there is a growing interest in developing learning programs that are based on Adult Learning techniques. In these the employee's learning preferences are included in the program design.

The purpose of this section is not to make you a specialist in the design and delivery of Adult Learning. These few tips can substantially increase the returns and rewards of learning. Whether you are trying to:

- develop a learning program,
- evaluate a proposal from a training company, or
- maximize what the learner wants to retain from a learning opportunity.

There are three components to Adult Learning: knowledge, skill development and attitude. Effective Adult Learning should include all three components to be successful.

Soliciting input from employees is simple enough to do.¹⁵ If you are not controlling the design of the training program, you can still determine what your own personal learning goals are using the information in this section. Share them with your boss or the trainer hired to lead a session on Green Productivity.

Design your own Green Productivity learning program. Start by conducting a needs assessment.

What information do you or your employees need to know to improve their job performance by incorporating Green Productivity? Is there a skill required? Do you have it or need to acquire it? Does this change require a new perspective? A reason to make it important so that it will be adopted?

What additional information or skill would you or your employees like to have to incorporate environmentally sound practices in your daily tasks? How will these efforts to incorporate change be supported?

Some environmental awareness programs include information on how to change habits at home or outside the workplace to enhance environmental quality. This is a cultural context issue. If appropriate to your culture it may elevate your reputation in the community.

Keep in mind:

1. Who is the program being designed for? Target your audience. Be specific in identifying what their current knowledge is and what needs and wants they have.
2. Why is the program being implemented? Is it for a specific Green Productivity option, or a broader awareness issue? Define your objectives clearly and simply.
3. How is the program going to be implemented? Outline the content of the program and the time assignments for each component.
4. Where and when will you hold the training program? Will it be during office hours? During evenings or weekends? Will it be in your building, at a training center, at a hotel or a special facility with a particular landscape feature? Will it be provided on-line?
5. How will you evaluate your learning? Decide what criteria are important in the design phase.

Nominal Group Technique (NGT) is a fast way of ranking ideas to overcome some of the social biases of the group. It can be used in the design of Adult Learning or in Brainstorming sessions.

Learning should be connected to an understanding of the system in which you operate. Deming's System of Profound Knowledge discussed in Chapter 5 builds on the benefits gained from Adult Learning.

Evaluation is an important part of the training process as it can:

- Prove that you have accomplished what you set out to do
- Assist you in getting further funding (if this is a consideration)
- Help to associate you and the learners with the improvements in Green Productivity that result (and can lead to recognition)
- Demonstrate what was successful and what needed improvement in the design and facilitation of your program
- Give you important information and feedback for redesigning the program
- Give you a basis for reporting your success to your organization, the community and others, as appropriate

The real success of a learning program is proven when the new behaviours are retained, based on new knowledge, skills and attitude. Environmental results are sometimes harder to track where their effects spread far beyond the corporate wall. Training is not the only option. There are other tools in the Green Productivity framework that can help foster success.

Industrial Field Visits

“Seeing is believing”. There are some key benefits to visiting other organizations as part of a learning experience. The first is to have an exchange with another business, which has already implemented Green Productivity. This opportunity allows top management and staff to see Green Productivity in action. Success is a strong attractor and motivator. At the same time, an industrial visit can also show you what not to do. Learning from the mistakes of others can be a very cost-effective learning tool.

An Industrial Field Visit is not a random social call. It should be planned. You need to structure this event to capture information and insight. In your preparations, try to find an industry within your sector, similar in size and nature to your operations, where Green Productivity¹⁶ has been implemented successfully.

Tips to help you prepare for an Industrial Field Visit.

- Make sure that the people going on the field tour understand the purpose of the visit. Ensure they understand any boundaries. While exchanges of this nature are a good way to learn, other organizations can be sensitive to the exposure that it brings. If there is the chance to ask questions of the host organization, it is helpful to pose the questions in a positive manner. This way the host is more likely to let you know where the real challenges are. Asian society holds politeness in high regard. Politeness can overshadow information about a root cause of an issue, or prevent discussion about ongoing challenges to which the host has not yet found an answer.

- A visit is an opportunity for an exchange. Information should be two-way. What insight or unique experience can you offer to the host?
- Prepare your employees by letting them know what you want them to look for. Encourage them to share their ideas on how to improve their work performance.

Questions to consider:

- Did the organization you visited have a management system in place before Green Productivity was initiated? If yes, how was it integrated with Green Productivity? What were the drivers?
- What was the composition of the team that implemented Green Productivity? How did this relate to their size and organizational structure?
- What were the problems faced by the organization? Are these consistent to the industry sector? Is there an opportunity for continued industry dialogue to encourage problem solving?
- What method(s) were used to identify their problems? Did they define these problems as environmental, productivity or other?
- How were the Green Productivity options chosen?
- Were there difficulties in implementing these options? How were these overcome? What was the biggest barrier they faced?
- What were the results of their Green Productivity options in terms of the productivity and environmental improvements? What were the costs and benefits (direct and indirect)? What was the most important thing they learned?
- How is continuous improvement practiced?

Keep notes about what you found most useful and the least valuable from the tour. This information can prove useful when you assume the role of a host to demonstrate your Green Productivity success.

Waste Prevention

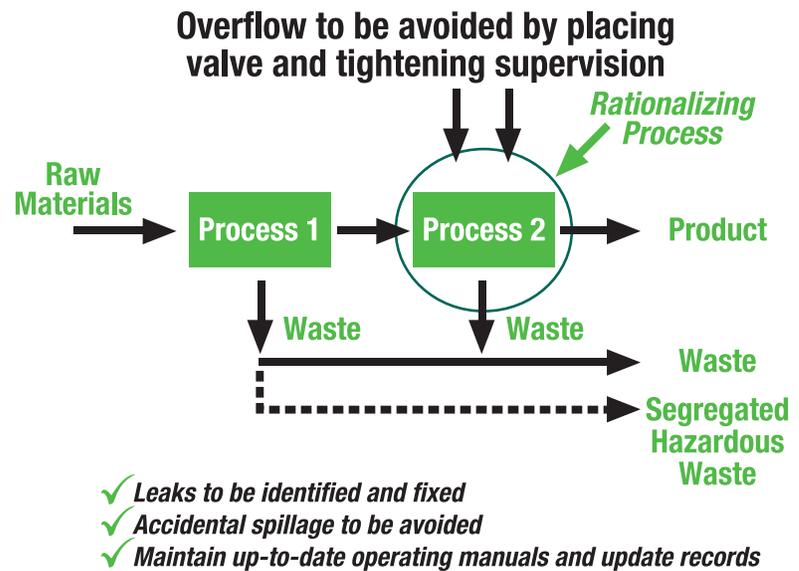
Waste Prevention covers activities such as Good Housekeeping, Improved Operating Procedures, Waste Segregation, the 5S Program and 7 Wastes.

Good Housekeeping

Good Housekeeping refers to a number of practical measures based on common sense. Organizations can undertake these measures to improve their productivity, obtain cost savings and reduce the environmental impact of their operations. An important statistic to consider is that adopting Good Housekeeping practices and making small operational changes can reduce up to 50% of the waste stream.¹⁷

Figure 3-7

Good Housekeeping to Reduce Waste Stream



Good Housekeeping is more of a habit than a technique.

Good Housekeeping is aimed at:

- Rationalizing the use of raw materials, water and energy inputs
- Reducing the volume or toxicity of waste, wastewater and emissions related to production
- Conserving material and energy
- Improving working conditions and occupational safety

The implementation of Good Housekeeping is relatively easy and the cost is usually low. Thus, they can be readily implemented by SMEs.

Good Housekeeping practices can provide a real economic asset and advantage for a company in terms of minimizing waste, raw material usage and energy. Minimizing waste can enable enterprises to reduce the loss of valuable material inputs and therefore reduce operational costs.

Soup Company Example

A training program that included the advantages of Good Housekeeping inspired a plant manager to share what he had learned with his team in the pouring room. With the help of the employees three actions were tabled to minimize product loss.

First - a rubber seal was added to the top of the huge copper cauldrons used to hold the soup during cooking. This reduced spillage caused by the stirring mechanism.

Second - by taking a little more time to pour product into the cans, further reductions in spillage occurred. Through these two actions the company realized more product for sale. The amount of product lost through daily carelessness was surprising to them.

Third – the plant manager installed a flow meter on the sewer to enable them to accurately measure and monitor how much product escaped into the sewers. Armed with these facts the plant manager was able to re-negotiate a sewer charge imposed by the city as the volume of spillage had been substantially reduced.

The company was able to sell more product and reduce cost for a minimum investment in equipment, time and materials. There was also a cost savings from the reduced city charge. In total, the company gained a net benefit of about US\$750,000 for an initial cost of about US\$30,000, which included the training.

The President recognized the plant manager and his team for these improvements. Employee morale was elevated. It led to other departments trying to find new ways of improving. The city recognized the company for its environmental improvement.

Improved Operating Procedures to Standard Operating Procedures

Procedural aspects of a manufacturing operation include the management, organizational, and personnel functions of production. Improved operating practices can be implemented in all areas: production, maintenance, raw material, product, waste handling and storage. As good operating practices can often be implemented at a low cost, they usually have a high return on investment. Operating procedures should be clear and concise but not heavy in detail.

Material Handling and Storage

All production facilities store raw materials, intermediates, products, and industrial wastes. They transfer these items from one area of the plant to another. Proper material handling, transfer, and storage can minimize the possibility of spills, leaks, fire, explosion or any other losses that could result in waste. Companies have strong economic incentives to handle and store materials properly, as failure to do so can result in downtime, injuries, increased external scrutiny and higher costs due to the perception of higher risk. Increasingly, there are legal requirements that regulate the movement and storage of materials that are of a greater concern because of the risk associated with them. Often, small business operates in volumes or at levels that are not captured in legal requirements. The tendency in the smallest businesses may be to ignore the law, as it is not applicable at the small volumes used by micro-enterprise. However, even when regulations state volumes that exceed what your business may use, information and guidance contained in the law may be useful to identify materials society views as higher risk. This can lead to ideas on how to avoid problems.

Material and Energy Consumption

Industry and sector norms can be used to ensure that the consumption of resources and energy are within limits. Benchmarking allows a comparison with industry norms in a sector and enables the identification of deviations. When you or a member of your team is conducting an industrial field visit, this is a good time to observe operating procedures in another company. This information can be used to check your own performance and determine if improvement is a priority.

Scheduling Operation

Batch production of a variety of products using common equipment can be an important generator of wastes. Timing has a special significance in batch production operations, where the amount of waste from equipment cleanup is directly related to the cleaning frequency. To reduce cleaning frequency, batch sizes should be maximized. Alternatively, follow with a similar product that may not require cleaning between batches. This action requires diligent managerial scheduling and planning as it may affect inventories of raw materials, finished products, and shipping deliveries.

Philipinas Kao, Inc. manufactures chemicals and chemical products such as fatty alcohol methyl ester, refined glycerine, tertiary amines, alkanolamides and surfactants, monoalkyl phosphates.

The company identified that glycerine loss from the process contributed to high chemical oxygen demand (COD) of wastewater. Philipinas Kao's engineers, with the help of Japanese engineers, organized a team to analyze and evaluate the existing operating parameters of the glycerine process. This revealed a substantial deviation between the actual and design operating conditions of this process.

Through constant monitoring, Philipinas Kao was able to optimize operating conditions of the glycerine process.

This led to increases in productivity by reduction of glycerine loss by 32%. Daily glycerine yield increased by 5%. That is an additional 6 kilograms everyday.

Prevention of glycerine loss at the source reduced chemical oxygen demand (COD) of wastewater.

The benefits realized along with the economic value included increased glycerine recovery generated (P32, 000). Savings on chemical treatment costs amounted to P1600000.

Waste Segregation

Waste Segregation refers to the separation of waste streams according to points of generation, composition, volume or media, which may be beneficial when considering options related to management, recyclability, treatment and disposal.

Segregation at the source can reduce the quantity of hazardous wastes. When a non-hazardous waste is mixed with hazardous waste, the entire mixture is classified as

hazardous. Keeping them separate reduces the amount of hazardous waste. This can yield substantial savings. It is easy to understand that not allowing hazardous and non-hazardous wastes to mix is a better idea. Furthermore, isolating hazardous waste by contaminant (i.e. by segregating wastes) often reduces disposal requirements and increases cost control.

Incompatible hazardous waste types should not be mixed. Why? First, the obvious reason may be that they are chemically reactive when combined. Second, segregating spent solvents from cleaning metal parts and used motor oil fosters the reclamation of each, again with the potential for cost savings.

Waste Segregation has other benefits. For example, it facilitates end-of-pipe treatment of materials of diverse composition. It also increases the possibility of recycling or reusing materials. Materials that are pulled out of a waste stream are usually assigned a higher value. Segregation does have some challenges. It may require an increase in storage space. It may necessitate special storage conditions to retain the value of the material until it is reused. This can lead to higher capital and operating costs for waste transportation and storage. A good understanding of the benefits and costs is important to decide on the best course of action. A flowchart of the process can also be used to investigate whether this material is necessary or if diversion at an earlier point in the process can increase its value. Revisiting the manufacturing process periodically using a flowchart can identify places where changes have occurred. This may enable the removal of a now non-essential piece of equipment. It is also a good idea to talk to the market to which you wish to sell. Is the material in a form that they can use? Do they have quality specifications? Do they have volume requirements that you need to meet? If you have lower volumes than the market normally accepts, can you find someone else to consolidate with to meet the purchasers' minimum volume? Some jurisdictions have started waste exchanges. Companies can post what they wish to market and thereby avoid the cost of disposal. By definition, waste has no value. These are really material exchanges. It is unfortunate that the term waste exchange has caught on. This can create the perception in the mind of the seller or the purchaser that proper management of these materials can be ignored. When this happens, inappropriate handling or improper storage can lower the value of the material. The term waste becomes a self-fulfilling prophecy.

Normally, due to increased recyclability and better treatment or disposal, the benefits outweigh the initial investments incurred for segregating waste streams.

5S Techniques

The 5S are a set of management techniques that focus on maintaining processes, equipment, workplaces and people in the way they should be – organized, neat, clean, standard and disciplined.¹⁸

Seiri

In general terms this step means establishing order - sorting out what is necessary and dispose of those items that are unnecessary. Organization should be accomplished in accordance with specific rules or principles. The emphasis here is on stratification management. Deal with causes to get rid of unnecessary items. Eliminate the cause or source before it becomes a problem.

Seiton

Seiton means arranging necessary things in a systematic manner. The order should be logical to the user. This means having things in the right places or the right layout so that they can be used in a hurry. It is a way of eliminating searches.

Seiton categorizes items into actions as:

- Not used – discard (note this does not mean disposal – finding a new home for an item is a more profitable solution than sending it to waste)
- Not used but valuable to keep on hand – store as a contingency item
- Used infrequently – store someplace remote
- Used sometimes – store in workplace
- Used frequently – store in an easy to reach area or keep it on you

Seiso

This means cleaning and inspection. This step ensures that items can be kept clean and in good functional order so that they are ready when required. Get rid of dirt, grime and foreign matter. Cleaning and keeping things clean is becoming more important to ensure quality standards are met or exceeded. In some industries, clean is critical in order to maintain precision and finer processing requirements where the minutest variance in detail can have vital ramifications. Achieving zero tolerance should be the prime objective.

Seiketsu

Seiketsu means improvement and standardization. This process is continually repeated until the required standard is achieved. The emphasis here is on visual and colour management.

Shitsuke

Shitsuke means self-discipline and doing that which is important as a habit. By teaching everyone what needs to be done and having everyone practice, bad habits are broken and good habits are formed. Green Productivity needs to become Shitsuke.

TECHNIQUE	MEANING	AIMS	ACTIVITIES	PRINCIPLES
Seiri (Organization)	Distinguish between what is necessary and get rid of what you do not need.	<ul style="list-style-type: none"> • Establish criteria and stick to them to eliminate the unnecessary • Practice stratification management to set priorities • Be able to deal with the root cause of filth 	<ul style="list-style-type: none"> • Eliminate the unnecessary • Deal with the cause of filth • KAIZEN and standardization based on fundamentals 	Stratification management and dealing with the root causes.
Seiton (Neatness)	Establish a neat layout so you can always get just what you need, in the right amount, when you need it.	<ul style="list-style-type: none"> • A neat looking work place • Efficient layout and placement (including quality and safety considerations) 	<ul style="list-style-type: none"> • Functional storage based upon the 5Ss & Good Housekeeping • Practice and compete in putting things away and getting them out • Tidy workplace and equipment • Eliminate the waste of time when looking for things 	Functional storage and eliminate the need to look for things.
Seiso (Cleaning)	Eliminate trash, filth and foreign matter for a clean workplace. Clean as a form of inspection.	<ul style="list-style-type: none"> • A degree of cleanliness commensurate to your needs • Achieve zero grime and dirt • Find minor problems with cleaning inspections • Understand cleaning is inspecting 	<ul style="list-style-type: none"> • 5Ss where it counts • More efficient cleaning • Cleaning and inspection of equipment and tools 	Cleaning as a form of inspection and noting degrees of cleanliness.

TECHNIQUE	MEANING	AIMS	ACTIVITIES	PRINCIPLES
Seiketsu (Standardization)	Keep things organized, neat and clean, even in personal and pollution related aspects.	<ul style="list-style-type: none"> • Management standards for maintaining the 5Ss • Innovative visible and colour management so that abnormalities are easy to see 	<ul style="list-style-type: none"> • Innovative visible management • Early detection and early action • Tools, including manuals to record standard operating procedures 	Visual management and 5S standardization.
Shitsuke (Self-discipline)	Train and the ability to do the necessary things even when it is difficult.	<ul style="list-style-type: none"> • To cultivate good working habits in the workplace among the employees • To constantly practice the previous 4Ss without being told to by management 	<ul style="list-style-type: none"> • Train and learn new things to improve the workplace, including the environment, health and safety • Practice good 5S habits daily 	Maintenance of 5S at the workplace autonomously.

7 Wastes

It is common for people to think of waste as having a physical presence – such as materials, water, electricity, etc. Early approaches to waste management using quality philosophy started to re-orient people’s thinking about what waste really was, and what it wasn’t. Reuse, recycling and recovery activities were undermined by a mindset that held that materials could be thrown away after their primary use. This affected handling procedures, adding cost and lowering the quality and usability for the ensuing process. However, in the context of Green Productivity, waste is defined as: **Any form of work that does not add value to the final output!**

In the famous Toyota Production System, wastes have been specially defined as 7 Wastes to include things like excessive stocks, waiting, movement or transport, etc.

1. Waiting

This is one form of waste that is very familiar. You encounter it everywhere. For example:

- Waiting for a machine that has broken down
- Delay in arrival of materials
- Somebody is late for a meeting
- Waiting for a return call on information
- Waiting for computer systems to respond, the line-up at a shared printer

The causes of such waste are often bad planning, bad organization, lack of proper training, lack of control, sometimes laziness or lack of discipline.

In some cultures, it is normal to wait for people for up to an hour to show for a meeting. The longer the wait, the higher they are in importance. While this is not generally the case in Asian business practices, if you are involved in business discussions with some of the Latin American countries waiting is a cultural norm. You can avoid the frustration by planning for it and putting the time to good use. Bring an article to read, share a new experience or discuss ideas about Green Productivity during that time. Time is truly the most non-renewable resource.

What can you do when you are constantly interrupted with problems from the shop floor? A Western executive complained that he was always behind schedule as he was constantly disturbed to resolve problems arising on the shop floor. The executive was asked to account for how much time he was losing – about an hour a day. It was suggested that he schedule ninety minutes a day for chaos – to plan for the disruptions and revise his schedule to reflect this. Instead of being behind, he ended up getting his work done on time. He spent any additional or ‘found’ time to help his staff learn how to solve more problems on their own.

2. Transporting

This is another common form of waste. Handling costs and the potential for damage increases when transporting or moving things from one place to another. This does not add to the value of the product. In fact with some materials, every time it is touched there is a reduction in value. Hence transporting should be eliminated or reduced as much as possible. There are two aspects to be considered.

One, eliminate the need for movement by designing a better layout.

Two, improve the method of transport by using appropriate material handling equipment.

The issue of transportation need not relate to distance. Its impacts can be felt in a small office; a warehouse; from one location to another on-site; across a city or around the world.

Consideration of the timing involved in transportation may lead to improvements. Think about the number of people in the world and the bottlenecks or gridlock that can occur at peak travel flows. Changing the time of the transportation can result in energy reduction and lower risk of accidents. Thinking through the opportunity can be done with simple tools, paper and a pencil. This is also the intention behind route optimization software - to provide real time access to the path of least restriction. Another transportation consideration is weather. One of the challenges of Climate Change is the increased unpredictability and volatility of weather that can further hamper transportation. The Asian business culture is arguably better prepared to respond to the consequences of Climate Change than Western society given the Asian's experience with natural disaster.

3. Processing

These are wastes inherent in the process or design. For example:

- An electronic typewriter has fewer parts and processes than a mechanical typewriter.
- Replacing a metal dustbin with a plastic one can reduce several steps in the production process.
- Using pre-printed forms can save a lot of paperwork.

Periodic checking of a process may lead to ways to streamline and reduce costs.

4. Inventory

When excessive inventory is carried, valuable financial resources may be tied up. In addition, product quality may deteriorate with time. Inventory can also take up space in the factory, which could be used for better purposes. It may require energy to maintain the product, and security may be required to protect it.

5. Motion

All physical work can be broken down into basic motion. Motion Study is one aspect of industrial engineering that assists you in ways to reduce wasted motions. Usually this can be accomplished by:

- improving the workplace layout,
- practicing Good Housekeeping and workplace organization, and
- introducing jigs and fixtures and low cost automation.

6. Defects

Producing poor quality products and defective parts or bad service is another common form of waste. This includes time spent to rework poor quality products or addressing customer complaints. Space is wasted to store them. Last minute urgent requirements may disrupt your systems and cause delays in delivery to your customers. Sometimes poor quality can even cause accidents.

While the benefits of a systems approach will be discussed in Chapter 5, it is important to determine the root cause of defects. Is it in your process? Or is it caused by poor quality of raw materials? Defects in your product caused by poor quality inputs can be expensive and very frustrating. Substituting with greener products does not mean you should accept lower quality. Work with your purchasing department to make sure that you still get the quality you need to avoid problems. If you are the purchasing agent for your company, poor quality product may be resolved by changing suppliers. Sometimes explaining the problem to your supplier may show that the root cause is not poor quality but the wrong product for your intended purpose. Good communication is important.

7. Overproduction

Often in manufacturing, production exceeds more than what is actually needed (the printing industry typically has a 10% overrun). The unused products may have to be discarded when not required at a later stage. This can add substantially to cost, with

no addition of value. Over-production is caused by poor planning, poor forecasting, producing too early or lack of quality control.

Preventive and Productive Maintenance

In the changing times as more and more industries are going for hi-tech capital intensive and complex equipment, maintenance has a major role to play in the organization. The objective of maintenance is to achieve the desired quality, equipment performance and plant availability at an optimum cost. As machinery becomes older, maintenance becomes essential and requires a comprehensive program for preventive maintenance.

The plant or equipment availability depends on the following factors:

- Reliability
- Down time due to:
 - Off-line preventive maintenance
 - Corrective maintenance
 - Non-availability of resource
 - Non-availability of information

Reliability of the equipment essentially depends on the extent of preventive maintenance and the design, including durability of the parts used. Improvement in preventive maintenance practices and development of a suitable plan is vital for improving the reliability of the equipment.

Preventive maintenance comprises of the following activities:

- Cleaning
- Lubrication
- Inspection of protective coating
- Replacement of parts and overhauls

Maintenance techniques and systems, over the last two decades, have witnessed significant developments. They have progressively changed from the concept of breakdown maintenance to that of Fixed Time (Periodic) Preventive Maintenance, Condition Based Maintenance, Corrective Maintenance, Predictive Maintenance and Reliability Engineered Maintenance. Although each of these maintenance systems is quite powerful in their own right, singular applications have failed to produce the desired results in industries. Any program is always more powerful when it is tailored to the specific needs and culture of the company.

Total Productive Maintenance

Total Productive Maintenance (TPM)¹⁹ is a maintenance program where the goal is to markedly increase production while, at the same time, increase employee morale and job satisfaction. It mirrors many of the attributes of Total Quality Management (TQM) and Total Quality Environmental Management (TQEM) such as employee empowerment, benchmarking, documentation, and others.

Proper maintenance of equipment is as indispensable to Green Productivity as it is for productivity. It is not a non-profit activity. Top management right down to the line operator must understand that maintenance must be planned for and scheduled, not just slipped in when there is a break in material flow. The goal is to keep emergency and unscheduled maintenance to a minimum, thus achieving higher productivity.

The concept of 'productive maintenance' as a means to improve productivity is thought to have originated in General Electric, USA in 1954. In the late 1960s, Nippondenso, a Japanese manufacturer of automotive electrical parts, was known for its TPM success. Seiichi Nakajima, an officer with the Institute of Plant Maintenance in Japan is credited with defining the concepts of TPM and seeing it implemented in hundreds of plants in Japan.

TPM ushered a positive meaning in maintenance culture and widened the understanding of its importance to productivity to all concerned. The entire work force must first be convinced that upper level management is committed to the program. The person assigned to lead the coordination of TPM should be a member of the GP team.

Design of a Cost Effective Maintenance System

The design of a cost effective maintenance system should include:

- Classification and identification of equipment
- Collection of information (this can be done as part of your initial Walk Through)
- Selection of maintenance policies
- Preparation of preventive maintenance program
- Preparation of corrective maintenance guidelines
- Organizing for maintenance
 - Resource structure
 - Administrative structure
 - Work planning and scheduling system

All equipment should be classified and codified to enable proper management of the maintenance records, instruction manuals, drawing, cost data, down time data, etc. This will aid computerization and control.

There is a need to go further than just scheduling maintenance as suggested by the manufacturer. These recommendations are generic and are often written with a specific concern about liability. However, following generic recommendations can result in machines being over-serviced in an attempt to improve production. This can result in more oil or lubricants being used than actually needed. This incurs additional clean-up costs. Involving the operator as an active participant in the maintenance of the machine is important. Routine daily maintenance checks, minor adjustments, lubrication, and minor part changes become the responsibility of the operator. In larger companies, extensive overhauls and major breakdowns are handled by plant maintenance personnel but should still include the operator. Even if outside

maintenance or factory experts have to be called in, the equipment operator must play a significant part in the repair process. He or she knows the unique characteristics of the machine that can save resources.

Large companies such as Kodak have reported a US \$16 million increase in profits that results from a \$5 million investment in TPM. In literature on TPM, most companies reported 50% or greater reduction in down time, reduced spare parts inventory and increased on-line deliveries. Reductions in the need for outsourcing part or all of a product line were found in many cases. It is easy to see how this can lead to environmental benefits, such as less oil and lubricant use, lower energy demand, smaller storage requirements, and all leading to cost savings.

Resource Conservation

There are three key approaches to Resource Conservation, which are Recycle, Reuse, Recovery (Off-site and On-site), Energy Conservation, and Process Modification (which includes Input Material Changes and Process and Equipment Changes).

Recycle, Reuse and Recovery

Known as the 3Rs, these options are part of the waste management strategy that evolved in the late 1970s to prevent materials from going to landfills. It is important to find a good use for materials. Each of these three options have merit and can bring opportunity to your business when the right option is found for the respective material, good or process. These terms are not applied consistently in all markets, a point to keep in mind when you are selling, sourcing or providing outsourcing services. Additionally, in some markets there is a hierarchy of value assigned to each option, which is tied to political policy and government approval processes. The terms that are shown here are defined for the Asian market.

Recycle refers to recycling materials and energy within the process. Reuse involves selling materials or waste to external dealers (i.e. off-site or on-site), where the material or waste is reprocessed or recovered and reused within the industry.

Recovery is the process of reclaiming valuable resources from wastes in the form of raw materials, by-products or products. Recovery normally is the activity that precedes the option to recycle or reuse.²⁰ However, recycling and reuse options can incur somewhat increased risk and liability due to threats to product quality risks.

It may not always be feasible or economical to recover waste at the operating unit when it is generated. If a plant has a number of different departments and processes generating waste solvents, a central distilling department within the plant may offer economic advantages. A single recovery operation may be less expensive from both a capital and operating labor standpoint. The disadvantages of this type of operation are the additional storage, segregation, and handling requirements. All of these activities increase the possibility of environmental risks and liabilities. The overall economics of centralizing a recovery operation must be assessed on a case-by-case basis. Eco-industrial parks are a planning and site development approach that waste

Materials or products can still have value for others once you are finished extracting value from them for your own business needs. You can obtain a financial value from them by selling them, or giving them to someone else in exchange for the cost of transporting them out of your operations. This opportunity will be enhanced when you think of them as materials with value and not as waste. Anything that does not leave your business as product is a cost. A change in attitude helps to make sure that your process and handling systems maximize the return you get.

management fostered. Refer back to the section on cooperative competition and the discussion on Kalundburg to understand how one industry's by-products were used as a source of raw material or energy for another.

On-site Recovery and Recycling

Recycle within the Industry (on-site)

Waste generated in a manufacturing process in many cases can be remanufactured into the original process with or without treatment to remove impurities. For example, material containers can be reconditioned and re-used with minimal efforts (refillable beverage containers). If these materials cannot be directly reused in the original process because of potential contamination, they may be treated to remove contaminants. For example, organic solvents used in parts cleaning and pharmaceutical manufacturing processes are often collected, distilled, and recycled into the original process. Sometimes if the impurities in the material are high, it may not be recycled in the original process but used in a secondary process (e.g. water in washing, used solvents in degreasing).

The assignment of costs to material (waste) streams should be conducted in the planning step. This is the time where you need to identify and set priorities for these remaining resources according to their market worth. The broader market may set the value of these materials as commodities, hosted on waste or material exchanges.²¹ Asset recovery is another business term used to refer to this opportunity.

On-site recovery and recycling can be practiced by your business to recover valuable resources to be reused in your own process, or sold. On-site recycling is employed when:

- the resource can be easily segregated
- it has a substantial reuse value to the industry or an external market
- there are no risks involved to the industry in the recovery process.

On-site recycle and reuse of alcohol wash solution in a Chemical Industry

In this plant, Phenol formaldehyde is manufactured in batch reactors. The reactors are cleaned with alcohol every time a change is made in product specifications. The plant generated 6,000 gal/year of reactor wash solution containing approximately 50% alcohol, phenol formaldehyde resin, and water. Economic considerations prompted the plant to recycle on-site by distilling and reusing the alcohol. A distillation kettle was already available on-site. Steam was available at negligible costs. The resin removed from the reactor could also be reused.

More than 67% reduction of waste generated was possible.

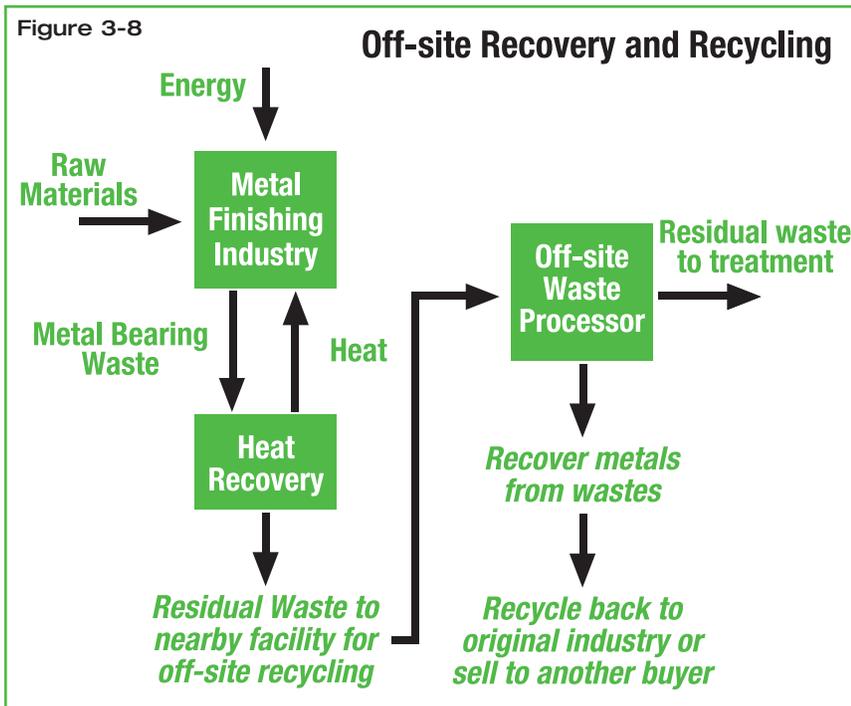
Liabilities were reduced due to reduction of the quantity of hazardous waste generated and US\$15,000 annual savings in material and treatment costs were achieved.

On-site recovery options are normally first attempted by a company to recover valuable materials before they are treated as waste; this can save you money. If these on-site reuse options are not feasible, then the next step is to investigate off-site recovery and recycling, to save on treatment and disposal costs. The recycled material could be either returned to the generator for reuse at the generation site, or sold for use at other facilities. Material exchanges, waste exchanges, waste brokers, commercial recyclers or co-operative agreements can assist in matching generators with potential end-users.

Off-site Recovery and Recycling

Recycling outside the industry (off-site) refers to recycling options that send material to external users. Waste that is not of any use to the generator is sold to other industries or users for whom this material could be a process input.

The example in Figure 3-8 presents a case of off-site recycling where a metal finishing industry sends its metal bearing wastewater to a recovery firm. This firm extracts valuable metals from the waste and disposes the residual wastes.



The recovered metal can either be sold to the original generator or could be sold to other buyers.

Energy Conservation

There are four ways to achieve energy conservation at a facility or in a process.

1. **Energy Conversion:** The focus is on optimizing the energy conversion efficiency of units such as industrial boilers, power reactors, etc. as they convert fuel to steam, or fuel to electricity.
2. **Energy Transfer:** When energy is transferred from the point where it is generated to the point where it is used, there is always some loss. An objective of Green Productivity is to make the energy transfer as efficient as possible along energy conduits. This can be achieved by insulating steam piping as it can contribute significantly to reducing losses in energy transfer. Also, reducing the distance between the heat source and the user can minimize heat loss. (Think back to what the managers involved in Kalundburg achieved when they designed their industrial park.)
3. **Energy Utilization:** This refers to the actual consumption of energy in a process. Your attention needs to focus on the efficiency of individual equipment in terms of unit product output against the energy utilized. How much energy does it take to make one unit? How much energy does the machine use? Is there an opportunity to reduce energy use through TPM? The next time the rebuild of a furnace occurs can DfE lead to a more energy efficient design? When an opportunity arises to replace an appliance, include in your purchase consideration models that are more energy efficient. There are many opportunities for improvements. Brainstorming with the people who have a stake in improvement can yield surprising results. Think about including someone from purchasing, operations, and maintenance to act as part of a teamed effort.
4. **Energy Recovery:** In some circumstances, energy can be effectively recovered and recaptured into the processes. For example, when hot effluents are discharged to the treatment plants, consider employing heat exchangers to draw off the excess heat in the effluent, and re-circulate the heat into the process. Sometimes, the material in a waste or by-product has a high calorific value. Rather than dispose of it, use it as a source of secondary fuel. It is important to think through the process carefully. Tires can be a good source of energy when their primary use is over. As a consequence of making new tires last for longer and longer periods of time, the technology to unbound the rubber polymers is expensive and energy intensive. Yet there are so many tires in existence, their value as a heat source is growing. The question you need to address is whether your process can optimize their heat value without adding to air pollution. If not, you may be better off to sell the tires to someone as a revenue stream and use the money to improve in ways that do not cause other environmental problems.

Input Material Changes

The purpose of changing input materials is to substitute existing material inputs to a process with materials that have lower negative impact on the environment. This should be done without adversely affecting product quality.

Materials that meet this goal are often called environmentally friendly. The attributes that are sought include materials that:

- are less toxic to the environment
- can be easily treated or avoid the disposal option
- make the working place safer
- are more efficient, (i.e. less energy intensive)

Input material changes fall into two major categories. First, those that reduce or eliminate the hazardous nature of process residues. Secondly, those that enhance the efficiency of the conversion process.

In many cases, through material substitution, water-soluble cleaning agents can be used in place of organic solvents. The latter may have to be disposed of as hazardous wastes or recycled off-site after use. This change would create cost savings.

There are other opportunities. Raw materials with higher purity may be used to reduce the quantity of wastes generated. For instance, using an organic liquid or acid that is relatively free of metals or other impurities may reduce the waste that is typically generated due to reaction or non-reaction of these substances. The use of low-sulphur coal in industrial boilers so that sulphur dioxide (SO₂) emissions are minimized is yet another example.

Certain input materials may be more effective in reaction or catalytic actions in the process and hence would increase efficiency. It is important to know enough about the science of your process to make sure that the changes you propose lead to an improvement in your business process and the environment. If you operate a large enough company to have a research & development department, check with them. If you operate a small business and do not have sufficient scientific knowledge, there are outside information sources that you can contact at no cost to you, or at a cost that is within your budget. For example, some of your large company suppliers, who are concerned about their own product stewardship, may be quite pleased to assist you as they will benefit from supply chain improvements. It also may be part of their culture of service. The Responsible Care® network²² is usually very responsive to questions of any kind related to chemicals, they have a history of being very proactive in helping people solve problems related to proper management of chemicals. Additionally, many countries have government or inter-governmental support programs²³ to aid research in this area.

Changes to input materials can lead to an opportunity to modify a process, making it more efficient and using less energy.

Process Modification

As earlier discussed, manufacturing processes do not have a 100% conversion efficiency. Consequently, some waste is generated in the form of air emissions, effluents, solid wastes and heat releases. Green Productivity techniques described in this section attempt to improve on the conversion efficiency and to reduce the generation of waste.

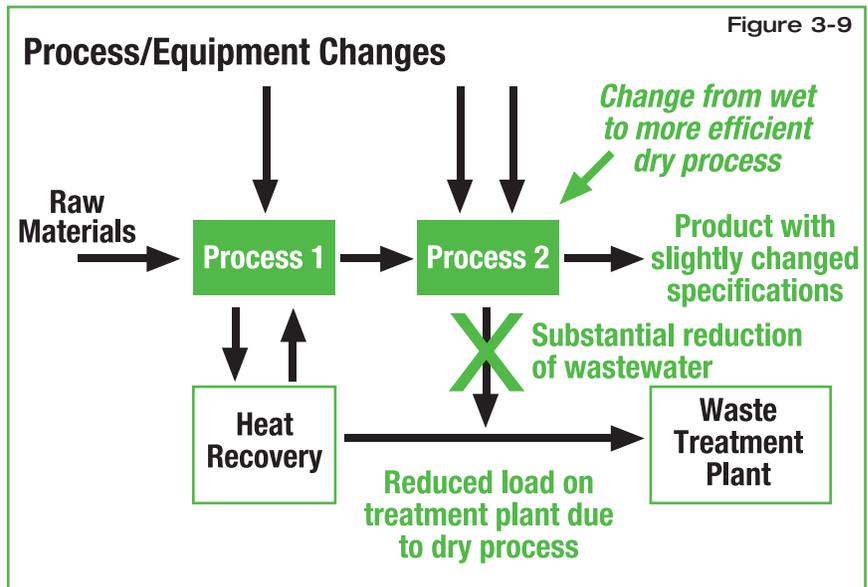
Modifying a process to reduce waste means that an alternate approach is developed to obtain the same or better product specification, while generating less waste.

Replacing inefficient or old processes with newer technology can often achieve this goal.

Reactor design changes can also significantly reduce waste by providing proper mixing, catalyst and reactant contact, minimizing temperature and concentration gradients, and optimizing procedures for reactant addition and temperature profiles.

Figure 3-9 illustrates the use of Process Modification such as changeover from wet process to dry process thereby reducing wastewater generated as well as processing time.

Tools such as Failure Mode Effect Analysis could be effectively used while making process changes to assess the product quality risks involved.



Dunalakk Paint Producing & Servicing Ltd., Budapest, Hungary

Initially one of the main factors causing the company to consider the development of environmentally sound products was the fact that the factory, which had once been on the outskirts of Budapest, was now surrounded by the city and a residential area. Drivers for change included new environmental legislation (lower emission limits, etc.) on the national level, and pressure by the local community and authorities concerning the environmental impact of the company.

Dunalakk seized this as an opportunity to also improve health and safety conditions for its employees. In 1995, Dunalakk realized that its products would be in a weaker competitive position unless it improved to meet Western European standards and legislative developments in this market.

As early as 1972, Dunalakk's management realized that powder-coating paints, which they had first produced in 1968, could become the most significant future coating material. These powder coatings produced no chemical emissions during application. In 1972, Dunalakk bought the production process patent from the first powder coatings producer in the world, which was Liber of Belgium.

Since 1976, the Dunalakk plant has produced powder coatings as an independent product line. The company decided to develop further environmentally sound painting products for its product range, such as solvent-free two-component paints: water-soluble and aqueous dispersion paints. Management outlined several areas that needed to be dealt with in order to develop an environmentally sound product strategy. These included:

- minimization of manufacturing process emissions;
- reduction in the use of hazardous raw materials;
- reduction of chemical emissions during paint application;
- minimization of the fire and safety hazards associated with certain raw material usage, accompanied by improvement or preservation of product quality, and;
- reduction of hazardous wastes produced during paint application.

Alternatives for replacing solvent-based paints in its product range were explored. The main objective was to develop solvent-free, water-soluble or aqueous dispersion paints.

In 1996, the company's solvent-based concrete enamel was replaced by an aqueous dispersion-based paint, Naofix, which is a paint that can be used for concrete and asbestos slate.

The company also developed technologies for reusing paint wastes resulting from the application process.

During application of powder coatings, the use of air filters facilitates collection and reuse of six per cent of the material used. This material would normally be incinerated. The recovered material is reprocessed in a special mixtruder (a type of mixer). The use of the air filters improved health and safety at the workplace.

Dunalakk also advises the companies, to whom it provides paint application technology, on the recovery alternatives available.

The installation of the special mixtruder required an investment of HUF 50-60 million. In addition, the development of environmentally sound products involved 10 to 30 percent higher costs than those associated with the development of more traditional products.

In 1994 turnover was HUF 830 million, and the value of exports was HUF 16 million. In 1995 turnover increased to HUF 1,300 million, and exports to HUF 80 million.

The company estimated that between 50 and 60 tonnes of paint waste is collected for reuse per year. The payback period on this investment was about four to five years.

Print Works in Massachusetts, USA

This is a case where productivity was the driving force for change. Productivity tools were used in diagnosing the problem and developing a process solution.

Azoic dyes²⁴ were being used at the plant for dyeing. Acetic acid²⁵ was employed, being manually fed into the process. This led to variability in the process, causing conditions that affected product quality. Moreover, as a toxic substance, the acid had health and safety implications on the workers.

A multi-disciplinary team, applying the Deming Quality Process, employed control charting for tracking processes throughout the plant, with the goal to minimize use of toxic substances while improving product quality.

By using control charting, the management identified improvement opportunities and implemented a set of measures involving modification of the acid aging process to minimize environmental impacts and generate economic benefits for the company.

Process improvements that resulted from the information shown in control charting helped to reduce annual acetic acid usage by over 128,000 pounds. Product quality improved extensively together with improved occupational health and safety.

Acetic acid procurement costs were reduced by over \$33,280 annually. Total savings in chemical costs amounted to approximately \$78,520 while treatment costs were lowered by \$200,000.

NOTE: The cost of treating materials as waste usually far exceeds their purchase price. This is added incentive to focus on the front end to eliminate problems at the source, or even better in design. Noteworthy too, is the fact that health and safety costs can be substantially reduced when Design for Environment removes toxics from the process.

Management of Waste

Wastes need to be treated and disposed with due consideration to the science involved. Increasingly wastes are also covered by laws, which dictate how wastes are managed, and often include strict reporting requirements. It is important that you find out if you need to abide by applicable environmental legal requirements.

The proper treatment and disposal of wastes in specially designed facilities is another important way to manage wastes. This can be accomplished either on-site or off-site. Waste treatment facilities also do not have 100% conversion efficiency, so residues and rejects get generated in the process of treatment. The waste treatment facilities for air, effluent and solid waste should also be managed with the same care and attention as your manufacturing processes. Wastes from manufacturing processes become inputs to these facilities; treated wastes are the outputs. If the conversion process is inefficient, off-spec product will be produced. This could result in added costs. If the treated product does not comply with environmental standards required in regulations, further treatment would be required.

These residues can be minimized once again by employing Green Productivity techniques. Options exist for all forms of media releases: air, water and land. Air emission control serves to cover stack emissions and fumes and odours in the workplace. If not controlled properly, these odours can drift into the community leading to severe conflict with government authorities and neighbours. Legislated plant shutdowns can cost you a great deal in money and ill will. There are cases where plants have been closed permanently as the company failed to manage severe odour problems after years of unresolved conflict. Effluent treatment plants are designed to improve industrial effluents and domestic and sanitary wastewater, including cooling water. Solid Waste Management includes industrial solid wastes, both hazardous and non-hazardous forms, and effluent treatment plant solids or sludge residues.

Air Emission Control

Industry contributes to air emissions in several ways. The problem is manifested in particulate matter and gaseous pollutants. Both can impact the colour of air, reduce visibility, increase health risk and generally lower the quality of life.

All reactions from combustion processes generate emissions containing unburnt carbon and its compounds, such as carbon (CO), carbon dioxide (CO₂) and other gaseous compounds arising due to impurities (e.g. sulphur in coal forms sulphur dioxide - SO₂). These combustion reactions occur in industrial boilers or process furnaces. Fumes and odours from the reaction, storage tanks, and piping systems are other sources of fugitive emissions. A fugitive emission is defined as any chemical or mixture of chemicals, in any physical form, which represents an unanticipated or spurious leak from anywhere on an industrial site.

The problem caused by fugitive emissions is not a trivial issue. Based on information from the USA, fugitive emissions from leaking valves, pumps and flanges have been estimated to be in excess of 300,000 metric tonnes per year. They account for about one third of the total organic emissions from chemical plants. The same is true for Europe. Irrespective of any environmental impact that it may cause, this is a tremendous financial burden on industry because it represents a huge loss of potentially valuable materials and is a cause of plant inefficiency. Yet in most instances, the true costs to industry are not appreciated. Many of the costs associated with fugitive emissions are invisible.²⁶ Leakage from valves is often the biggest culprit, reportedly accounting for around 50% of the fugitive emissions within the chemical and petrochemical industries. Leakage from pumps and flanges represent smaller, but still important, proportions.

Interestingly enough, the dilemma of fugitive emissions (incremental loss, low visibility, cumulative high cost) may be indicative of many of the environmental challenges you face, not just air emissions.

Some of the primary air pollutants that cause concern include: carbon monoxide, oxides of nitrogen, hydrogen sulphide, methyl and ethyl mercaptans, hydrogen fluoride, etc. The information here is not exhaustive. You are not expected to be an expert in air quality control when you finish with this section. Rather the purpose is to provide you with some insight of what to look for and expect. With this basic understanding, you can apply the necessary GP tools, techniques and methods to reduce your impact on the environment and enhance productivity.

You need to think about how to capture particulates and gaseous pollutants unless you are able to employ changes in input materials or process changes to eliminate air emissions.

Devices that control particulate matter include:

- Gravitational settlers
- Cyclonic collectors
- Bag filters
- Electrostatic precipitators
- Fabric Filters

Devices that control gaseous pollutants include:

- Adsorption equipment using adsorbents like activated carbon, alumina, bauxite, etc.
- Absorption units like spray towers, plate or tray towers, packed towers and venturi scrubbers
- Condensers using surface and contact condensers
- Combustion equipment using direct flame or thermal or catalytic combustion

Residues would be left in the wastewater (liquids from wet scrubbers) or solid waste (particulate from filters) for which proper residual treatment and disposal needs to be adopted.

These lists of air pollution control equipment are only part of a treatment system that you need to consider. The option chosen requires a more detailed understanding of the science involved and application of decision-making tools available under GP. The purpose is to evaluate an environmentally efficient and cost effective solution.

Effluent Pollution Control

There are three kinds of effluents that are typically generated by industry (yours included). First is domestic effluent (this would include wastewater from offices, administrative blocks and canteens). Second is industrial process effluent. Third are the effluent releases from cooling water operations and washings. The pollution loads in these streams are such that they cannot be discharged without treatment. Different techniques are employed to treat these wastewaters, depending on their composition. It is beneficial if effluent streams are segregated prior to treatment, according to:

- the treatment required,
- the volume of flows involved,
- the concentration of pollutants present.

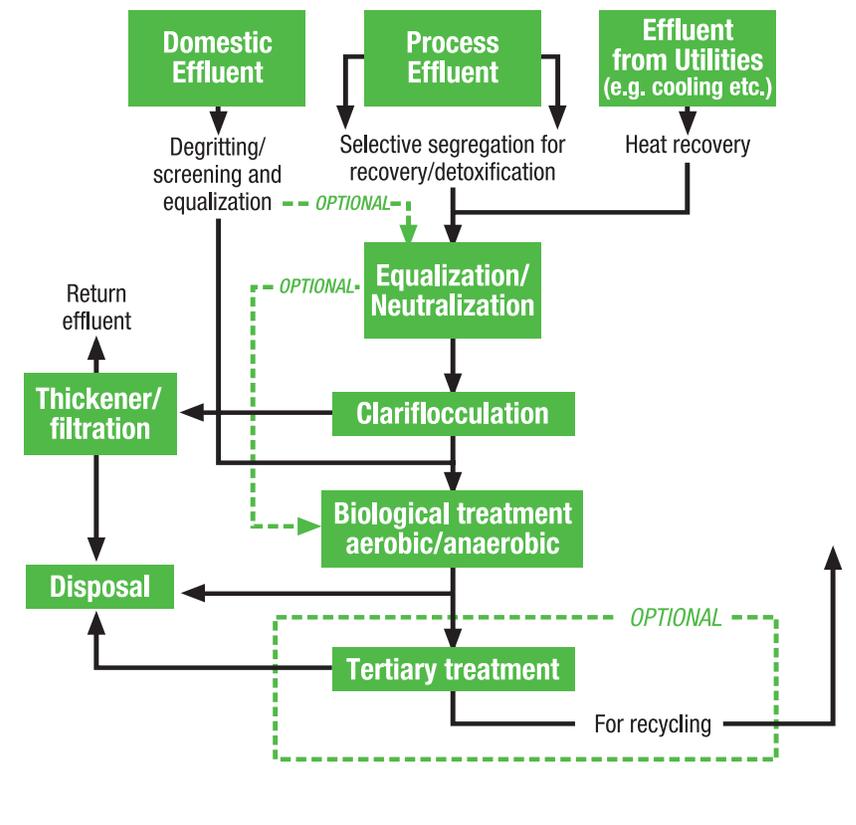
The goal is to facilitate handling, treatment, recovery, reuse and disposal.

Domestic effluent is mostly highly organic in nature, with little to no inorganic material or heavy metals. In this situation, biological treatment alone (with some essential unit operations such as screening, grit removal, etc.) is used to reduce the organic load. Sometimes domestic and industrial process effluents are blended to increase the treatability. The design of the treatment plant should be robust yet economical. It should achieve and maintain the desired treatment efficiency and comply with the regulatory standards governing discharge. Apart from the need to be in compliance, regulations often hold information that is helpful to understand design tolerances. Where experience has shown that certain characteristics (depth requirements, retention periods, etc.) are critical to avoid risk, they are often captured in the details of the law (in regulation or appendices). As such they are generic rules to which adherence is prudent.

Industrial effluent containing several contaminants of varying nature and concentrations is the most difficult to treat. Industrial effluents are typically characterized by high Chemical Oxygen Demand (COD) / Biochemical Oxygen Demand (BOD)²⁷, heavy metals, toxic chemicals, inorganics, etc. A combination of techniques needs to be applied in the proper sequence and with adequate control to achieve the desired outlet effluent standards. Complexity adds cost. Figure 3-10 shows an example of multiple techniques and their correct sequence.

Figure 3-10

Effluent Pollution Control



Most of the treatment technologies require a uniform flow pattern for effective treatment. Hence the various flows from the industrial process need to be equalized first. Process effluent is acidic or alkaline in nature and needs to be neutralized (which is monitored by pH).²⁸ Further, depending on the amount of organics, anaerobic treatment might be necessary before aerobic biological treatment²⁹ to bring down the BOD. Heavy metal streams on the other hand are segregated, oxidized or reduced before blending with the rest of the industrial effluent.

If high volatile organics³⁰ are present in the effluent, it might be economical to recover or separate these by stripping or extraction and recycle them back into the same process, or to other secondary uses. The effluents are sometimes treated at a tertiary level if it merits recycling either on-site or off-site.

Residues of wastewater treatment would be in the form of sludge and dried cakes of settled matter. These residues need to be channelled to the proper Solid Waste Management and disposal system.

Peter Paul Philippines Corporation, Philippines

This project was carried out under the Industrial Environmental Management Project (IEMP) of the Philippines.

This case is illustrative of how waste can be utilized as a resource to generate revenue as well as improve environmental performance.

Waste coconut water generated from the production of desiccated coconut had high BOD and COD levels.

Collaboration with a Chinese company resulted in the recovery of the coconut water, which was collected from Peter Paul Philippines Corp. and channeled to the Chinese company's plant for processing and freezing. It was sent to Taiwan for sale as a commercial drink.

Breakers were installed to improve coconut water collection.

Operating practices such as paring of coconut were improved. Incentives were provided to workers in the form of payment for each full-pared coconut resulting in improvement of the quality of desiccated coconut.

Production of desiccated coconut increased by 13.6 kg / ton of coconut processed. This led to annual savings of US \$370,000.

The main environmental benefit was a 50% reduction in BOD level. This reduced the annual operating cost of the wastewater treatment plant. Treatment costs were reduced by \$3700 per year.

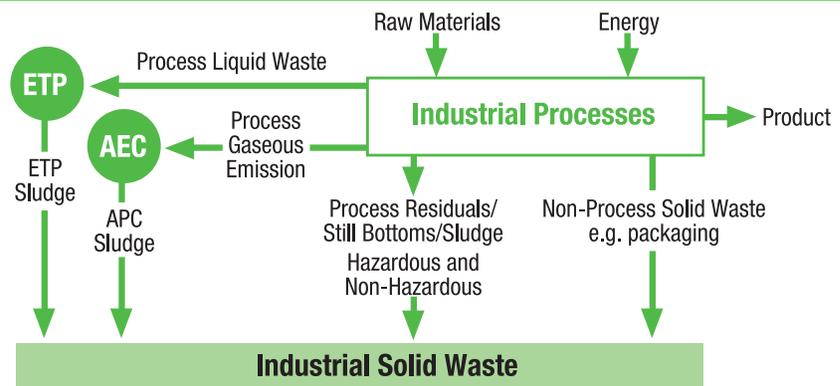
Solid Waste Management

Solid Waste Management presents several opportunities for waste recovery, reuse and recovery in which opportunities for savings in material, money and energy can be realized. An industrial facility can have various sources of solid waste generation, as shown in Figure 3-11.

Figure 3-11

Sources of Solid Waste Generation

- ETP** Effluent Treatment Plant
- APC** Air Emission Control



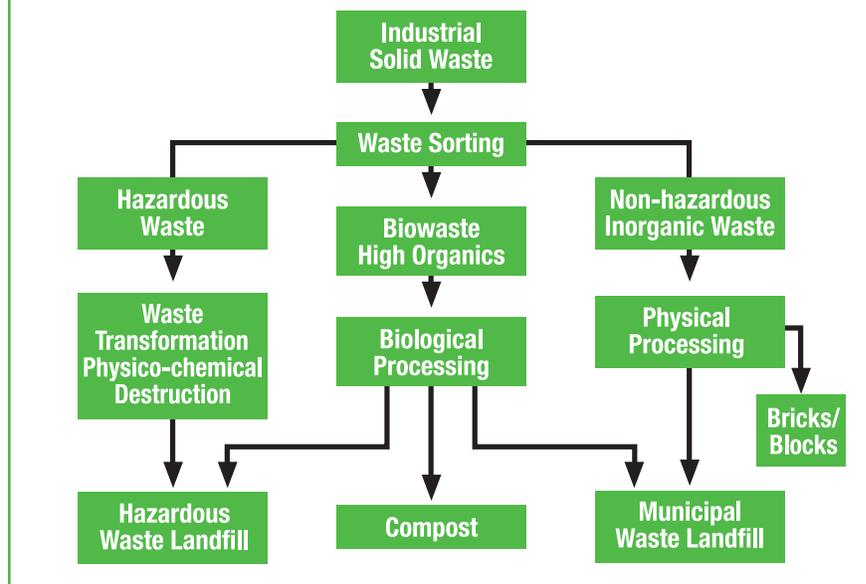
The major components are:

- Residual Solid wastes / sludge from effluent treatment plant (e.g. from thickeners, filter press or sludge drying beds)
- Residual solid wastes from air pollution control equipment (e.g. particulate from bag filters)
- Direct process solid waste (e.g. tank bottoms, stills etc.)
- Non-process solid wastes (e.g. unused raw materials, containers, packaging material, etc.)

As mentioned earlier, residues from the air pollution and wastewater pollution control facilities finally come to the Solid Waste Management facility. Here further treatment is provided or the residues are disposed of in a suitable manner.

A strategy to manage the components of solid waste is summarized in Figure 3-12. While waste management, in all its forms, is important to your business, eliminating waste at the source by improving product brings a greater opportunity for savings.

Figure 3-12 Strategies for Solid Waste Management



Product Improvement

Environmentally compatible products minimize the adverse effects on the environment resulting from their manufacture, use and disposal. As previously indicated, the environmental impacts of a product are, to a large extent, determined during its design phase. By taking environmental considerations into account during product planning, design and development, your company can minimize the negative impacts of the product on the environment. This has benefits far beyond the limit of your company.

Product Improvement techniques address aspects involved in product development and design such as:

- New concept development
- Selection of low impact materials
- Optimization of production techniques
- Reduction of the environmental impact in the user stage

Product design changes involve manufacturing a product with a lower composition of hazardous materials, or using less toxic materials. It can mean that less toxic materials are formed in production. It also allows for changing the composition of input materials so that no hazardous substances are involved. For example, a manufacturer could use an active ingredient in a formulation with a non-hazardous solvent rather than a chlorinated solvent. Or, mineral oil could be used in electrical transformers instead of Polychlorinated Biphenyl (PCB) liquids; organic pigments could be used in lieu of paints rather than heavy metal pigments.

Revisiting Design for Environment (DfE)

Although Design for Environment was discussed in conjunction with Life Cycle Assessment earlier on in this chapter, it is important for you to see how it fits in under product improvements. Conventional product design and development process emphasize how economic value can be enhanced, (i.e. how to reduce production costs and achieve higher performance). Today, in recognizing the power of tools like LCA, Green Productivity has incorporated the principles of eco-design into its framework. Improving product design therefore becomes designing for the environment, with the potential for developing a niche market and a competitive advantage. Figure 3-13 shows different opportunities for benefiting from DfE.

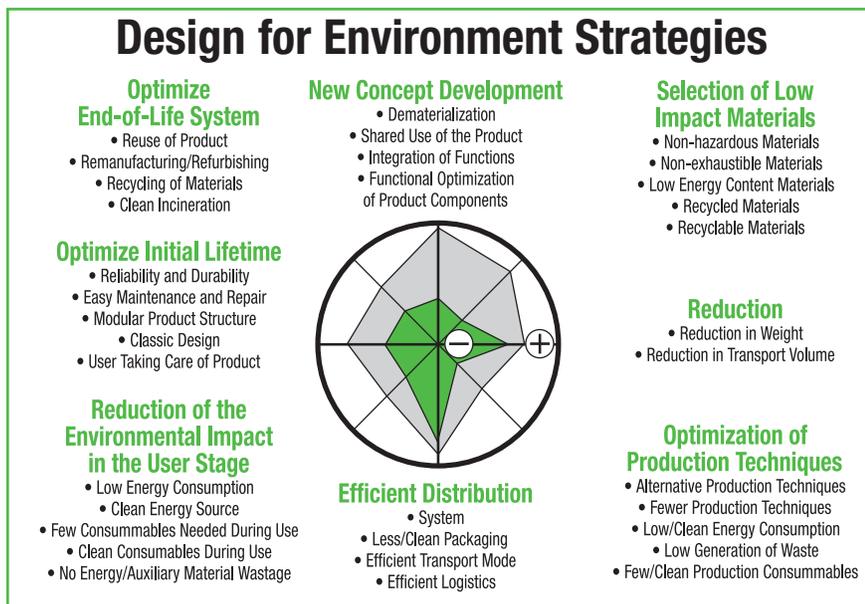


Figure 3-13

3.3 Summary of Chapter

The objective of Chapter 3 was to provide you insight on how to operationalize Green Productivity. It outlined how to make GP work for your business by introducing you to a variety of tools and techniques.

In 1959, the Productivity Committee of the European Productivity Agency wrote "The Concept of Productivity and the Aim of National Productivity Agencies", which defined productivity.

"Productivity is above all a state of mind. It is an attitude that seeks the continuous improvement of what exists. It is a conviction that one can do better today than yesterday and that tomorrow will be better than today. Furthermore it requires constant efforts to adapt economic activities to ever-changing conditions and the application of new theories and methods. It is a firm belief in the progress of humanity."

Green Productivity builds on the creative foundation of productivity. It integrates the ideal of nature's efficiency with manufactured products and services to improve environmental performance and enhance existing productivity levels. While GP starts as an intellectual dare – the tools, techniques and solid framework it offers you can be used to transform the ideal to the practical. Through this transformation you can become more profitable and achieve competitive advantage.

Where are you in your understanding of Green Productivity?

Build on your knowledge of productivity, your confidence in using tools and techniques to enhance your productivity and your attitude towards making Green Productivity a business priority.

Please indicate your new level of knowledge concerning productivity and Green Productivity measures where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of productivity and Green Productivity measures is at this level:

1 2 3 4 5

Please indicate your current level of skill in using tools and techniques to enhance your productivity where: 1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My level of skill at applying these tools is: 1 2 3 4 5

Please assign a value to the importance of your being able to leverage Green Productivity to enhance your profitability and environmental performance where:

1 (not important) 2 (slightly important) 3 (average importance) 4 (a core business concern) 5 (a critical business tool)

I think the level of importance of Green Productivity to my business is:

1 2 3 4 5

3.4 Questions

1. Many of the tools used in GP are geared to encourage the generation of new ideas. Which ones would you use to initiate new thinking in your organization to introduce GP?
2. Green Purchasing offers significant opportunity to improve the environmental quality of your organization's products or services and lowering costs by moving to sustainable sourcing. How can you use the concept of cooperative competition to introduce GP to your key suppliers? Do you understand what the cumulative benefit of change throughout the supply chain might be?
3. Surprisingly, people at the 'bottom' of the organization usually resist change the least. How can you best garner the will of these people to introduce your first GP project?
4. Many of the tools and techniques under the GP umbrella in of themselves are not difficult to understand. Can you select one and explain it to a colleague as a way to introduce GP?
5. If productivity is a state of mind, as the European Productivity Agency articulated, how would you explain to your boss or Board of Directors, the need to include GP into your business plan? How would you change their current mindset to embrace GP?
6. If they are reluctant, can you draw a flowchart of the system in which your enterprise functions to identify ecosystem inputs and your production inefficiencies (wastes)?
7. Take one product or service that you have now. How would you re-design this product or service by incorporating the efficiency that a GP approach engenders?

3.5 Point to Ponder

Whole systems thinking – Interface Carpets

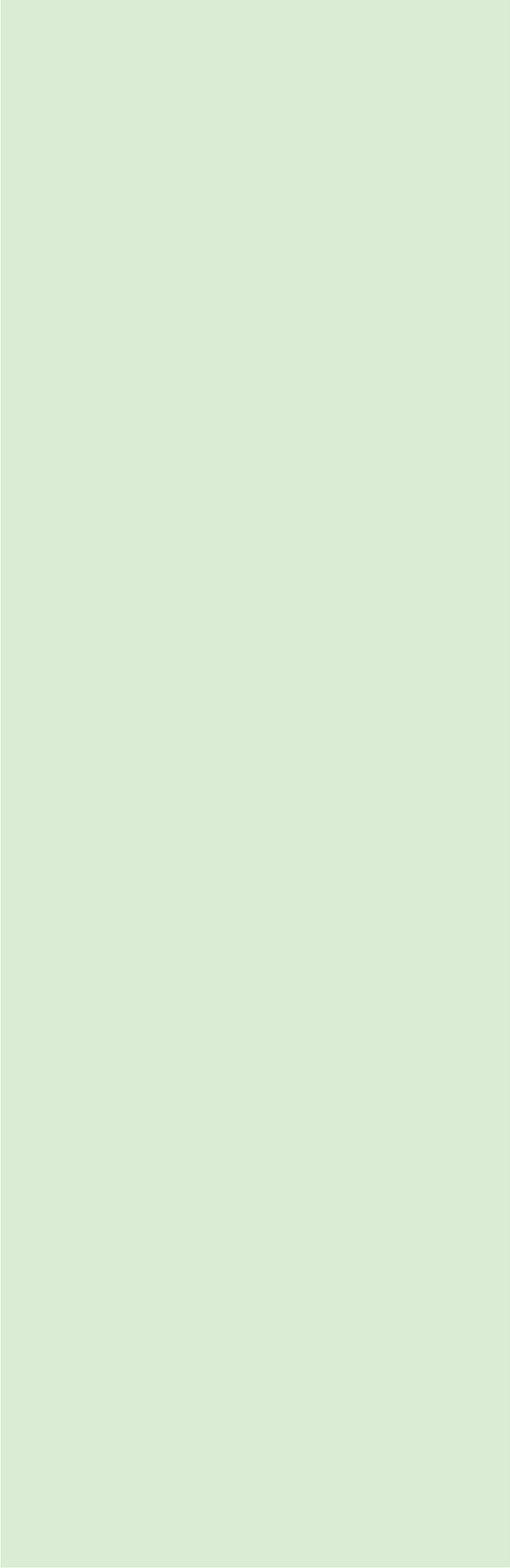
In a new carpet factory that Interface Corporation was building in Shanghai, a liquid had to be circulated through a standard pumping loop, similar to those used in nearly all industries. A top European designer developed the system to use pumps requiring a total of 95 horsepower. Before the start of construction, Interface's engineer realized that two simple design changes would allow them to reduce the power requirement to 7 horsepower, a savings of 92% in system costs. The first change was to incorporate wider pipes, creating less friction in the system and therefore needing far less energy to move the fluid through the pipes. While the designer was following the norms outlined in textbooks, he was focused on designing part of the system. The second change made was to reduce friction further by making the pipes short and straight rather than long and curved or bent. The norm for designers is to situate the various tanks, boilers and other equipment and then leave it to the pipe fitters to connect them together. In this case Interface's engineer laid the pipe first in a design that reduced the friction, made them easier to insulate and reduced the time required for the pipe fitters and their related cost.

Through a simple shift in mindset, by optimizing the whole system, Interface saved in a number of ways. Interface:

- Reduced the higher capital cost of the fatter pipes and the lower capital cost of the smaller pumping equipment
- Saved 70 kilowatts of heat loss and repaid the insulation costs in 3 months
- Lowered the cost of ongoing electric bills
- Reduced the power size of pumps saving costs

If the US applied whole systems thinking to all existing motor and lighting systems applications to optimize, they could reduce the nation's \$220-billion a year electric bill by 50%. This would include switching from ordinary motors to premium-efficiency motors. Also beneficial would be changing ordinary lighting ballasts to electronic ballasts that automatically dim the lamps to match available daylight. The after tax return on investing in these changes would in most cases exceed 100%. Other energy saving improvements could further reduce the US dependency on energy, cutting overall consumption by 75% with 100% returns a year on the investments made. Is rock logic, outdated mindsets, the only thing stopping them from benefiting from Green Productivity?





CHAPTER 4

Green Productivity Methodology

CHAPTER 4

Green Productivity Methodology

CHAPTER 4 GREEN PRODUCTIVITY METHODOLOGY

4.1 Purpose of this Chapter - Overview of Green Methodology

The methodology for Green Productivity was originally developed to solve environmental and technical problems in the manufacturing industry. It adopted and adapted proven methods of process engineering and quality control. The concepts of continuous improvement and of steady incremental and systematic improvement inherent in Green Productivity methodology owes much to Deming's PDCA cycle and the Japanese concept of continuous improvement called KAIZEN commonly used in quality improvements in factories.

In the early implementation of the APO Green Productivity Demonstration Projects from 1996 to 1998, the projects were mainly focused on SMEs, such as those in the electroplating, textile, food processing and papermaking industries. Consequently, there was a very strong emphasis on the manufacturing process in the methodology used.

Subsequently, the application of Green Productivity extended to farms and also to solving problems of village communities. The methodology had to be modified and made more generic so that it could be applied to other areas related to productivity and the environment.

It became evident that Green Productivity methodology could be analytically broken down into three components.

1. A step-by-step framework for problem solving.
2. A set of tools, techniques and technologies used within the framework.
3. The social, economic, environmental and cultural principles and values that govern the choice of tools, techniques and technologies within the design of the Green Productivity process.

The purpose of this chapter is to walk you through the six major steps that will enable you to implement your own Green Productivity program. Each step is broken down into one of 13 tasks that will help you understand how logical Green Productivity is, and how easily it can be used to enhance your productivity. Figure 4-1 and Table 4-1 outline how GP can guide your success.

Figure 4-1

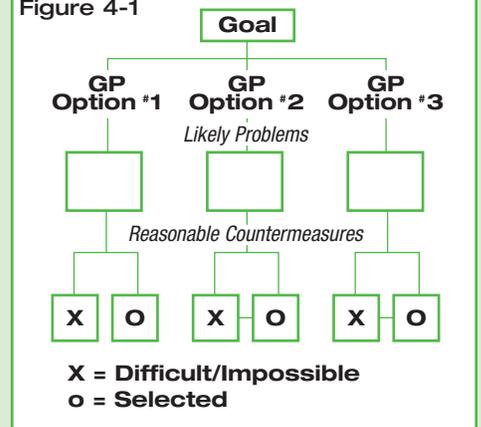


Table 4-1 Overview of Green Productivity Methodology-Success in Six

Step I: Getting Started

Task 1	Team formation
Task 2	Walk Through Survey and information collection

Step II: Planning

Task 3	Identification of problems and causes
Task 4	Setting objectives and targets

Step III: Generation, Evaluation of Green Productivity Options

Task 5	Generation of Green Productivity Option
Task 6	Screening, Evaluation and Prioritization of Green Productivity Options

Step IV: Implementation of Green Productivity Options

Task 7	Formulation of Green Productivity implementation plan
Task 8	Implementation of selected options
Task 9	Awareness building, training and developing competence

Step V: Monitoring and Review

Task 10	Monitoring and Evaluation of results
Task 11	Management Review

Step VI: Sustaining Green Productivity

Task 12	Incorporating changes into your organization's system of management
Task 13	Identifying new/additional problem areas for continuous improvement

Build on your knowledge of Green Productivity by developing an understanding of the value of the methodology that is available through Deming's Plan-Do-Check-Act process and the spirit of continuous improvement embodied in KAIZEN. Please indicate your current level of knowledge concerning Green Productivity methodology and its PDCA and KAIZEN roots where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of the methodology is at this level: 1 2 3 4 5

Please indicate your current level of skill in obtaining the commitment of top management to adopt Green Productivity where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My level of skill at negotiating to obtain commitment is: 1 2 3 4 5

Please assign a value to the importance of you being able to implement Green Productivity to enhance your business where:

1 (not important) 2 (slightly important) 3 (average importance)
4 (a core business concern) 5 (a critical business tool)

The importance of Green Productivity methodology to my bottom line is:

1 2 3 4 5

(1) The Step-by-Step Problem Solving Framework

The problem-solving framework, in one form or another, is widely used in many organizations and enterprises. The actual number of steps is in a sense arbitrary but the logic of the sequence is consistent.

First, you need to identify the problem and try to understand it by analyzing it systematically and thoroughly. After determining the root causes of the problem, consider all possible options to solve the problem. Evaluate the options to determine the optimal solution, and devise a plan to implement the option chosen. Monitor and

review the implementation and adopt and incorporate the best solutions in the whole process. You are now ready to go onto the next problem and repeat the cycle. In this way there will be continuous incremental improvement.

After the implementation of a number of Green Productivity Development Programs, APO decided to adopt a 6-step approach with 13 different tasks, as it is simple enough to be used by the factories, farms and communities practicing Green Productivity. Some flexibility is to be expected and one need not be dogmatic about the actual number of steps as the conditions in various situations can be very different.

(2) Tools, Techniques and Technologies.

The number of tools, techniques and technologies available now is very broad. They can be management, engineering, environmental, economic or other technical tools and techniques. These will be described in this section as you go through the steps in the problem-solving framework.

The technologies that you need to employ to implement your Green Productivity program will depend on the issue or problem to be solved. Technologies tend to be more knowledge based and therefore the advice of resource persons skilled in the field will be essential. However, they may not know the Green Productivity process methodology and they should be asked to understand the whole Green Productivity concepts before they give their solutions. What they may deem appropriate as 'common' or standard solutions may no longer apply. Your Green Productivity team will have to evaluate these options with the resource persons.

(3) Social, Economic, Environmental and Cultural Principles and Values.

These principles and values are often not explicit but hidden in the choices that you need to make concerning the use of tools, techniques and technologies.

Since the objective of Green Productivity includes both the socio-economic improvement of society and the protection of the environment at the same time, you need to consider productivity from a broader basis. Considerations such as the more efficient use of energy and natural resources, phasing out the use of toxic chemicals, the reduction of waste at source and social objectives will have to be incorporated into the Green Productivity process.

From past experiences in Green Productivity demonstration projects, Green Productivity methodology has proven to be flexible and robust and can be applied to many different sectors of the economy as well as to problems of community development.

There can be numerous psychological barriers to implementing a plan of Green Productivity. Some think that improvements to their operations would be literally impossible when taking into consideration the company's inflexible processes of the last 10 years or more.

Cost is another barrier. Many people have the impression that improving their operations required a lot of money. This is not true! The latest developments in productivity techniques enable companies to continuously improve without having to seek out extra sources of funding.

From the perspective of business processes, inputs include manpower, machines, materials, methods, utilities, energy and so on. Inputs are then processed in the workplace before they are converted to outputs, usually in the forms of products or services. These products or services must then meet customers' requirements. This is very important in that if the products or services do not meet the requirements or specifications, the customers might reject the final output!

Careful observation will show that other items are involved in the output processes: waste, and often environmental pollution. Waste is an output that definitely needs to be addressed, as it will unnecessarily consume valuable resources and make your business less competitive. A business may have to spend a lot of financial resources to treat environmental wastes before discharging them into the environment.

What is the true cost of waste?

Consider the following whole systems view:

1. Materials are purchased.
2. Energy is expended.
3. Labour is assigned.
4. Equipment is needed.
5. Administration is involved.
6. Storage is needed (pre and post production).
7. What is not sold as product has to be managed, either as a waste to be disposed of, or as a raw material for remanufacturing internally or to be marketed.

The costs do not necessarily end here – if the waste generated is hazardous, for example, and it is not disposed of properly you may incur a whole new set of costs including legal, loss of market, and loss of reputation.

You can apply the concept of small incremental continuous improvement to processes in order to reduce long-term waste and environmental pollution. Attention to the effect of businesses on the environment will not only help the state of the planet, but will also make your business more competitive.

With KAIZEN in mind, you still need a sound approach to continuous improvement. The approach adopted in the Green Productivity Methodology is modified from the famous PDCA cycle developed by Dr. Edwards Deming. When combined with the concept of KAIZEN, you can rotate the cycle up the improvement ladder by improving one area at a time in your processes. When you are happy with the improvements

you can then standardize them. For those companies with ISO 9001 or ISO 14001 management systems implemented, standardization means changing some procedures or work instructions to reflect the new operation methods. Dr. Kaoru Ishikawa, a quality guru from Japan: “The essence of total quality control lies in repeated applications of the PDCA cycle until a goal is attained”.

4.2 Commitments and Involvement of Top Management - An Important Pre-Requisite

Unless you obtain the commitment of top management to Green Productivity it is unlikely that your efforts will be as successful as you need them to be to achieve your desired returns. Obtaining the commitment of your top management is a pre-requisite for moving forward as top management plays a critical role in several tasks.

One of the essential ingredients for systematic implementation of any methodology is the use of a set of tools. Tools serve various functions through data collection, analysis or presentation of the information. In the implementation of Green Productivity methodology, environmental management and productivity tools play equally important roles and should be applied in an integrated manner.

Task 1: Team Formation

Take initiative to identify a Green Productivity team leader and recommend composition of the Green Productivity team.

Task 4: Setting Objectives and Targets

Review the objectives and targets to ensure compatibility with the policy of the company, check the time frames, resource and fund requirements.

Task 7: Formulation of Implementation Plan

Review and approve the implementation plan.

Task 8: Implementation of Selected Options

In the case of SMEs, in particular, the owners may need to supervise the implementation of options.

Task 11: Management Review

Review the post-implementation report to check for the following:

- whether or not Objectives and Targets are being met
- whether benefits and savings are as envisaged, e.g. productivity, profitability and better environmental management
- main constraints and barriers to Green Productivity programs: the effectiveness of training programs

Task 12: Incorporating Changes into your Organization's System of Management

Ensure that the Green Productivity programs are established by incorporating appropriate changes into your organization's system of management to enable continuous improvement.

Top management plays an important role in the success of Green Productivity. Make sure top management understands the value of your GP plan.

Ecological illiteracy
is common around
the world.

Good Housekeeping is a simple habit
to adopt with the potential for quick
results that lower risk. Results are
improved by continual self-
assessment, which is easy to do
with little cost.

More recent data puts the numbers
of small business within APEC far
higher than 98 million. Small
business within APO member
countries amount to well over 52
million alone.

Barriers to Commitment of Top Management

Attitudinal Barriers

Resistance to change is one of the common attitudes observed in top management, particularly among SMEs. Fear of the unknown and fear of failure are the primary reasons for this attitude, yet are entirely unnecessary. Deming listed fear as one of the key challenges to overcome, noting that it is a highly leveraged quality. Fear can result in enormous amounts of waste; its ambiguity makes facing one's fears even more difficult to overcome. The outcome of fear is one of the invisible numbers that detract from the improvement of your bottom line. The culture of the company is important. To be able to improve, there must be a parallel commitment to learning. Just as learning keeps the mind young, an organization that is intent on learning is more likely to stay fit in the marketplace.

If SMEs appear to be disinterested in environmental management, it is important to determine the root cause of their apparent indifference. Some surveys of small business indicate a high interest in sustainability although the owners may see management of this issue as beyond their control.

How do small businesses learn? How can you change ingrained habits? Answering these questions can be especially difficult in family run enterprises, where habits are reinforced by personal history; breaking out of the cycle can be very difficult. Good Housekeeping and management of environmental issues are often treated as a low priority when compared to the business operations. This oversight tends to be caused by lack of knowledge about the interaction between human action and the impacts that result on the environment. Lack of ecological literacy is common in today's business world, yet attention to this problem can enable twenty-first century improvements that will position you at the leading edge and give your business the competitive advantage that it needs.

The lack of ecological knowledge is compounded greatly by a number of common myths. Take a moment to review some of these myths:

Myth A – “*I am so small that what I do is not important.*”

Fact – It is the seemingly trivial contribution of individual actions that have led to the current state of environmental degradation.

According to APEC¹, there are more than 40 million legally constituted small businesses operating in this economic region. If each one has that attitude, it can be no surprise that the environment is in such a poor state.

Myth B – “*Efforts incorporating environmental management are expensive, with no accrual of financial benefits.*”

Fact – Life Cycle Assessment research has indicated that in most, but not all cases, for every dollar of environmental savings there is a corresponding dollar of cost reduction, with obvious benefits to the bottom line. Many people have mindsets, which trap them in the belief that the environmental management is a cost, rather than an

aspect of business that can provide a competitive advantage. Remember the challenge of rock logic outlined in Chapter 1?

Myth C – “I cannot afford to pay for this, let someone else (i.e. a bigger company with deep pockets, government).”

Fact – The question is not who pays, but how everybody pays. When no one takes control of costs, the price is uncapped, the process is inefficient, the outcome is not effective. It also potentially puts the decision for your business in the hands of a third party who may know nothing about your business at all; a risky position, isn't it?

Information Related Barriers

Lack of Awareness and Information

Often, management may not be aware of the downsides of their business. They may not understand the environmental impacts of the activities of their organization. Also, internal communication in the organization may be weak, creating barriers to infiltration of the awareness coming from the bottom up.

Lack of Exposure.

Benefits of a system based and business-environment integrated approach are often not known to the top management.

Technical Barriers

The state-of-the-art information on new technologies, operations, industrial processes is often not available to the top management (particularly in SMEs) and technical support is not updated within the industry. Lack of technical expertise also is a major barrier.

Economical Barriers

Lack of Financial Resources

One of the main barriers for small companies to implement GP options is access to capital. In many cases, internal financing is just not possible. Many experts agree that access to capital is difficult and will continue to be a problem for small companies.

Means of Achieving Commitment of Top Management

Depending on the culture, information related barriers can be overcome by getting top management to attend a presentation, or by meeting with top management of a company that has already embraced Green Productivity. Alternatively, providing top management with a few articles on success stories so that they can read about the value of Green Productivity may be a way to start.

How to obtain the commitment of Top Management

The awareness programs could be tailor-made for specific organizations based on the type and size of operations and existing level of awareness.

At the October 2006 Stockholm conference, Sustainability of the Planet, participants articulated five gaps between today and progress towards sustainability. Of the five, industry felt that the lack of incentives was the primary reason for inertia.

The awareness programs should target the following:

- Understanding how actions or possessions cause environmental impacts
- Elements of productivity
- Introduction to Green Productivity: concepts and benefits
- Illustrations of Green Productivity: success stories
- Overview of Green Productivity: methodology

Visits to industries that have successfully implemented Green Productivity should be organized. Preferably, visits should be in the same sector and scale of operations. Management would then have a chance to examine success in Green Productivity and understand outstanding challenges first hand.

During industry visits, the emphasis should be on:

- What were the problems faced by the industry?
- What Green Productivity options were generated and implemented in response to these problems?
- What were the results in terms of productivity and environmental improvement? What were the costs and the benefits?
- How is continuous improvement practiced?

Once you have secured the commitment of top management to Green Productivity, you are ready to start your processes of adoption.

4.3 Step 1: Getting Started

Objectives

By the end of this step, you should have:

- Decided on the members and formed your Green Productivity Team(s)
- Contacted external consultants, if required
- Selected your Green Productivity leader (which may be you)
- Decided on responsibilities
- Prepared schedules for regular meetings to discuss progress (sharing accomplishments and barriers to success)
- Conducted a Walk Through
- Collected baseline information

Task 1: Team Formation

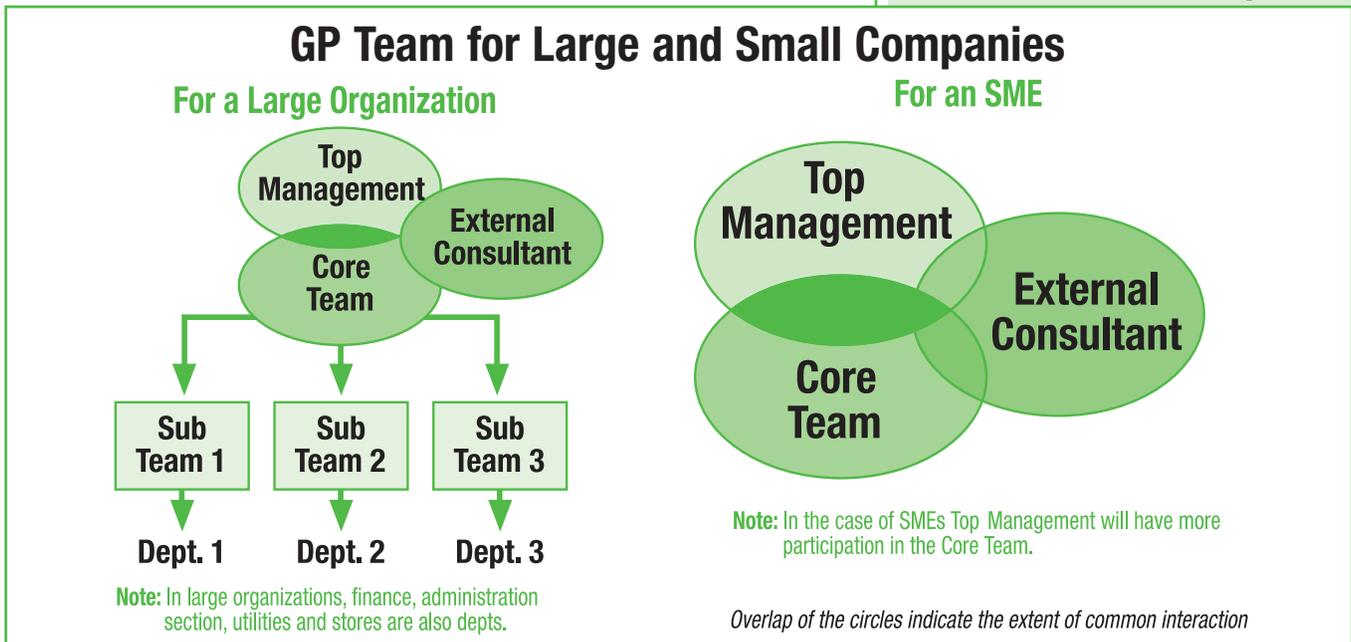
Having the right resources includes having the right people involved. Teams should not be formed on the basis of one person from each department. A needs analysis should drive the selection of members. In smaller organizations, there are more defined sets of resources, a factor that may require external assistance. An external

consultant need not be a professional consultant; someone from your supply chain, either upstream or downstream, may fulfill this role.² As the scope of the tasks change, so too may the team. Evolve the composition of the team to match the dynamic nature of the task.

In larger firms, there may be different levels of teams, and different teams in operation at the same time. A core Green Productivity Team would be responsible for supervising the implementation of all Green Productivity programs. A sub-team would assist the core team on specific areas and functions according to a plan. The assignments may be system-wide to follow the flow of a process from the input through to the output phase, or it may be divided by departments. The composition should also suit the culture of the organization.

Figure 4-2 Sample GP Team for Large and Small Companies

Figure 4-2



The Green Productivity Team needs to address the following tasks:

- Conduct a Walk Through;
- Collect baseline information;
- Identify problems;
- Generate and evaluate Green Productivity options;
- Prepare a Green Productivity implementation plan;
- Implement Green Productivity options;
- Take corrective actions as needed;
- Build documentation;
- Communicate with top management and seek approvals at various milestones.

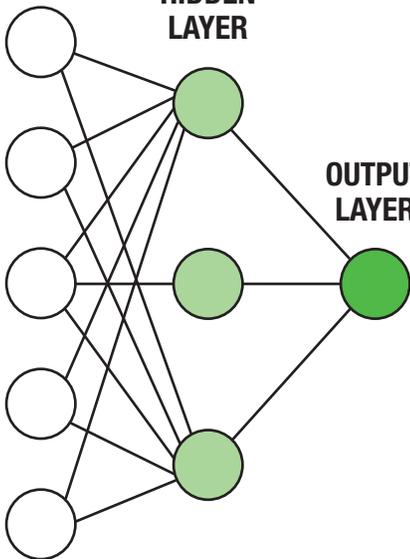
There are three tools that can help your GP team prepare: Brainstorming, attribute analysis and needs analysis. Chapter 2 outlines the process for conducting a needs analysis for training; Brainstorming is found later in this chapter.

Attribute Analysis is an assessment tool that is often associated with location-based problems, where the real criteria are masked. The attributes themselves assist in the interpretation because they can delineate the edges of the concealed targets.

INPUT LAYER

HIDDEN LAYER

OUTPUT LAYER



Qualities of a Team Leader

A Team Leader should have:

- in-depth knowledge of processes and operations in the industry;
- access to all departments;
- healthy relationships with staff;
- managerial qualities.

Responsibilities of the Team Leader

- Preparing an agenda;
- Summarizing and getting agreements;
- Making assignments for taking actions;
- Setting and conducting review procedures;
- Reporting to management;
- Communicating management's views to the members of the team.

Build success into your teams. There are certain behaviors that you need to adopt and others that you need to discourage and avoid.

ADOPT	AVOID
Cooperative	Argumentative
Openness to feedback	Closed mindedness
Honesty	Fear
Active listening	Interruptive
Patience	Intolerance

There are four phases to the development of a team:

Orientation – the team is *formed*, members get acquainted, develop an understanding of their respective roles.

Conflict – a period of *storming* when alternative views are tabled, members state their ideas; differences of opinion may emerge.

Emergence – the team *normalizes* and sets how they will interact, finding how they will achieve consensus and where they will need to compromise.

Reinforcement – the team starts to *perform* with a shared sense of commitment and unity of purpose.

The faster you can get your team to the fourth stage the sooner you will start to see results. If your team has met before, the first few phases may only take a few minutes while the members get reacquainted.

A Sample Team Formation

A department-wise allocation of tasks is shown below for a large organization.

Purchasing: Develop and implement controls of materials, maintain inventory, procure information on material hazards, environmental impacts, eco-friendly alternatives.

Human Resources: Define competency requirements and job descriptions for various roles in Green Productivity. Develop training programs based on a needs analysis, as discussed in Chapter 2. Integrate the Green Productivity system into reward, discipline and appraisal systems.

Maintenance: Implement preventive maintenance for key equipment. Track equipment performance, cost efficiency, etc. Maintain logs and inventory on equipment, machine parts, etc.

Legal: Check requirements on compliance to all applicable regulations and laws, update legal documents, communicate risks of non-compliance.

Finance: Evaluate Green Productivity options for economic feasibility; prepare budgets for Green Productivity options; track data on costs incurred and benefits accrued in Green Productivity program.

Engineering: Prepare relevant drawings such as Process Flow Diagrams, Eco-maps, Control charts, Check Sheets, etc. (these are discussed later in this section); prepare Material Balances; carry out Benchmarking; set objectives and targets; develop performance indicators; generate and evaluate Green Productivity technical options; prepare implementation plans; implement Green Productivity options; carry corrective actions if required; support training of line workers.

Other important issues to be considered in the formation of the Green Productivity Team include:

- External expertise for production, operations and environment-related aspects might be required. This is often the position that SMEs find themselves in as often one person holds more than one area of responsibility. Recalling a retired staff member may be useful since he or she would have substantial experience with the industry's operations in the past.
- Frequent meetings are a must to consolidate the work done and decide future strategy to keep the team focused on their objectives. This meeting could be coincided with when the weekly management-staff meet.
- Integration of Green Productivity team in larger organizations with teams operating on any other quality or management systems in place, like ISO 9001 or ISO 14001, can be effective in terms of time, human and financial resources.

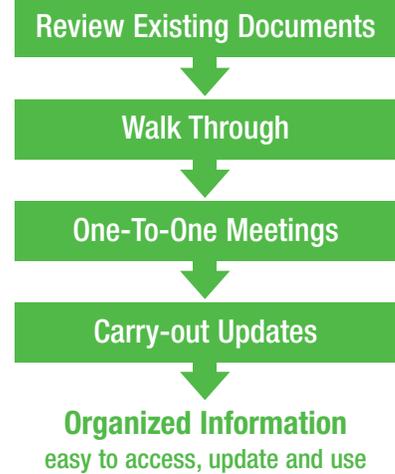
Task 2: Walk Through Survey and Information Collection

There are two key components to the second task that are part of preparation, composed of four options as shown in Figure 4-3. This is a process that has an input phase, a data-gathering phase, a throughput (categorization, cataloguing and organizing) and an output phase. Organized information should be easy to access, update and use as needed.

In companies where a team culture exists GP options may be implemented swiftly with quick results.

Figure 4-3

Information Collection



It is also beneficial to ensure that your GP team understands the big picture, to have a common understanding of the process that they are going to improve. Hence, a Walk Through is necessary for several reasons:

- Many environmental problems are location-based; a Walk Through can allow you to see many of the problems that will provide you with quick returns. This can also help you see where the potential for problems are – thus allowing you to remedy a situation before the costs are incurred by a mistake such as a spill.
- It is quite likely (especially in the case of large industries) that the members of your team may not be very familiar with the production activities in departments other than their own.
- People from other production departments may look at the entire scenario more objectively with an independent perspective.
- Identification of more and more opportunities for improvement is therefore possible when a whole systems perspective is enabled.

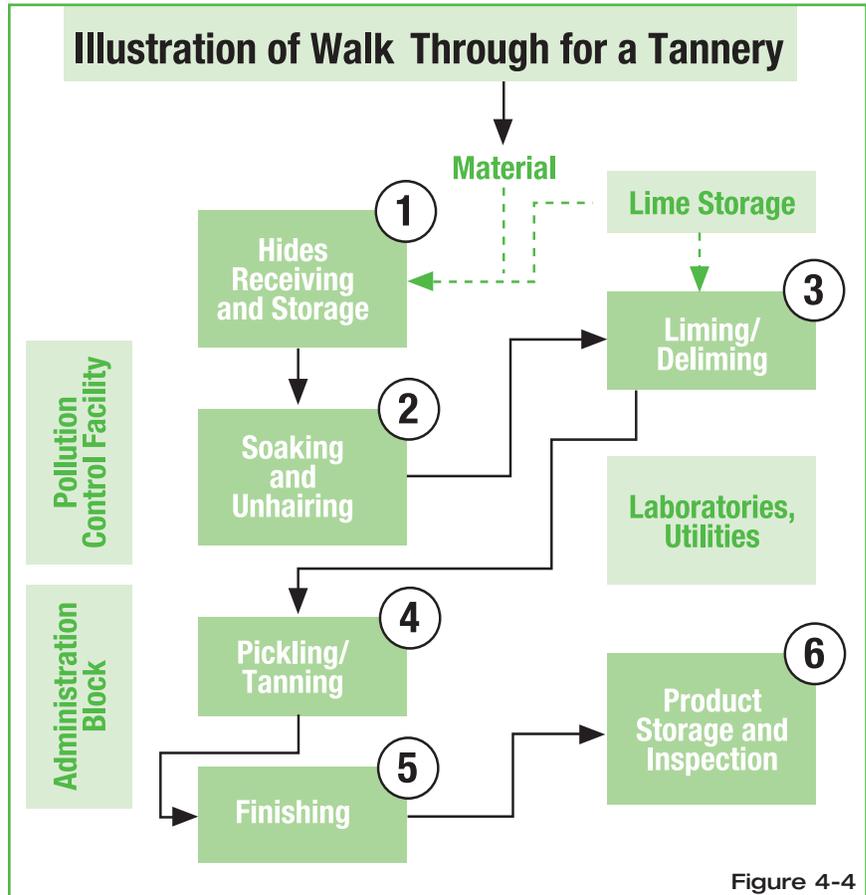


Figure 4-4

It is a good idea to have a briefing before the Walk Through. The briefing should cover the scope, provide a basic description of sequence and operations, points of emphasis and the time schedule. Additionally, some preparatory work is required to ensure that the Walk Through is an opportunity to learn and a chance to visualize the opportunity. Information that should be collected for the benefit of the Green Productivity team members includes:

- Layout showing process equipment, utilities, storage areas and offices;
- Process Flow Diagram (at least on the block level) and the date of last revision of the diagram;
- Layout of water supply lines, drainage channels, steam lines, etc. as applicable;
- Production related information in terms of scheduling.

A de-briefing session after the Walk Through should consist of reactions from the members, questions that are critical but have remained unanswered and a listing of additional information required. For this meeting, the team leader may invite select members of the staff to assist in the Walk Through.

Maximize the value of your Walk Through

- Ask questions but do not find faults
- Take notes
- Make sketches
- Take photographs (seek permission if required)
- Cover units such as pollution control facilities, boiler house, laboratories, canteens, wash areas and toilets, etc. in the Walk Through exercise

Techniques for Information Collection

Collecting information is not merely data gathering. Data is unconnected fact; in isolation it has lower value. Information is data that has been assigned to categories and classifications schemes or other patterns to enhance knowledge. Information is clustered to increase its value. Information should be gathered to suit a purpose, you or the person assigned as the team leader, should establish the parameters of this exercise before deployment.

In collecting information, the following steps are useful:

- Review Documents (existing and updates)
- Existing documents could help in identifying problems, whereas updates could help in generating options
- Assimilate information
- Clarify Issues - for example if an operator reports that the Stenter, a machine, is underutilized, the production manager in-charge would be able to assist in finding any possibility of doing additional jobbing
- Discuss with staff, external consultants, suppliers

A Walk Through provides you with a great opportunity - to discern where real improvements can be made.

Encourage your team to express ideas.

Figure 4-5

Types of Information

Organizational

Employee information.
Organizational and
Reporting Structure.



Financial

Balance sheets and
income expenditure cash
flows. Unit costs of
labour, water, steam, fuel,
electricity and raw
materials.

Service

Packaging and
disposal. Supply
chain requirements.

Environmental

Waste collection/conveyance
system. Waste treatment and
disposal operations.
Environmental impacts of
operations.

Production

Technologies, processes,
equipment, efficiencies.

Resource

Material Inventories. Supplier
Information. Fuel type and requirements.

Materials and Product

Material inventories, MSDSs,
consumption patterns and properties.

Documents existing in the industry should be studied as they may provide insight on things that have already been tried and failed, or ideas that were not acted upon but spark an improvement opportunity.

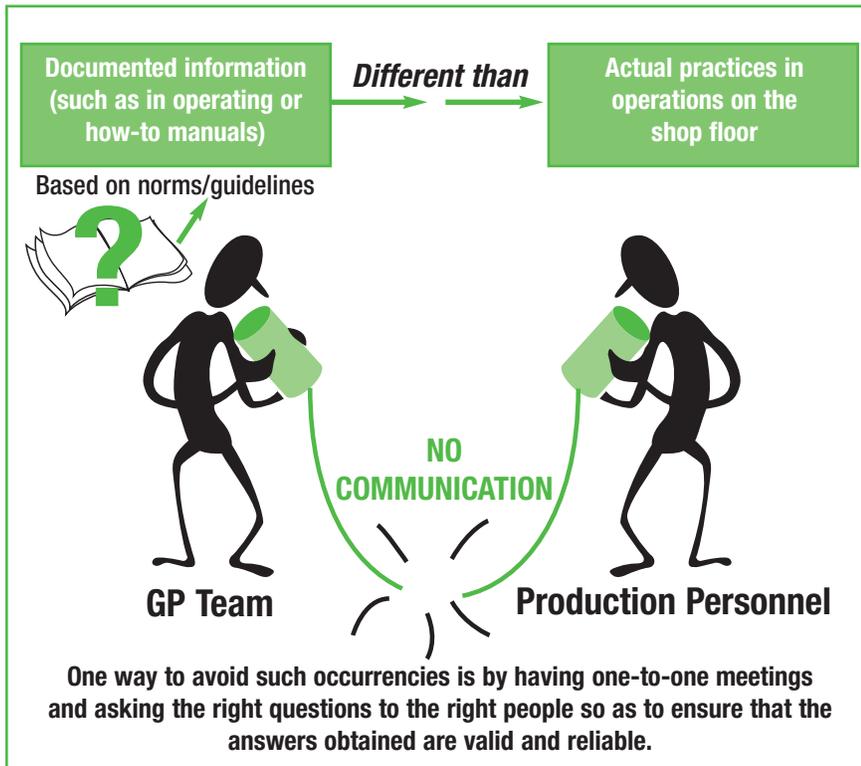
- Organizational
- Resource related
- Production
- Service related
- Materials and Product
- Environmental
- Financial

Walk Through the Industry

Conduct a Walk Through with the primary aim to get the Green Productivity Team acquainted with the operations, validate existing information such as Process Flow Diagrams, layout, etc. and identify problems by marking them down to develop Eco-maps. While gathering information during the Walk Through increase the value of your time by interviewing operators and staff to validate or clarify the information collected. Where there are gaps, the team can decide how critical the information gaps are during the debriefing.

One-to-One Meetings

Points arising during the review of documents and Walk Through could be further discussed by conducting one-to-one meetings with concerned staff, so as to seek clarification and crystallize the understanding of the information collected.



Queries unanswered during internal meetings could be discussed with external experts, vendors, suppliers and other interested parties.

Questions that could be asked in One-to-One Meetings

- What is the time taken for each batch operation?
- What are the raw material requirements? How are they weighed and transported to the production area?
- What are the water and energy requirements? How are they measured to achieve the desired optimum level?
- How is the completion of the production batch ascertained? Is there any indicator/alarm or is it dependant on the operator's judgement?
- What rejects happen as a result of the processes? What is their quantity? What is the frequency of discarding these rejects?
- What is the frequency and water-energy consumption for the operations, such as floor washing, container cleaning etc.?

Carry out Updates

Updates would include state-of-the-art information on technologies, processes, materials and resources. Searching the Internet can be a useful and inexpensive way to find material if something is in a transition period.

Items to be covered during information collection

TYPE	EXAMPLE
Organizational	Organization structure and reporting systems (structure). Employee number, shifts and profiles in terms of skills and experience.
Resource Related	Material procurement data and inventories maintained. Consumption patterns of utilities like water, steam, fuel and electricity. (This data may be collected on monthly averaged and daily averaged basis.) Supplier information/ quality of raw material.
Production Related e.g. for industries	Description of technologies and processes used. Equipment details, utilization and conversion efficiencies. Quality control related information in terms of quality thresholds and percentage of rejects. Productivity related norms and benchmarks.
Service Related e.g. for hotels	Services provided. Services utilized. Levels of services.
Materials and Product Related	Packaging and disposal. Supply chain requirements.
Environmental Related	Waste collection/conveyance system. Waste treatment and disposal operations. Any common waste collection, treatment and disposal systems in the neighbourhood. Any environmental measurements on the working environment e.g. noise, air pollutants, odour. Any records on occupational safety and health. Any data on environmental quality of air, water and land in the neighbourhood. Environmental regulations applicable. Local government policies. Any relevant national agreements made on international issues.

Financial	Balance sheets and income-expenditure cash flows. General cost structure showing contribution of labour, water, steam, fuel, electricity, raw materials. Unit costs of labour, water, steam, fuel, electricity, raw materials. Capital and operating costs of waste collection/conveyance, treatment and disposal systems.
Potential sources of information could be: <ul style="list-style-type: none"> • Documentation on the operating procedures • Documentation on the design and equipment specifications • Documentation on ISO 9001-QMS, ISO 14001-EMS, TQM/TQEM • Environmental Assessment reports, Environmental Monitoring reports, Industrial health and hygiene surveys • Internal reports on Resource Consumption and Productivity • Libraries / Internet / Research Organizations 	

As mentioned before it is beneficial to have a debriefing after the Walk Through.

The meeting should consolidate answers to questions such as those given above, focussing on questions that are critical but have remained unanswered and a listing of additional information required.

Tools for Getting Started

Flowchart

Flowcharting is a graphical method of representing activities or decision processes, showing pictorially how all the steps taken in a process linked together enables work. By definition, a flowchart presents the sequence of activities as well as the function of the activities, e.g. information collection, analysis, operation, decision making, etc.

Flowcharting allows all relevant processes to be consolidated, along with the identification of gaps, duplications and dead ends. It facilitates process simplification. As very large process diagrams are hard to validate and control, they should be split into smaller levels. Care must be taken to keep elements of the chart at the same level of detail.

Process Flow Diagram

A specialized flowchart presenting the processes and their sequences in an industry is called a Process Flow Diagram (PFD). Often, individual processes on the production line have sequential batch operations, e.g. dyeing process is a batch operation consisting of washes and dyeing activities. Such operations within a process could be captured in a specialized flowchart such as an Operational Sequence Flowchart.

While collecting information, due consideration should be given to:

- Seasonal variation in product demands and raw materials.
- Operational variations including shut downs for maintenance.
- Deviations from normal operating procedures.
- **QUALITY of information!**

The PFD must start with raw materials at the top of the diagram and end with the final product at the bottom (finished and packaged goods).

Colour coding can be used to indicate different media releases, the nature of discharge, for example continuous, intermittent and recycled flows.

It is also useful to include as much detail as possible while maintaining clarity. For example, it is useful to indicate existing and newly constructed portions of the facility. Including land contours can be important especially on sites that occupy large undulating or sloping areas.

ETP = Effluent Treatment Plant

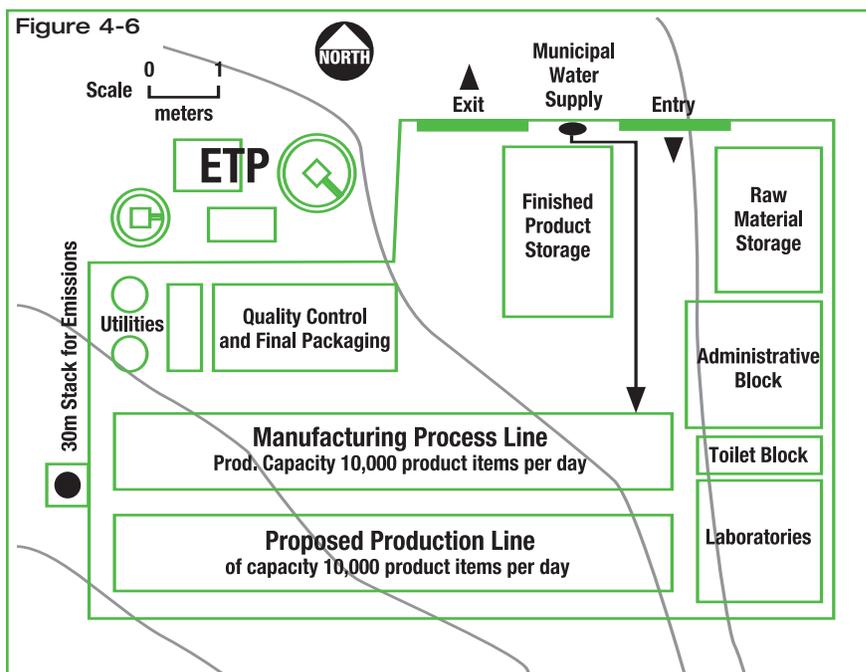
Existing PFDs should be checked for completeness during the Walk Through or a new PFD should be prepared. It is best to start with a general list of the main operations in the processing stage. Detailed listing can then be done for each unit operation that may be the focus for the productivity and environmental improvement program. A PFD can be prepared by connecting the individual unit operations in the form of a block diagram.

A PFD should address the following:

- All processes and operations should be in the proper sequence.
- Inputs and outputs for each process stage should be clearly indicated.
- Details on any relevant process and/or monitoring data may be shown in the side boxes.
- Points of measurements and quality control should also be shown.
- Releases or emissions in all applicable forms such as air, water, solids should be clearly shown.
- Separate flowcharts may have to be drawn for capturing special process variations. These variations may be applicable for certain products, seasons, etc.

Plant Layout

Layout, in combination with the PFD, provides a good basis for the complete understanding of the process sequence and operations. The layout diagram, shown in Figure 4-6, should be drawn to scale, clearly indicating the North direction.



Layout should show the facilities/operations as they exist on the floor. The locations of various utilities (e.g. boiler house), laboratories, canteens, administrative blocks, storage areas (especially of hazardous substances) should be clearly indicated. Areas that are marked for future expansion should also be shown. The compound wall should be indicated clearly showing the entry and exit gates.

Special thematic forms of layout can also be prepared that show water supply lines, steam lines, cabling, effluent drains, storm water channels, etc. Results of line balancing, time and motion studies can also be depicted on the layout as a specialized theme.

For facilities that have emissions to air (especially of odorous compounds), showing of a wind rose is useful in assessing the environmental impacts.

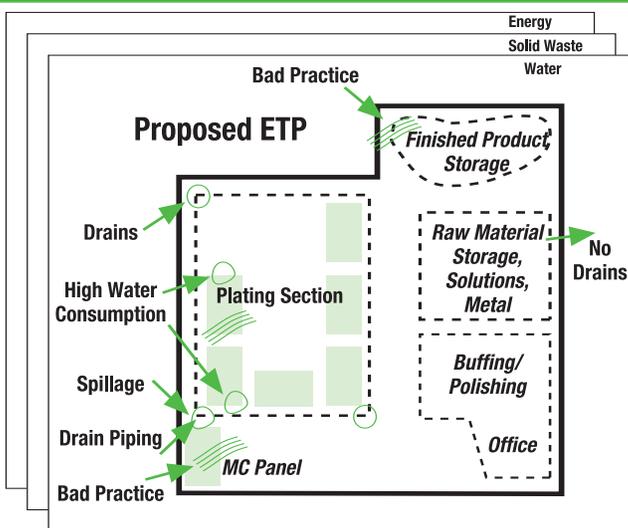
Finally, layout forms a base for the preparation of Eco-maps that further assists in the identification of problems and problem areas.

Eco-mapping®

Eco-mapping is a very simple and practical tool to analyze environmental performance. Eco-mapping is especially useful for SMEs as it requires little technology and can be completed at a very low cost. It provides a visual diagram that shows a bird's eye view of the company's operations and processes. As it gives an inventory of practices, Eco-mapping can quickly pinpoint housekeeping techniques that are less efficient. Eco-mapping helps in the company's corrective measures to enable improvement of environmental performance and the efficiency of its operations. Analyzing Eco-maps enables you to understand the company's current practices and pinpoint problem areas so that improvements can be made.

Eco-mapping is being used in many countries by very small enterprises - companies with less than five people. It is an easy tool to comprehend. It can give you quick results!

Figure 4-7



Steps in Developing an Eco-Map

1. Draw a layout map of the factory or work-site. It should include roads, parking lots and nearby buildings.
2. The interior spaces of the factory should be drawn to scale as accurately as possible.
3. Directional signage and some key reference points should be incorporated so that anyone looking at the map can immediately orient their location relative to the site.
4. For a factory covering more than one single floor, a layout map of each floor should be made and marked accordingly.
5. Use a copy of the layout to develop an Eco-map for each key issue. Areas are marked on the Eco-map where practices are incorrect, deviate from the norm, or simply where housekeeping and storage practices need to be improved. Key issues include:
 - Water consumption and wastewater discharge
 - Energy use
 - Solid and hazardous waste
 - Air, odours, noise and dust
 - Health, safety and environmental risks
6. Other valid problem areas can also be added, such as:
 - leaks/overflows and other housekeeping challenges in the production area;
 - transportation practices for raw material/finished products;
 - material handling and storage losses for raw material/finished products;
 - working conditions, ambient noise levels, etc.;
 - safety issues, disposal practices for wastes, reject raw materials and products;
 - variances in standard operating procedures, identifying any discrepancies.
7. For each Eco-map, everything that is related to that problem category should be included. For example, an Eco-map for water consumption and wastewater discharge should pinpoint the locations of spillage, discharge, over-consumption, and contamination.

Important Assumptions: To benefit from the use of an Eco-map, it is assumed that the physical set-up and the production process of a company can be translated into visual diagrams. A bird's eye-view captures the important environmental problems, which can be understood by the person producing the Eco-map as well as the decision-maker.

Other Information

- 1. Level of Effort:** For an effective session, all participants should have a fair understanding of a given production process in which a particular Eco-map is to be produced.
- 2. Skill Level:** Although technical drawing skills are not required, participants should be able to draw simple diagrams.
- 3. Time Required:** Producing a simple Eco-map for a given floor level of production requires about an hour.
- 4. Resource Requirements:** A floor plan of the company/factory is required. Flip chart, marking pens and colour pencils will facilitate the identification of the environmental problem(s).
- 5. Initial Inputs:** You will need a floor plan of the factory, a description of the factory in terms of raw materials used and the final products produced. Including a statement of the Green Productivity issue, question or problem that you are trying to solve can enhance the value of this activity.
- 6. Output:** Eco-maps for each problem category.
- 7. Utility:** Eco-maps can be used to develop your understanding of the problem areas. They can also be used during monitoring and review. An Eco-map developed before the introduction of the Green Productivity option can be used to compare the facility after implementation to examine the change. To maintain their utility, Eco-maps should be updated annually or every time there is a change such as a renovation or expansion.

The four major activities in developing an Eco-map are Draw, Document, Collect Data and Estimate. A description of these activities is given below.

An Eco-map in 4 steps:

ACTIVITY	EXPLANATION
Draw	Areas where raw material is stored. The route for loading/unloading and hauling material. Handling of solid waste. Major areas of material use (plating tanks, soak tanks).
Document	Material inventory. Permits for solid waste disposal. Plan of solid waste handling system.
Collect Data	Material Consumption (relevant units). Spot checks on material/weights/volumes. On quantity and type of pollutants/contaminants in solid wastes.

An easy way to determine where your major risks are, is to utilize a variation on Eco-mapping by adapting an overlay process, a technique used by an American town planner, Ian McHarg. Create a base map and then using tracing paper or Mylar, highlight the areas you have indicated as high priority in each category on a separate sheaf. Lay these on top of each other. If you have a number of priority areas in the same spot, you can quickly see that you have a critical location where multiple conflicts exist. This can also help you in considering how to proceed in terms of taking action and may demonstrate to you the need to think holistically and creatively about the combination of GP options.

ACTIVITY	EXPLANATION
Estimate	Wastage of material. Poor practices. Impact of pollutants.

Keep the keys simple

Signifies the priority areas where immediate action is required



Smaller problems or lower risk areas



Monitor potential environmental risks for future review



Benchmarking

The objective of Benchmarking is to identify best practices in any type of organization that has established a reputation for excellence in the specific area of interest. The outcome of this is to enable you to identify and fill gaps in performance by putting in place best practice, leading to superior performance.

In the Green Productivity context, Benchmarking introduces the idea of measurement, which helps to focus on the mission and to identify measures and targets for important business processes. It is also the basis of continuous improvement. Benchmarking can be used effectively for identifying problems and causes. Benchmarks are also valuable in setting objectives.

The procedure for conducting Benchmarking:

- Identify the functions / processes / parameters to be benchmarked.

Establish a Benchmarking team. This may be your existing GP team but may also involve someone with specific expertise just for this activity.

- Decide the benchmark upon which you wish to compare your performance. You may wish to make this a sector initiative, or seek other partners. Do you want to seek best-in-class regionally or world class, or simply find a better practice than you currently employ? The higher the target, the more resources it may require.
- Check for the similarity of background conditions. For example, the water consumption for wool processing mill and a cotton textile mill will not be the same.

Collect and analyze Benchmarking information. This can be based on norms found in research literature, or by comparison with other industries in the sector or even competitors.

- Take action. Integrate the better practices as part of your GP options.
- Repeat the procedure periodically considering the variability of the parameter(s) due to technology improvement, performance efficiency, etc. and changes in norms set as benchmarks. Benchmarking is a cyclical activity to engender continual improvement.

For many sectors, Benchmarking is a cyclical activity to engender continual improvement.

Resource Consumption	<ul style="list-style-type: none"> - Water - Steam - Electricity - Fuel - Raw Materials
Production	<ul style="list-style-type: none"> - Capacity Utilization - Quality Assurance and Right First Time - Labour Deployed
Waste Generated	<ul style="list-style-type: none"> - Air Emissions - Wastewater Effluent - Solid/Hazardous Waste - Noise Levels

How do you compare?

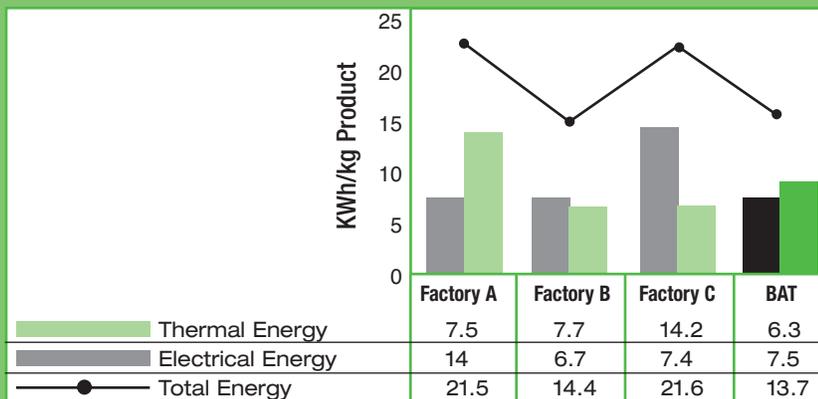
In the knit fabric industry, the following norms are used as benchmarks.

Consumption Per KG of Fabric	Energy	70 MJ
	Dye	4 grams
	Water	120 Litres

In cement manufacturing, the following emissions are norms for the industry.

Emission Type Per Ton of Clinker	Dust	0.2 kg
	NOx	1.5 kg (dry process) 4.5 kg (wet process)

Benchmarking of Energy Consumption



The chart on page 4-23 presents a competitive Benchmarking of energy consumption patterns for a particular process, observed in three textile factories situated in three different developing countries, and the observations are compared to the norms for the Best Available Technology (BAT) for that process.

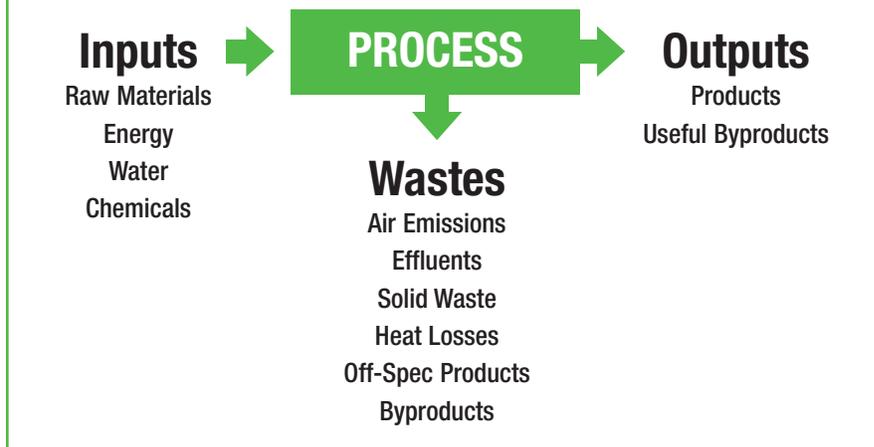
The observations in the Benchmarking exercise:

- Factories A and C exceed energy consumption inherent in BAT by more than 80 per cent. In factory A this is a consequence of excessive electricity consumption, most of which arises in the mercerizing, wet finishing and drying stages of the production process.
- The ultimate objective could be reduction of energy usage either through a change in technology and/or better housekeeping.
- Factory C's consumption of thermal energy is almost double that of BAT mainly due to losses in steam generated for drying and wet processing.
- Factories A and C need to set objectives addressing changes in technologies in the energy intensive stages of their production and move closer to best available technologies.
- Countries in which factories A and C operate also happen to be those where energy supplies are heavily subsidized. At the policy level, removal of price subsidies for energy in these countries is essential for better utilization of energy.

Material Balance

Material Balance is a basic inventory tool, which allows for the quantitative assessment of material inputs and outputs. The basis of the Material Balance for a process-based environmental management program is the development of a Process Flow Diagram as shown in Figure 4-8.

Figure 4-8



Material Balance establishes the major inflows and outflows; any discrepancies are quantified. This exercise helps you to understand what your specific consumption is relative to production and then allows you to compare this to a benchmark, be it an industry norm or a performance standard that you set for yourself.

Inputs to a process or a unit operation may include raw materials, chemicals, water, air and energy. Outputs include primary product, by-products, rejects, wastewaters, gaseous wastes, liquid and solid wastes that need to be stored and/or sent off-site for disposal or reuse. Material and Energy Balances are closely aligned, as a Material Balance carried out exclusively to understand energy is called an Energy Balance.

The basic principle of a Material Balance is easy to understand. In its simplest form, a Material Balance for any production system is drawn up according to the following principle:

Material and Energy Inputs = Products + Waste

Material inputs include: raw material, chemicals, energy, etc.

Energy includes: fuel, electricity, etc.

Products include: final products from the factory as well as by-products.

Waste includes: effluents, air emissions, solid wastes, waste heat, and off-spec products.

Material Balance also serves as a useful predictive tool to speculate on outputs, for changed inputs or for improved processes. You can see the pattern of input, throughput and output here quite easily. When discrepancies appear, you can trace the process backwards to identify problems and start to address the root cause(s).

Planning a Material Balance

A Process Flow Diagram (PFD) is a useful tool. It should be finalized and checked for correctness and accuracy before starting the Material Balance assessment. Make sure that the equipment necessary to record and measure parameters is installed and tested to ensure that it is calibrated correctly. Flows and concentrations should be simultaneously measured. Poor data management means that you will not get a true reading of your balance. This defeats the purpose of improving your productivity.

Sampling procedures and locations should be established based on the parameters involved. If biological or chemical analysis is required, it is important to make the necessary laboratory arrangements beforehand. Check with the lab for any specific handling instructions; some sampling is time critical or temperature dependent. If these details are overlooked, it could skew your results and provide false readings, again defeating the purpose of your efforts. Composite sampling³ is preferable over grab sampling⁴.

Remember that energy is the currency of productivity.

A Material Balance applied to toxic materials usage is referred to as a Toxic Release Inventory (TRI), a universal measure of inefficiency.

Sources of Information for Material Balance

- Routine monitoring data on inputs and outputs;
- Raw material purchase records;
- Equipment cleaning frequencies and procedures;
- Process Operating Sequences;
- Log sheets by operators and supervisors;
- Right First Time (RFT) or Reject statistics;
- Weekly material inventory statistics;
- Monthly statistics on water, fuel and electricity consumption.

**Considerations in Developing Material Balance

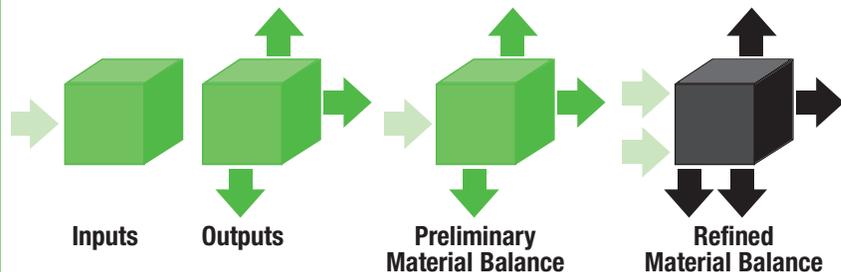
A Tie compound is the parameter or substance for which the Material Balance is established around a unit operation or process. A simple example of a tie compound could be the water added to account for most wet operations. In practical situations, more specific tie compounds, e.g. Nickel or Zinc in electroplating shops or dyestuff in textile processing, would be ideal. Another good example would be that of chromium in leather tanning. Selection of an appropriate tie compound for checking Material Balance is an important step.

Criteria for selecting tie compounds:

- an expensive raw material/intermediate;
- material common in most processing stages;
- a substance of hazardous nature;
- a substance/compound easy to measure/estimate.

Steps in Developing a Material Balance

1. Determining Inputs
 - recording raw materials procurement, water and energy usage
2. Quantifying Outputs
 - accounting for wastewater, gaseous emissions, solid wastes, energy
3. Selecting a Tie compound
4. Preparing a preliminary Material Balance
5. Evaluating and refining Material Balance



A Material Balance Sheet takes just 5 steps:

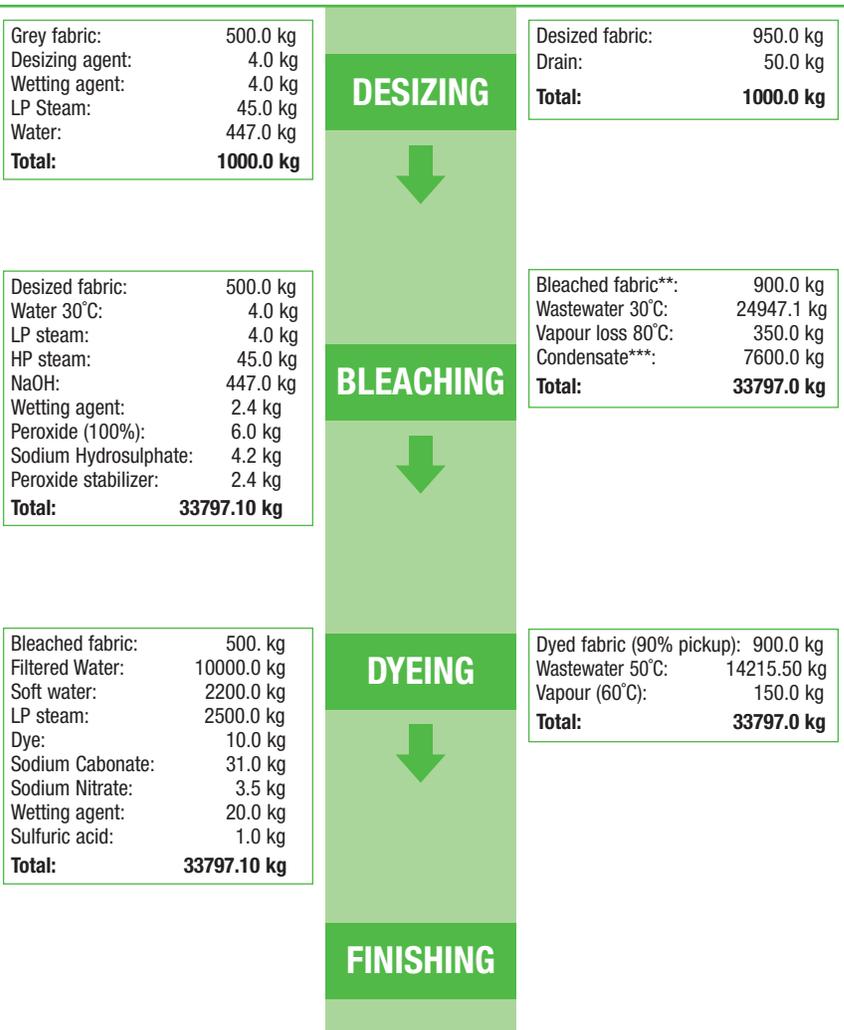
Determine Inputs	Include raw materials, chemicals, water, energy, etc. to the process/operation for which Material Balance is being assessed. Measurements should be taken for an appropriate length of time so as to ensure that the results are representative. Averages should be taken wherever necessary and appropriate. Existing levels of material recycling should not be missed. They should be incorporated while balancing.
Quantify Outputs	Outputs consist of products, by-products and wastes. Attention should be paid to any off-spec products and reprocessing sequences.
Selection of Tie Compounds**	Suitable and representative tie compounds should be selected for preparing the Material Balance.
Prepare a Preliminary	Based on the inputs and outputs, a preliminary balance should be constructed. Discrepancies should be calculated and wherever in doubt, measurements or analysis should be repeated to refine the Material Balance.
Refine Material Balance	The preliminary Material Balance should be improved by verifying the collected data during site inspections and by Brainstorming.

Before commencing measurements in a Material Balance, check with the operators and staff on standard operating procedures, frequencies and amounts of material inputs.

Chemical Oxygen Demand (COD) is another very useful tie parameter which sharpens the Material Balance exercise, especially to link production areas with the effluent treatment plant. Confirmation of the quality of the data can be achieved by:

- checking contributions of each department's process in terms of total COD load in kg/day,
- knowing the volume of wastewater and its COD discharged by each department, and
- cross checking it with the COD load observed at the treatment facilities.

In addition to water, chemicals, etc., energy is an important tie compound particularly for energy intensive and process sectors such as iron and steel, coke oven, textile, pulp and paper, etc.



Case Study for a Material Balance from a textile drying mill

This illustrated case study shows the Process Flow Diagram (PFD), with inflows at the top, the material inflows on the left, affiliated with the stage of the process and the outflows on the right.

Note that the Material Balance examination does not have to be excessively accurate (to the order of 99%). Precise accuracies are difficult when operations and processes are complicated. They should be accurate enough to be meaningful; a tolerance range of plus or minus 10% is generally acceptable in engineered systems. In the case of toxic, hazardous or bio-hazardous materials, there is a higher need for accuracy. The higher the risk, the lower the tolerance for inaccuracy.

Energy Balance

An Energy Balance may be defined as a quantitative account of the input and output forms of energy in a production process. Similar to a Material Balance investigation, the first step in an Energy Balance requires you to develop a Process Flow Diagram for the plant. Quantities of various forms of energy inputs for the plant or operating unit would then need to be measured and recorded. Energy inputs to a process or an operating unit may be in the form of steam, hot water, electricity, etc. as shown in Figure 4-9. Include the fuel sources needed to generate the heat in the inputs. The output is to be quantified in terms of the enthalpy (the heat content of the process)⁵ of the products, wastewater (process, condensate and cooling) and any energy losses such as steam leakage, etc.

Doing an Energy Balance is very similar to a Material Balance.

Figure 4-9

Energy Balance

Steam

Type	Quantity
-----	-----

Electricity

Quantity kW

Fuel Consumption

Item	Quantity
<i>Coal</i>	-
<i>Oil</i>	-
<i>Any other</i>	-

PROCESS

Products

Item Heat Content Qty.

P1 _____
P2 _____

Energy Losses

Item Heat Content Qty.

1 _____
2 _____

Wastewater

Item Heat Content Qty.

Process
Condensate
Cooling

Conducting an Energy or Material Balance is very similar in principle to accounting procedures whereby accountants perform balances to show the flow of money. The two balance concepts introduced here are to outline flows to help discern opportunities to improve your productivity.

Case Study – Revisiting the case of the textile-dyeing mill from page 4-28, this example shows both the Material and Energy Balance for the boiler house that generates the process steam for this manufacturing process.

INPUT	BOILER HOUSE	OUTPUT
<p>Material Balance:</p> <p>Condensate Water: 20.0 tons Make up Water: 60.0 tons Fuel: 6 tons Air (13% excess): 69.53 tons Total: 175.55 tons</p>		<p>Material Balance:</p> <p>Steam: 20.0 tons Blowdown: 8.0 tons Flue gases: 75.55 tons Total: 175.55 tons</p>
<p>Energy Balance: 10³ kcal</p> <p>Condensate 95°C: 1900 Make up 60°C: 4800 Fuel 60°C#: 180 Heat Combustion*: 62250 Air (30°C)[^]: 501 Total: 68431 <i>#Cp for fuel is assumed to be 0.5 kcal/kg°C</i> <i>*Calorific value 10375 kcal/kg fuel</i> <i>[^]Cp for fuel = 0.24 kcal/kg°C</i></p>		<p>Energy Balance: 10³ kcal</p> <p>Steam: 50112 Blowdown (160°C)[^]: 1488 Flue gases (231°C)#: 4608 Losses: 12223 Total: 68431 <i>#Cp for gas = 0.264 kcal/kg°C</i> <i>[^]Saturated temperature at 7.5 bar</i></p>

A Material Balance can be conducted using secondary or documented information when it is available. In some cases, calculations can be supported by field measurements to fill in any gaps. Care should be taken to ensure that all quantification is expressed by using the correct units for volumes and concentrations, preferably SI units⁶; and to ensure that these units are used consistently.

Energy and Material Balances can be carried out for the various equipment and utilities that enable production, it can include maintenance and cleaning, in addition to the main process. As a last crosscheck, keep in mind that for Material Balances “what goes in must come out somewhere”.

This concludes the activity entailed in the first step. Have you:

- Decided on the members and formed your Green Productivity Team(s)?
- Contacted external consultants, if required?
- Selected your Green Productivity leader (you are it!)?
- Decided on responsibilities?
- Prepared schedules for regular meetings to discuss progress (sharing accomplishments and barriers to success)?
- Conducted a Walk Through?
- Collected the necessary baseline information?

If yes, congratulations are in order!

If no, make a list of what is outstanding and what you are going to do to complete the task(s).

Is the remaining challenge a decision as to who should be responsible for completing any of the sub tasks? Try using a matrix to define and design who needs to do what.

Task	Who			
	Team Leader	Team Member	All Team Members	Consultants

This task can be accomplished when you start your process. Copy this form onto a flipchart. You can also use it to monitor progress, add a column to check off when tasks have been completed. If someone is having trouble completing a task, do not single them out and ridicule them. Use the group and the power of the team to determine what the problem is and create a solution. In this way everyone wins, including you.

4.4 Step 2: Planning

So many problems in this world could have been avoided; so many resources could have been used far more efficiently, if people had taken the time to plan.

At the end of this Step you should have:

- Identified problems and causes
- Set objective and targets
- Identified performance indicators
- Decided on the sub-teams which will be involved in the generation of Green Productivity options for each objective (in smaller companies the team members are more likely to be the same)

Task 3: Identification of Problems and Causes

Analyzing the compiled information supported by the observations made in the Walk Through enables identification of problems and causes.

Often, the problems can be identified on the basis of:

- Process Flow Diagram (PFD), Layout and Eco-mapping;
- Material and Energy Balance;
- Cost of waste streams.

The next step is to verify operating conditions and process parameters with the standard instructions or operating procedures by comparing them against norms and benchmarks to identify deviations. This can provide insight about the likely causes. Problem-specific root cause identification can be done through cause-effect analysis using tools such as Brainstorming, Fishbone (Ishikawa) Diagrams, Control Charts,

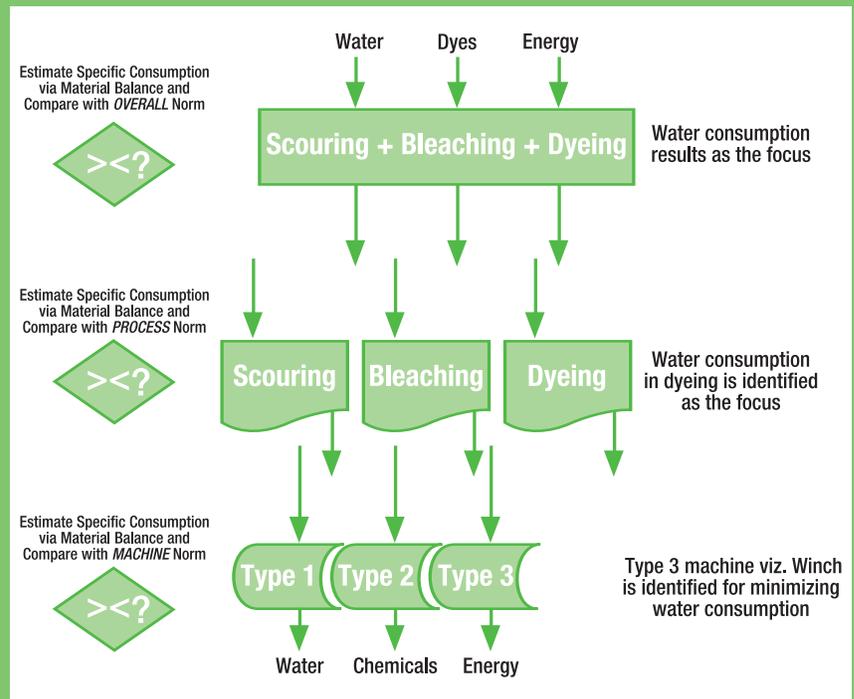
It's a good idea to date the information and identify the source in case you need to crosscheck. It is useful to establish a log or library that includes information as to who holds the material, if it is not in a central location. This can avoid time wasted later on. Keep it simple.

Concentration Diagrams, etc. This may require the collection of process specific or specialized information. In some cases it may be useful to conduct controlled experimentation or check through the operation of the system.

Material Balance assessments may require the collection of input data as well as output. This can be accomplished by reviewing secondary data or documented information when it is available. In some cases, calculations supported by field measurements can be used to fill in gaps in data.

Case Study

Comparing Norms and Using Material Balance to Identify Problem Areas



In the knitwear industry, the industry norm for specific water consumption for operations including scouring, bleaching and dyeing, is 120 litres/kg of knit fabric processed. If another plant in this sector finds it is using 180 litres/kg of knit fabric, there is reason to investigate the cause of the higher water usage. Material Balance can be used to calculate the overall specific water consumption using data on the water used during production. In this case, further comparison with the process specific norms (e.g. scouring, bleaching and dyeing) showed that the specific water consumption for bleaching and dyeing operations are above the norms, by 30% and 60 % respectively. What about the dyeing department's use?

Estimating Water Consumption

Install Water Meter

- cost/investment
- needed time period to order, procure, install and test
- could get damaged during use

Using Available Information

- amount of fabric processed in a batch
- number of batches in a day
- ratio of fabric to water (material liquor ratio)
- Wastewater measured by bucket and timer
- moisture in fabric was accounted for using calculations based on weight of fabric before and after dyeing

Conclusion:

Same purpose achieved in lesser amount of time, easily and without any major investments.

In this case, the dyeing machine did not have a water meter to show the volume input. However, water consumption can be estimated by knowing:

- how much knit fabric was processed in a batch,
- number of batches in a day, and
- the ratio of fabric to water (called the Material to Liquor Ratio or MLR) that is maintained in the machine.

Allowance is made in the water balance by considering the additional moisture pick-up in the fabric after dyeing. This was done by comparing the weight of semi-dry fabric that was drawn after dyeing.

What are the facts?

- A. A Jigger machine is used for processing the fabric
- B. Fabric processed in a batch = 250 kg
- C. Batches processed per day = 3
- D. MLR = 1:10, that is for every 1 kg of material processed, 10 litres of liquor is required

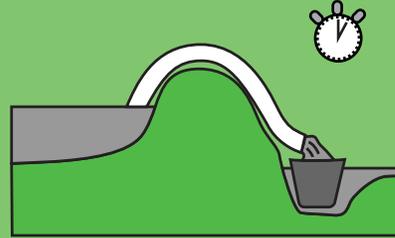
Therefore:

Water consumption (liquor required) = $250(\text{kg}) \times 3 \times 10(\text{L}) = 7.5\text{m}^3$

Case study continued on page 4-34

Note that the estimated flow of the wastewater can be compared with the actual flow by a very simple technique, the bucket and stopwatch method.

The bucket and stopwatch method: Take a bucket, for example a 5-gallon pail. Use a stopwatch to measure the length of time it takes to fill the pail. It takes 47 seconds.



To determine Flow rate = volume/time

$$\frac{5 \text{ gallons}}{47 \text{ seconds}} \times \frac{60 \text{ seconds}}{1 \text{ minute}} = 6.4 \text{ gm}$$

Use 450gpm = 1cfs to convert to SI units

The wastewater volume can be estimated by providing allowance for wet pick-up in the fabric. For example, when wet-pick-up is 90% of the weight of the fabric processed, this equals 225 kg of water, which is equal to 225 L = 0.225m³

If evaporation losses are assumed to be 20% of the fabric process, this equates to 0.05m³. Now you can work out the total wastewater used in a day.

Total wastewater = 7.5 - 0.225 - 0.05 = 7.225 m³ (drained from all batches in a day).

A systematic approach to problem solving involves moving from a view of isolated parts to an overview of the parts as a whole system including their interaction.

Identification of Problems

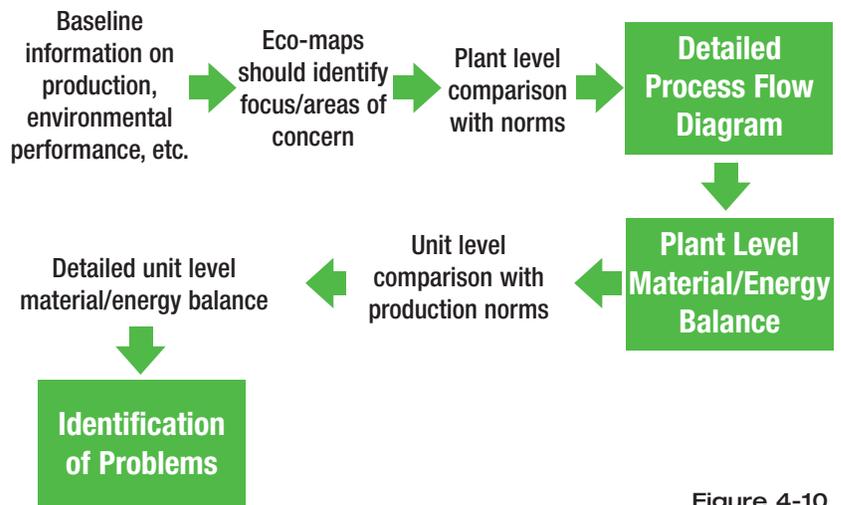


Figure 4-10

At the outset, a macro level assessment of the plant as a whole is done to identify the problem areas. For this exercise, tools such as Eco-mapping may be used. Eco-Maps are useful in identifying focus areas in the plant for various themes such as water, solid waste, energy, etc. Benchmarking is an effective tool that can be used to compare processes with the norms, both at the plant and unit operation level.

A Process Flow Diagram and Material Balance are useful to identify the basic problems. They can be used together with Benchmarking to identify problems at the level of the plant, departmental as well as in individual unit operations. By using a hierarchy of tools from Eco-maps and Benchmarking to Process Flow Diagram and Material Balance, the range of problems can be identified.

Once all the problems are identified, the next step is to carry out a cause-effect analysis. What are the cause(s) of the problems?

Figure 4-11 Identification of Root Causes

Figure 4-11

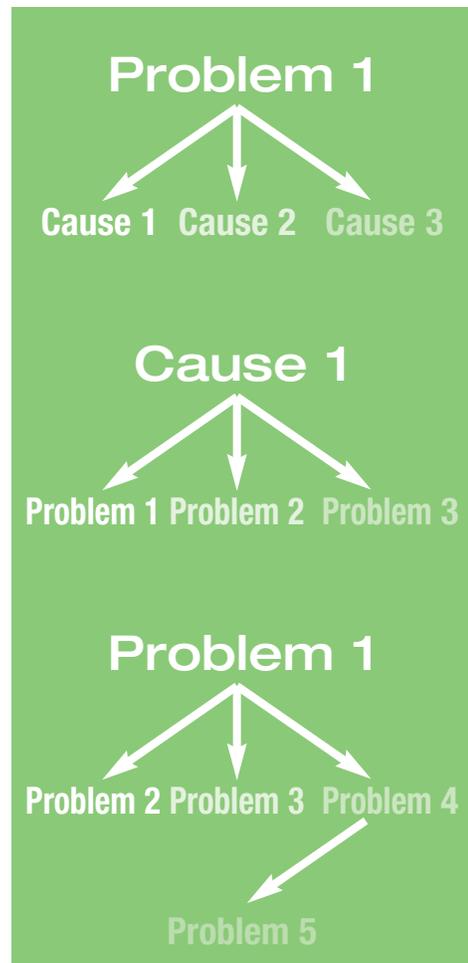
Why?



How?

Common Causes?

Common Problems?



A problem may have several causes. The key is to focus on the most critical causes.

Problems may involve several aspects of your business. Just as environmental problems are systematic so too are the productivity problems that can arise.

- Process
- Water
- Chemicals
- Energy
- Labour
- Costs
- Waste Generation
- Production
- Capacity Utilization
- Product Quality
- Market demand

Problems in the context of Green Productivity refer to:

- poor product quality
- poor equipment efficiency
- poor capacity utilization
- environmentally unfriendly practices
- non-compliance with regulation

These aspects need to be studied in order to identify the cause(s). You can check:

- how close your operations are to design and operating criteria
- the movement of material through the process and conversion efficiencies
- the efficiency of equipment utilization

The use of Brainstorming and the Fishbone (Ishikawa) Diagram are useful here.

When there are multiple issues, the challenge is to identify what the real problems are, not just what they appear to be and to determine which one is the most critical.

In a knit-fabric processing industry the main problem identified was that of not being able to consistently produce the desired quality. A number of causes however were found to be responsible for this problem. Some of them were:

- Poor bleaching efficiency.
- Low quality dyes with poor fastness.
- Winches used for dyeing were not operating under optimum conditions.
- Poor process water quality.

Sometimes many problems may stem from a common cause.

In a knit-fabric processing industry, the following problems were identified.

- High consumption of scouring and bleaching chemicals.
- Pin hole problems in dyeing.
- Frequent problem of color matching.
- White spotting on the cylinder rollers used for drying.
- Excessive formation of scaling in the boilers.

The root cause of all the problems listed above was **poor quality of water.**

Problems identified in the earlier tasks need to be prioritized to set objectives and targets.

The primary criteria for prioritization could be:

- Severity of the problem - the scale and seriousness (level of risk) of the problem.
- Frequency - the rate of recurrence or regularity with which a problem appears. An insignificant problem that reoccurs several times in a production cycle can cause greater damage than a severe problem once in five years.
- Cost implications – obtaining accurate costs related to possible solution(s) to the problem is an important step, good technical solutions that you cannot afford will not help you solve the problem. Check this out before setting a technical suggestion as an objective.
- The estimated cost of inaction, i.e. cost of not taking any action on a problem area. Too often this is not considered and the ramifications can be significant to your business as it increases your risk. It also increases the risk that you represent to others in your supply chain and your community. Remember that up to 70% of the cost, including environmental cost, which a customer is burdened with, is acquired through purchase. Estimating the cost of inaction for problems includes establishing the cost of waste streams. Table 4-2 indicates the range of considerations you need to include and an approach to rating the various issues to help establish priorities. A final score based on the integration of the above parameters would compare the problems on a macro level and aid in deciding the objectives and targets.

What if your shareholders judged you not only by the quality of the product or service that you offered, but on the quantity and quality of your waste stream?

The resources that are lost to waste streams (raw materials, products, or by-products) are costs that form part of the assessment. In its simplest terms, this can be inferred to be the cost of inaction.

Table 4-2 Prioritizing Problems

Problem	Severity	Frequency	Cost Implications for Resolving the Problem	Cost of Inaction (waste stream costing)	Score (1-10 scale) 10 is top priority
PRODUCTIVITY					
Material Consumption	High	Always	High	High	9
Product Quality	Medium	82% success	Moderate	Moderate to High	6
Housekeeping	High	Always	Minimal	Moderate	10
ENVIRONMENT					
Legal Compliance	Medium to High	Occasionally on air, always on effluents	High	High	7
BUSINESS					
No. of Rejects from Customer	Minimal	5%	Minimal	High	4

Task 4: Setting Objectives and Targets

Once the problems and likely causes are identified, you are ready to establish your objectives and targets. A universal reminder for objectives and targets is that they should be **SMART**. When setting your objectives and targets, stay:

- Specific
- Measurable
- Attainable
- Relevant
- Trackable (and Time dated)

Figure 4-12 shares a matrix where the SMART technique has been applied to objectives and targets.

<i>Setting Objectives and Targets</i>			
Objective	Attain the present applicable industry norm of 120 liters/kg water consumption within 3 years.		
Target 1	Move from present level of 180 litres/kg water consumption to 160 litres/kg.	By March, 2000.	Practice housekeeping, strict process supervision, elimination of unnecessary washes, practice reuse of first washes.
Target 2	Reach level of 140 litres/kg.	By January, 2001.	Change dyes and chemicals that reduce washoffs in the dyeing department.
Target 3	Achieve 120 litres/kg.	By April, 2002.	Change two winches to one jet dyeing softflow machine in the dyeing department.

Figure 4-12

Techniques such as assigning costs to your waste stream can also help to show if you are meeting your objectives and targets. When targets are set they should be tracked by establishing performance indicators, which assists you in monitoring and reporting your progress. Control charts, custom charts or multi-vari charts can all be used to indicate your progress against the target over time.

Points to be considered in setting objectives and targets:

- Objectives should be based on problems identified.
- One objective can have multiple targets, which could be phased in over time.
- Targets should be developed based on the need. For example, if legal compliance is the desired objective by the end of one year, then the target for this objective is a timeframe, one year.
- Indicators to track the target with the objective should be established.

Objectives can include commitments to:

- Meet the sector-wide production norms.
- Design products to minimize their environmental impact in production, use and disposal.
- Control the environmental impact of extraction of raw materials.
- Promote awareness of Green Productivity amongst employees and the community.

Assigning Cost to a Waste Stream: A way to set objectives and targets

There is nothing so focusing as the financial impact of waste on your business to help you take action; people often dismiss the cost of waste as being the cost of disposal. With Green Productivity it is easier to see the incremental additions of cost from input to output, leading up to the true cost of waste.

Think of it this way:

Cost 1 – you bought a raw material

Cost 2 – you paid to store it

Cost 3 – you paid for labour to handle it

Cost 4 – you used energy to process it

Cost 5 – there are administration charges, which may include reporting to government if the material in question is regulated

Cost 7 – if it is not leaving as product, you have to pay to warehouse it until

Cost 8 - you pay someone to take it away.

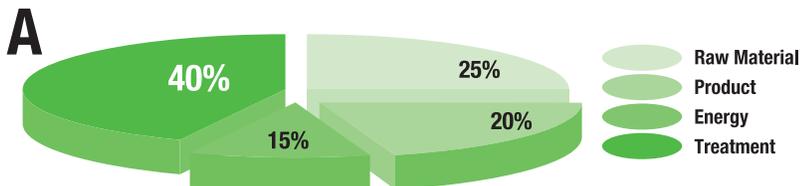
Green Productivity recognizes that assigning costs to the waste stream is a way to determine the monetary losses due to the generation of waste. This approach can also prove useful to prioritize which waste stream(s) need to be tackled first, and what kinds of options are needed to reduce cost, especially where the waste cannot be converted into a source of revenue.

Figure 4-13 shows the assignment of costs to waste streams as a way to set objectives and targets.



This is the place called Away.

Total Annual Cost of the Waste Stream 10,000 USD

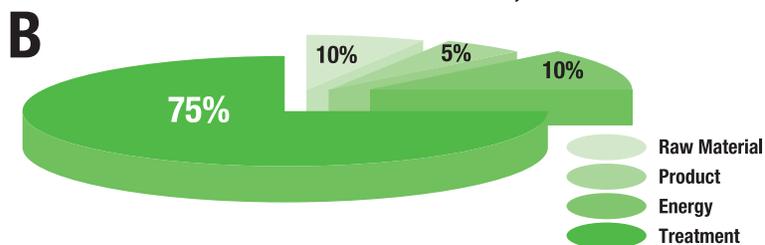


The pie chart A indicates that wastage of raw materials and product along with energy losses, contributes substantially to the total cost of the waste stream. Thus, there are the problems requiring attention (problem identification). Raw material wastage shares the highest percentage and should be tackled first (problem prioritization).

Figure 4-13

It is better to think of these streams as material streams or flows, not waste. Too often materials thought of as waste are handled in a manner that reduces their value.

Total Annual Cost of the Waste Stream 5,000 USD



After the implementation of the GP options, the total cost of the waste stream has reduced and the contributions to the waste stream cost are as presented in pie chart B. It indicates that the fraction of raw material, product and energy losses in the waste have reduced.

Figure 4-13 cont'd

Waste streams from a process can be a resource for someone else. For example, wastewater from pulping contains fibre; from phthalic anhydride⁷ production it contains maleic anhydride⁸ metals remain in plating wastewater.

Very often these resources have been found to be extremely high revenue generating. To identify the profit potential of waste streams you need to assign costs.

The first step in assigning costs to waste streams entails a detailed analysis of each waste stream to profile its characteristics and volume. Based on this understanding, the treatment of the waste stream required and costs can be estimated. While detailed analysis of the streams can provide you with data for identifying problems, which enable an analysis of the cause, assigning costs is a means to generate viable options.

Cost components associated in waste streams typically include costs of:

- raw materials in the waste
- product in the waste
- treatment of waste to comply with regulatory requirements
- waste transportation
- waste disposal

Assigning costs to waste streams can be used in several stages in the Green Productivity methodology:

- for the identification and prioritization of problems,
- setting objectives,
- in monitoring, and
- taking corrective and preventive action.

Case Study: Assigning Costs to Waste Streams: An Illustration from Dintex Dyechem, India: A GP Demonstration Project

A detailed analysis of the waste revealed three important waste streams:

- Mother liquor stream from the filtration step of the sulfonation stage
- Mother liquor stream from the condensation stage
- Particulate emissions from the flash drier

These streams were chosen based on the quality of discharge, pollutant strength and potential for raw material losses. The wash liquor streams were not found to be as significant as the Mother liquor streams and hence were not considered in the costing.

Mother liquor stream from the filtration step of the sulfonation stage

Cost of the waste stream = Cost of the raw materials in the waste + Manufacturing cost of materials + Cost of product in the waste = Cost of treatment over annum + Cost of waste transportation and disposal

A. Cost of raw materials in the waste

- = Cost of H_2SO_4 and HCl in the waste + excess ClSO_3H and ice
- = INR 70290/day
- = INR 21,087,000/annum

B. Cost of the product in the waste

- = Cost of Acetyl Sulfanil Chloride + sulfanilic acid in the waste
- = INR 18,500/day
- = INR 5,655,000/annum

C. Cost of treatment per annum

- = INR 5,298,000/annum

D. Cost of waste transportation and disposal

- = Cost of waste transportation and waste disposal
- = INR 8,800/day
- = INR 2,640,000/annum

Cost of the stream per annum,

(A+B+C+D) = INR 34,680,000; this is equivalent to US\$ 1,156,000.

What waste streams do you have?

What is the true cost of each waste stream?

Mother liquor stream from the condensation stage

Cost of the stream = Cost of the raw materials in the waste + Manufacturing cost of materials + Cost of product in the waste = Cost of treatment over annum + Cost of waste transportation and disposal

A. Cost of raw materials in the waste

= manufacturing cost of glycol and glycol esters in the waste + the cost of excess ethylene oxide

= INR 22,844/day

= INR 6,853,350/annum

C. Cost of product in the waste

= Cost of Glauber's salt in the waste

= INR 21,600/day

= INR 6,480,000/annum

Cost of the stream per annum,

(A+B) + C = INR 13,333,350; that is equivalent to US\$444,445

Emission from Flash Drier (included as the potential loss of product was highest in this process)

A. Cost of the stream

= cost of product in the stream

= INR 8,200/day

= INR 2,460,000/annum

Cost of the stream per annum (C) = INR 2,460,000; that is equivalent to US\$ 82,000

What GP tools and techniques would help you establish and maintain quality control for the materials within your waste stream? The higher the quality the greater the potential for a buyer. The net result for you is less waste (reducing your costs) and a new revenue source. Your community also benefits from a lower dependency on landfill.

Developing Green Productivity Indicators for Objectives and Targets

How do you know you have been successful? The use of performance indicators is important to:

- Check how your objective relates to your Green Productivity policy
- Determine the feasibility of the objective
- Estimate the approximate time necessary to achieve this objective
- Check whether the value of the target is adequate to achieve your objective. For example if the objective is environmental compliance but there is an expectation that the regulations will change before you can reach your target, it changes the assessment of value.
- Estimate what investments are necessary to achieve your objective. You need to have an approximate idea of the scale of the Green Productivity options required. Information on objectives considered common or cross-sectoral (such as water conservation or waste minimization) may be found in libraries, from research institutes, or on the Internet.

Useful criteria for selecting performance indicators includes:

- Representative
- Responsive to change
- Helpful for predictive purposes
- Understandable
- Relevant

See how developing GP indicators are tied to examples and Green Productivity Progress Monitor.

Some examples of Indicators used by companies

1. *Roche* uses 'Eco-efficiency Rate', defined as ratio of sales to environmental expenditure and environmental damage.
2. *General Motors* uses energy consumption per vehicle produced.
3. *Fiat* uses recycling index.
4. *DOW Canada* reports on greenhouse gases and emissions avoided as a result of various environmental initiatives.
5. *Novo Nordisk* calculates "Environmental Impact Potentials" for global warming, ozone depletion, acidification, eutrophication by site.

To be successful,
define it up front.
I will be successful
when...

Avoid indicators that mislead.

Case Study – Illustration of indicators used by Fiat to measure and report environmental performance

Fiat used the following indices to calculate, record and report its environmental performance on an annual basis:

Specific energy consumption expressed in equivalent tons of oil per billion lire of remanufacturing cost;

Water re-circulation index expressed as the ratio between the total re-circulated water used in the manufacturing process and total water requirements x 100;

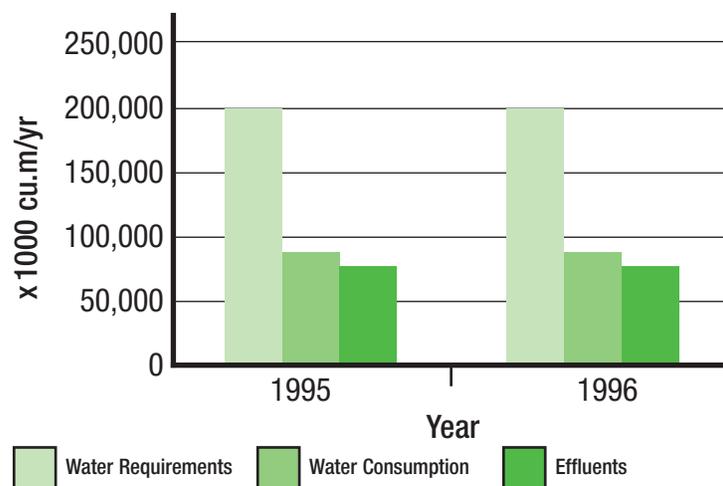
Specific water consumption expressed in cubic metres of water per million lire of manufacturing cost;

Specific waste generation expressed in tons of waste per billion lire of manufacturing cost;

Solid waste recycling index expressed as the ratio between the quantity of recycled waste and the total quantity of waste generated during remanufacturing x 100.

Using some of these indicators, such as water requirements, water consumption, volume of effluent, etc., the performance of Fiat's Italian plants can be compared for two consecutive years (1995 and 1996 as shown). Using these indicators, performance between these and Fiat's other plants could be compared.

Yearly Comparison of Water Requirements, Water Consumption and Effluents



Source: Fiat, Environmental Report, 1996, Italy

Tools for Planning: Introduction

Identification of problems and causes requires taking stock of the baseline situation in the industry, comparing with Standard Operating Practices (SOPs) or Benchmarks in the industry, and studying the impacts of the industrial operations.

For you to set objectives and targets that are SMART, you need to know how to prioritize the problems and set realistic goals, which can be achieved with best available technologies in line with your budgets.

Tools for Identification of Problems and Causes

Check Sheets

Check Sheets are very simple tools that can be used for collecting data over time to show trends and recurring patterns, which need to be understood and controlled. Check Sheets are particularly useful when the number of times a defect or value occurs is an important clue. However, they do not explain isolated incidents or random sequences. You can use this tool either during problem identification when baseline data is being collected, or after a solution is implemented, when you are collecting data to monitor the situation.

Check Sheets can be beneficial to you as they can help you establish the facts surrounding the incidence of failure; your team can then work to identify the cause(s) of failure. As a result, actions can be taken based on evidence, not supposition.

Case Study

Check Sheets

Number in a week

Number of instances lights were kept on by customer while leaving the room.

||||| |||||

Number of instances water was left running by the customers.

||||| |||

Number of customers who demand daily change of room linens, towels...(unused)

||||| ||||| |||||

A hotel was trying to develop environmentally sound options for their rooms. To devise such options, the Green Productivity team decided to use Check Sheets to study the behaviour and habits of their customers. Behaviours studied included energy consumption, water consumption, cleaning and laundry requirements. The results helped the hotel management assess those habits that were the potential problems to be addressed first.

Options included:

- using room key controlled light switches, which switch off upon removal of the key from the holder
- putting banners and instructions for customers to conserve water
- instructing guests to identify used linen for laundry by placing it on the floor or in a basket

Involve customers in the improvement process. Show them the results of their efforts.

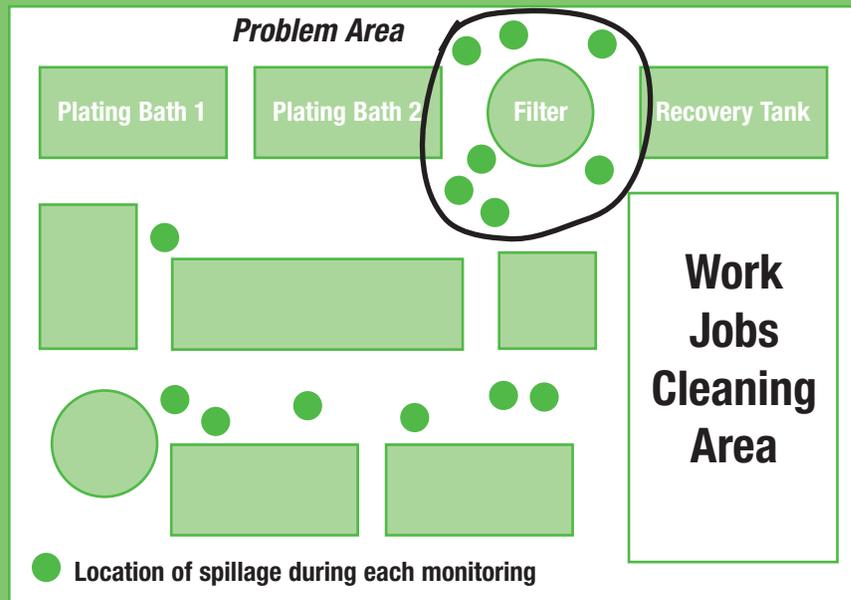
Concentration Diagrams

Concentration diagrams provide you with location-based information on events or problems. They can help you identify the source of a problem. Concentration diagrams are used to find out where problems are occurring in a process. The position of data facilitates the solution. It should not be used as the first diagnostic tool, or in isolation. They could be very useful when developed in conjunction with Eco-mapping. Like Check Sheets, concentration diagrams can be used for data collection during problem definition as well as during monitoring an implemented solution.

How should you use a concentration diagram?

- Decide on the data requirements in the diagram (activity or event to be recorded)
- Decide on the background (e.g. plant layout, operations within a process etc.)
- Categorize the collected data with respect to the locations on the background
- Plot data on the background diagram

Case Study



An electroplating shop observed high flow in its floor drains. The Green Productivity team monitored the locations of the spills along the production line for a period of time, using concentration diagrams. The diagram revealed a particular plating bath and the next dragout recovery unit as the area with the maximum number of spills. On checking the area it was found that a filter located between the two tanks (for continuous filtration of plating bath solution), increased the dragout spills during operation. Relocation of the filter solved the problem and the flow into the floor drains was reduced.

Brainstorming

Brainstorming is a commonly used tool for generating ideas. Brainstorming is not a mental free for all; it should be structured. Successful Brainstorming enables your team to be as creative as possible yet does not restrict the members from thinking “outside the box”. The primary objective of Brainstorming is to generate as many ideas as possible. Checking the feasibility of the idea is done by asking critical questions.

This tool is used by teams, while trying to identify possible root causes or when seeking solutions to a problem. Brainstorming can also be used while developing the implementation plan in terms of prioritizing and sequencing various options.

The following procedure may be used for Brainstorming; these steps are flexible and should be modified for specific situations.

- Keep the meeting in a relaxed setting.
- The team leader should only facilitate the meeting.
- Involve the right (relevant) members of the team.
- Define the problem clearly. It is necessary that everyone in the meeting has the same understanding of the problem; otherwise the ideas would stray from the primary objective.
- Two approaches are the ‘free wheeling method’ (free generation of ideas) or the ‘round robin’ (a contribution of ideas by each person after the other) to identify as many ideas as possible. There are other approaches, such as asking a team member what his or her opinion would be if they were Ishikawa, Sun Tzu, or Einstein.
- Write down every idea. Ideas should not be struck off unless found to be impractical.

The outcome of a Brainstorming exercise, conducted to identify causes of a problem, flows well into the next Green Productivity tool, the Fishbone or Ishikawa Diagram.

Fishbone Diagram (Ishikawa) to Analyze Cause and Effect

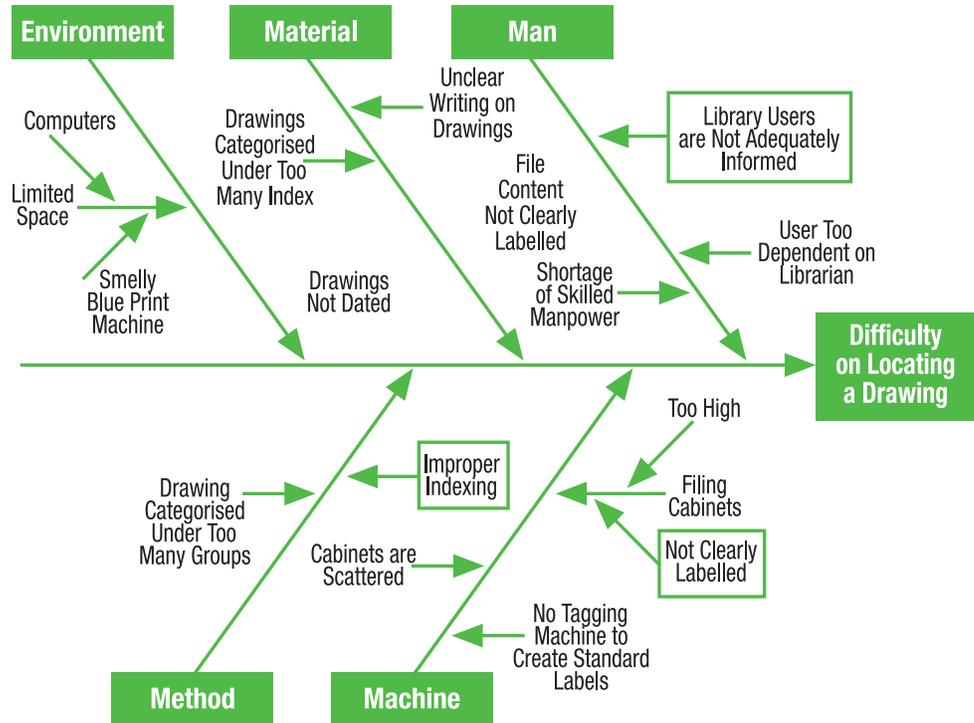
The Fishbone or Ishikawa Diagram is primarily used to identify causes of problems in the problem identification task or in the generation of options. This is where options arise by avoiding or eliminating the causes of the problems. It is sometimes referred to as root cause analysis. Cause and Effect Analysis allows the exploration of a problem in a systems approach rather than proposing quick fix solutions to get around problems.

Note: Why are some quick fix solutions risky? The environment operates systematically. When you ignore the connectivity that is the reality between what you do or what you have and the impact on the environment, the quick fix option may create a more destructive impact on the environment and in the end cost you considerably more.

Be careful not to dismiss ideas that appear 'too simple'. Simple ideas used by a great number of people can have a profound impact.

Figure 4-14 Fishbone or Ishikawa Diagram

Cause and Effect Analysis Ishikawa (Fishbone) Diagram



To construct a Fishbone Diagram the simplest method is to use a 4M1E method of categorization. Here, all the causes and sub-causes should be divided into impacts due to Man, Machine, Material, Method and Environment. The 4M1E categorization may be a starting point and more refinements are possible.

The main steps in this tool are:

- List the problem/issue to be studied in the "head of the fish".
- Label each "bone" of the "fish" using the main categories from the 4M1E.
- Use an idea-generating technique (e.g. Brainstorming) to identify the factors within each category that may be affecting the problem/issue and/or effect being studied. The team should ask... "What are the machine issues affecting/causing..."
- Join them to the horizontal line with sloping lines.
- Brainstorm subordinate causes and attach to main cause lines.
- Look for root causes by identifying causes that occur more than once or which are related.
- Propose solutions to root causes.

An Ishikawa diagram can be used when a team is trying to find potential solutions to a problem and is looking for the root cause. It is extremely useful when there is a fairly large-scale problem, perhaps involving a number of activities, which would have a number of causes.

Case Study

In a knit fabric processing industry, the right first time (RFT) in dyeing was found to be rather low, close to 60%. Identified as the likely main causes were:

- Poor quality of scoured and bleached fabric
- Poor operation of the dyeing machines
- Poor quality of input materials used in dyeing
- Poor maintenance of the dyeing machines

Further analysis and Brainstorming led to development of a detailed Ishikawa Diagram.

The primary causes were further studied and the secondary level causes identified as follows:

Cause for poor quality of bleached fabric

- Poor water quality, as raw water contains impurities;
- Improper fabric storage, due to dirtying of fabric during storage.

Causes for improper dyeing operation

- Errors in preparation of recipe;
- Liquor ratio is not always maintained.

Causes for poor quality of input material to dyeing

- Poor water quality;
- High impurities in the dyes;
- Shelf life of auxiliaries exceeded.

Causes for dyeing equipment not well maintained

- No regular preventive maintenance program.

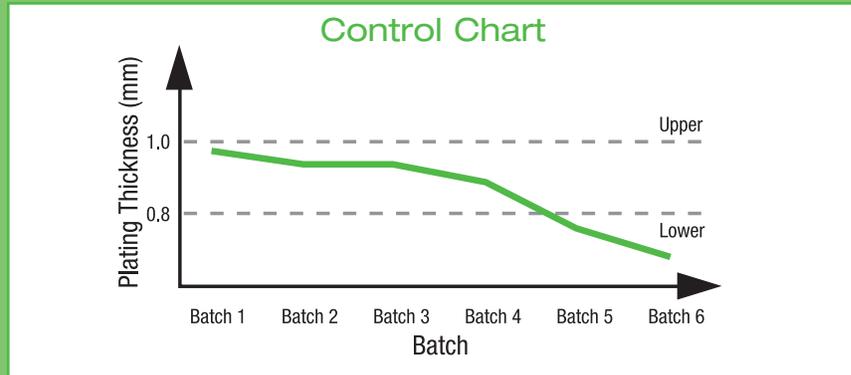
Control Charts

Control Charts are used to show deviations / variability of performance in a process from a benchmark (which may be a process / equipment / product parameter).

The procedure for drawing Control Charts includes:

- Decide the parameter to be tested;
- Decide the upper and lower limits of the parameter during operation, with appropriate units;
- Plot the selected parameter with the appropriate units;
- Mark the areas exceeding the limits.

Case Study



The upper and lower limits of acceptance for plating thickness are made clear by the use of this diagram.

An automated metal finishing shop observed that the percentage of rejects had increased and the client was dissatisfied with the plated pieces. The GP team concluded after Brainstorming that the plating thickness needed to be monitored for a period of time to determine the frequency of deviation of the plating thickness from the desired product specs. An average of 3 samples were tested from every batch of 24 pieces. Six such batches were examined.

It was observed that after batch 4, the thickness of deposits started to reduce. An Ishikawa diagram was drawn to explain the causes of this decrease and it was concluded that after 6 successive batches of 24 pieces, the metal bath solution needed to be replenished by 20% to maintain the desired plating thickness.

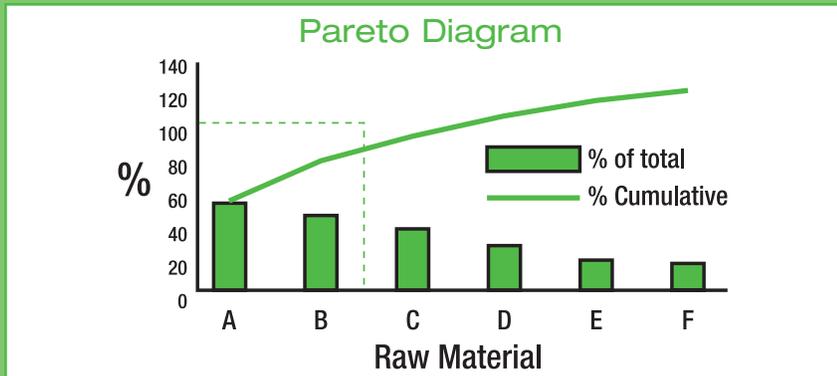
Tools for Prioritization of Problems and Causes

Pareto Diagram

Pareto analysis is a method of identifying the vital few causes (typically 20%) that can answer most of the problems (typically 80%).

Pareto analysis can be used in a wide variety of situations where there are a number of variables contributing to a problem and you need to know which are the most important. It is particularly useful in the task of selecting the option(s) with priority as well as implementation. Pareto analysis provides a strong visual presentation of how to prioritize problems, and where to concentrate resources for the best results. While interpreting the results, it is essential to use common sense as well as data to ascertain causes and priorities.

Case Study



In an industry conducting a Green Productivity program, an Ishikawa diagram was used to identify some of the causes for the high generation of off-spec products. The causes were as follows:

- A Impurities in Chemical A (raw material)
- B Low efficiency of mechanical equipment
- C High temperature in the process
- D Incorrect time period for the batch process
- E Operator fault
- F Amount of Catalyst B
- G Others

The Green Productivity team decided to use Pareto diagrams to determine the major contributors to the problem. Off-Spec production and its corresponding causes were monitored for a period of one month. The number of times each cause contributed was noted and the frequencies were determined. The diagram shown indicates that raw material impurity and equipment efficiency were the major factors. Accordingly, the supplier was contacted and the necessary input material specification was included as a supply condition.

Other Tools for Planning

There are other tools that you might find useful for problem solving. The ones that you have been exposed to include tools that provides you with analytical opportunities, and other diagnostic approaches. Other analytical tools include: Benchmarking, Eco-Maps, Material Balance, Energy Balance and Multi-vari charts. As you move into the next step, you may see some of these tools re-appear, as they have value outside of planning. Step 2 - Planning, contained quite a bit of detail, which reinforces the need to plan your Green Productivity efforts carefully. Take the time to plan, it will save you time, effort, energy, money and reduce the chance for frustration.

Notice how Green Productivity continually builds on your efforts, even your problem identification and solving activities take on a systematic flow.

This concludes the activity entailed in the second step. Have you:

- Identified problems and causes?
- Set objective and targets?
- Identified performance indicators?
- Decided on the sub-teams that will be involved in the generation of Green Productivity options for each objective? (In smaller companies the team members are more likely to be the same.)

Is there an obstacle to overcome? Take it back to your GP team and see if the problem needs to be redefined, or the cause(s) reassessed.

4.5 Step 3: Generation, Evaluation and Prioritization of Green Productivity Options

Doing the right thing first time (RFT) is always preferable. How do you know what right things you should do first? How can you determine that the option(s) you choose will help you meet your Green Productivity goals?

This section addresses this challenge.

At the end of this Step you should have:

- Generated Green Productivity options for each objective
- Decided on screening criteria
- Screened your Green Productivity options
- Decided on the final selection of Green Productivity options to be evaluated
- Collected option specific information
- Evaluated your Green Productivity options

Figure 4-15 Hierarchy of Tasks in Generation and Evaluation of GP Options

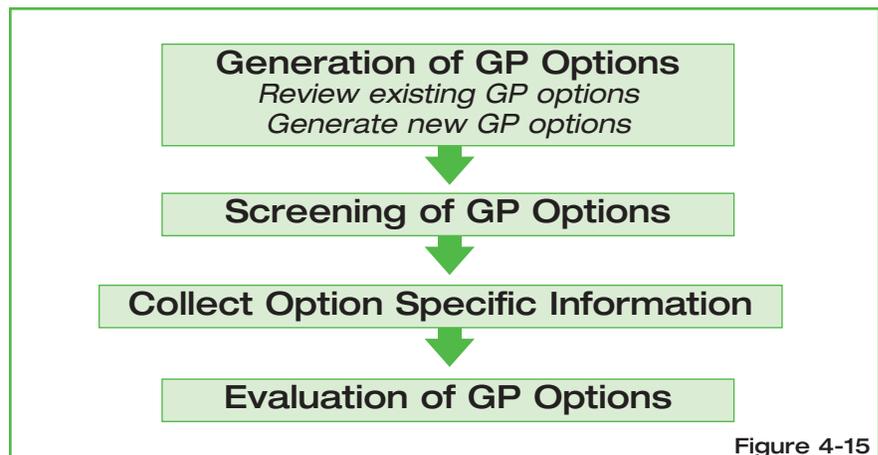


Figure 4-15

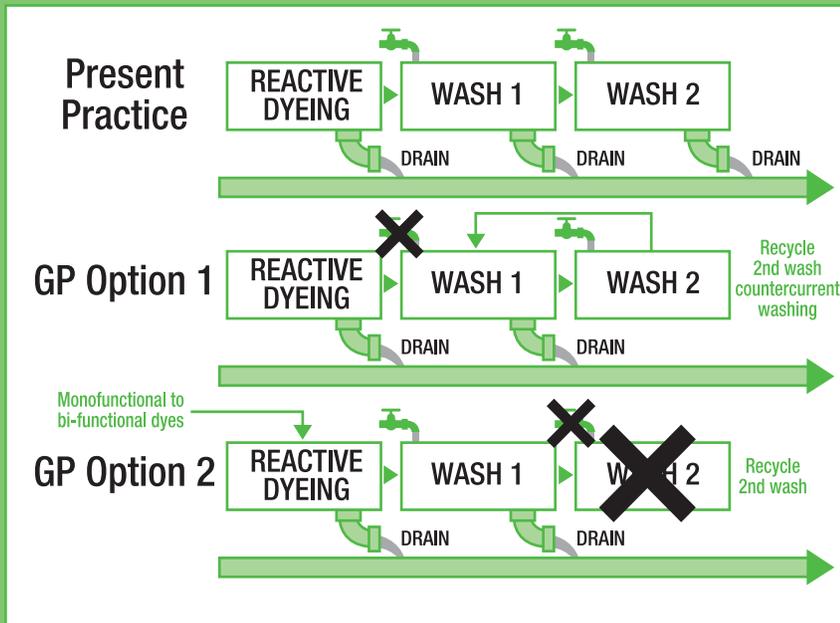
Task 5: Generation of Green Productivity Options

The hierarchy of (i) generation of Green Productivity options, (ii) screening, (iii) evaluation and (iv) final selection should be logically sequenced; this will enable you to generate and select the most appropriate options to meet or exceed your Green Productivity goals.

Where should you start?

The generation of options should logically begin with what has already been implemented in the industry. Why? Someone else has already taken the time to go through the process and has learned what works and what doesn't. You can save time and effort by leveraging their experience. You still need to consider new options along with these to ensure that the best option for your situation is applied as the case may have anomalies affecting your outcome. Brainstorming is a good way to use what you know about the problems, causes and available information to generate new Green Productivity options.

Case Study



In a knit-fabric processing industry, the dyeing process consists of a number of washes.

A number of possible Green Productivity options were considered:

- Recycle the last cold wash into the first cold wash to save on water consumption
- Change from mono-functional dyes to bi-functional dyes to eliminate one stage of washing

It was thought that this action would also assist in waste minimization. In the Brainstorming exercise, several questions were raised and suggestions given that led to further development and understanding of the option. These follow.

Is there a risk of deterioration in the dyeing quality due to the reuse of water? Research to see if another company has tried this would be useful, or a test would reveal the answer. Potential sources of information include:

- Various research and multi-lateral agencies have published sector reports on waste minimization and pollution prevention.
- On-line databases that describe case studies could be consulted.
- Interviews and discussions with sector experts can identify common problems and associated solutions.
- Visits to cross-sector industries may reveal they have faced similar problems and have found solutions.

For example, the washing operation is essentially a cross-sectoral operation that is used in the textile, tanning, pulping and metal finishing industries. Ideas and equipment used in washing fabric can lead to clues in the washing of hides in tanning operations. Cooperative competition here would be of value to all parties.

Should recycling be restricted only to batches when light shades are being dyed? Note that this requires further operator instruction and supervision.

Is it better to send the cold wash water to be recycled through a common sump? In this case, before pumping for reuse, water could be passed through a pressure sand filter to remove any suspended colloids.

Can cold wash water be reused for washing of rollers in the printing and finishing departments rather than recycled in dyeing?

Once you have a number of options, how do you decide which ones to use first?

An initial screening may be required for most options to eliminate the obviously unsuitable or conflicting options. This minimizes the effort of detailed evaluation that you need to do. Methods for screening will be discussed under Task 6. Once you have completed the initial screening, substantial option specific information may be required (e.g. technology details, operating guidelines, fabrication and design details, cost information, etc.) for you to evaluate the selected options. This information should be compiled before you actually begin to evaluate the options. Where you have decided to have sub-teams work on a specific option, you can assign them the task of collecting information specific to nature of the screened and therefore preferred options.

Collection of Information Specific to Each Option

The nature, amount of data and time required to collect information would depend on the specific options being considered; e.g. new equipment or process, modification in existing process, operating practices, options external to the company.

Option specific information is required to ensure that all information necessary for proper evaluation (such as technical, environmental, financial, etc.) is available.

Collection of Option Specific Information

GP Options

New Equipment	Suppliers, installation space, cost (capital, operating), personpower requirement.
New Material/ Chemical	Suppliers, quantity, cost, effects on other processes, safety sheets, transport.
Change of Supplier	New suppliers, reliability, costs, effect on market, other clients of the new supplier.
Modification in Existing Process	Installation, fabrication, commissioning requirements, costs.
Change in Operating Practices	Effects of new practice, changes due to new practice, time scheduling.

Case Study

Evaluate the option to change from a mono-functional dye to bi-functional dye.

Bi-functional dyes have a greater degree of dye-fixation. This allows for less consumption of dye and a lower release of pollutants into the wastewater. There is also the potential advantage of better wash-off properties after dyeing. The possibility exists to eliminate one of the after-washing operations. This can lead to reduction in water consumption, processing time, as well as the potential for reduction in the generation of wastewater. Details of specific information needed for evaluation of this option follow to demonstrate the kinds of detail you would need to uncover to take this option further.

What do you need to know about this option to ensure success?

Technical

- Technical literature on dye fixation properties of bi-functional dyes.
- Available color shades and a comparison with the shade card of the presently used mono-functional dye
- Present level of dye-fixation for various shades and anticipated level of dye-fixation
- Results of trial runs
- Market availability and reliability of supply
- Any special requirements on the operating use e.g. quality of water, salt levels and temperature
- Methods of quality control during trials
- Present consumption of the recipe (consisting of dye, auxiliaries, salt etc.) and anticipated consumption based on the recommended new recipe
- Present consumption of water and anticipated consumption of water after the change

Environmental

- Detailed Material Safety Data Sheets for the bi-functional dye.
- Special storage and handling requirements, if any, from the point of health and safety
- Comparison of the new dye or its functional group to the list of banned or red substances adopted internationally
- The efficiency of the treatment plant in terms of biodegradability of the dye in wastewater

Economic

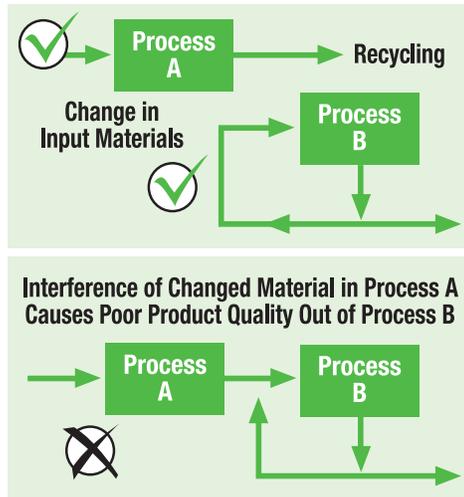
- Cost of the dye across various and frequently used color shades compared to similar data on the presently used dye
- Capital and operating costs of treatment of wastewater in terms of costs/m³ of flow, costs/kg Chemical Oxygen Demand (COD)
- Cost of water (include purchase, processing and pumping costs if any)

Once the information has been collected, you need to evaluate these options using the various tools that are applicable. Cost Benefit Analysis is one of the more valuable tools that can help you best evaluate your options. How do you test for the synergy of options? A cumulative evaluation of options will help you ensure that the various options you have singled out do not conflict or minimize the benefits of each option (a systems thinking perspective).

Why is this important? Although Green Productivity options are designed to address individual problem areas, they can impact other options where a potential interaction is ignored; it could, in fact, lead to other new problems. Therefore, reviewing the options in combination is important using the requisites or the necessary conditions and effects of a single option. You may also find that there is potential for multiple benefits when options are combined, including cost reductions, due to increased resource efficiency.

Importance of Options Synthesis

- Mere generation of options is not enough.
- Options need to be looked at in combination to develop cost-effective and technically viable implementation plan.
- This needs a careful options synthesis that looks at options that must go alone and options that cannot be implemented in combination.



Case Study

In this case there are two scenarios. In the first one the processes are independent, a change in input material of process A is attractive as it leads to a reduction of hazardous waste. In process B, there is an opportunity to recycle the material; the net result is the same.

However, in the second scenario, when the processes are sequential and A precedes B, a material change in A may lead to problems in the product quality arising out of B.

Therefore, the valid options include:

- Follow process A with a material change *OR*
- Follow process B and recycle.

In the second scenario, it is not acceptable to make a material change in process A and recycle in B.

Figure 4-16 Organization of the GP Techniques

Organization of Green Productivity Techniques

APO has organized the techniques to provide you with a clearer understanding.

Training and Awareness	Awareness Programs	
	Industrial Field Visits	
Waste Prevention	Good Housekeeping	Improved Operating Procedures
		Waste Segregation
	5S Program	

Figure 4-17

Organization of the GP Techniques

Waste Management

Training/
Awareness

Waste Prevention

Resource Conservation

Product Improvement

Resource Conservation	Recycle, Reuse and Recovery	Off-site recycling On-site recycling
	Energy Conservation	
	Process Modification	Input Material Changes Process/Equipment Changes
Management of Waste	Air Emission Control	
	Effluent Pollution Control	
	Solid Waste Management	
Product Improvement	Design for Environment	

Review of Your Options that were identified earlier on in your Green Productivity efforts

When reviewing your options it is useful to understand what actions were taken and why a certain outcome occurred. Keeping some brief notes about this review is a good idea in case you are asked later on why you chose a particular option or combination thereof.

What Was the Decision?	Why?	Your Observation
<i>An option was not implemented</i>	In the first case an option provides a starting point for proceeding with a more detailed inquiry into why the option was not implemented, followed by a comprehensive evaluation of the option.	
<i>An option was implemented but did not work at all</i>	The option that did not work at all naturally gets eliminated from further discussions. The reasons for why the option did not work can however lead to additional ideas for your GP team.	
<i>An option did not succeed as expected (partial achievement / elimination of concern)</i>	The option should be studied to determine the cause of failure and to understand if there is a way to further improve. You should investigate whether any alternative option exists that can be more effective.	
<i>An option succeeded as expected but has not been evaluated and documented</i>	In this case, the option should be evaluated and recorded as a reference in the documentation you keep for Green Productivity.	

Case Study

Due to a water shortage, the liquor used to soak hides in a tannery was re-circulated over successive lots of hides. The hide quality was severely affected. Clearly, this was an example of option failed.

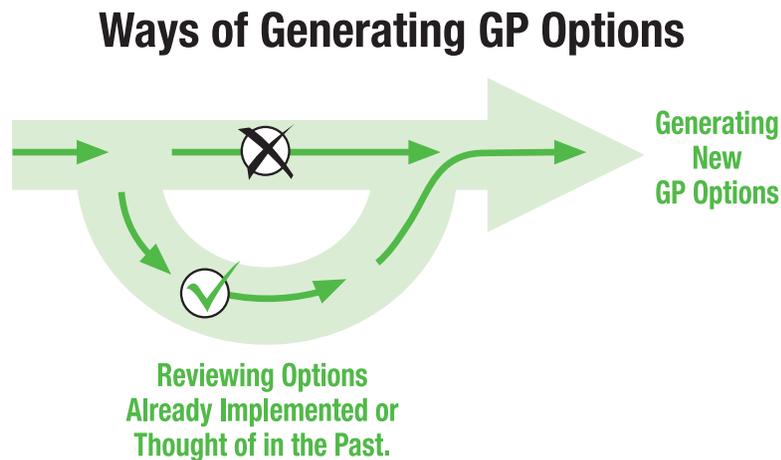
In a subsequent Brainstorming session, it was suggested to evaluate an option of adding a biocide in the main soak to suppress any biodegradation. Apparently, such a practice was carried out at another tannery without any problems. This led to a revival of the failed option. Learning from other people's experience is valuable.

Generating New Green Productivity Options

It is important to note that to generate an innovative Green Productivity option you need to go beyond the conventional and the most obvious ways of thinking.

Sometimes individual options may not suffice and adopting a system like Total Productive Maintenance (TPM) would have to be considered to properly address the problems that a company faces.

Figure 4-18



- Option was not implemented.
- Option was implemented but did not work at all.
- Option did not succeed as expected (partial achievement/elimination of concern).
- Option succeeded as expected but has not been evaluated and documented.

Generation of New Options

GP Techniques

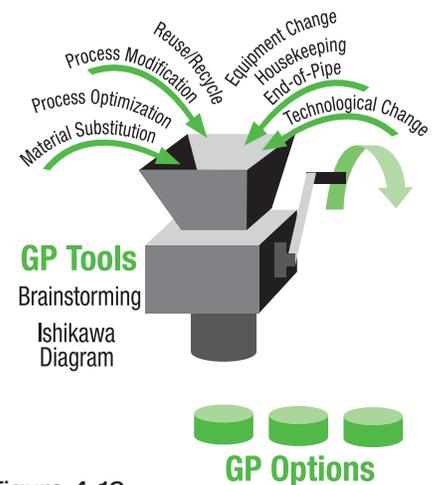


Figure 4-19

A Logical Approach to Generating New Options

It can be challenging to revisit a problem. You may have a sense of frustration when plans do not provide you with the results you desire. Green Productivity has a process to address challenges of this nature.

Steps you can take to overcome the barriers of conventional thinking include:

- Identify causes based on the tools such as the Fishbone Diagram for each problem.
- Conduct a Brainstorming exercise to generate options based on the identification of causative factors. Brainstorming sessions greatly assist in the generation of new ideas. The ideas should flow freely without interference so that all possible creative options are looked at (refer to Task 4 for tips on running a Brainstorming exercise).
- Determine the nature of solution⁹ required.

Do you need to:

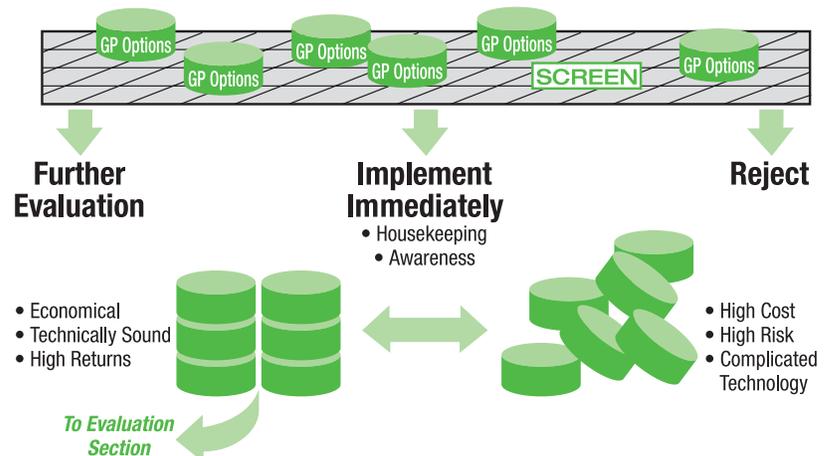
- tighten supervision?
- improve quality control and housekeeping?
- explore recycling, recovery and reuse of output streams?
- change the input materials or modify the equipment?
- change the process or layout of the plant and as a result the potential Green Productivity Techniques you employ?

Task 6: Evaluation and Prioritization of Green Productivity Options

Screening, when used to sort the preferred quality of materials from substandard product, is a simple way to achieve a goal – to end up with quality product that suits a purpose. Screening can also be used to prioritize your Green Productivity options based on defined criteria. Pareto charts (introduced in the last step) could also be used here to prioritize the options based on their impacts or causal relationship with the concern or benefits accrued.

Figure 4-20

Ways to Screen GP Options



Sieve Method – How do you apply it?

This method involves setting up cut-off values for certain critical parameters such as cost, time, person power, etc. All Green Productivity options that exceed this cut-off value are immediately eliminated. This is a first level screening that enables you to eliminate the options that are obviously unsuitable for your Green Productivity goals.

This step reduces the number of options that you need to further evaluate.

Criteria for Screening Options	Reasons for Rejecting an Option
The cost of implementing and maintaining the option versus the cost of inaction.	The option is very expensive, making it unaffordable for the organization.
Technical Feasibility or Complexity (this relates to the technical expertise required within the industry to implement this option).	<p>The process to implement the option is complicated; it demands special skills that are not presently available.</p> <p>The option offers good potential but there is not enough information available to you or it requires more resources than you have at your disposal; defer the option and re-assess at a later date.</p>
Risk (this refers to the risk of failure as compared to the investment risk; benefits expected or physical hazard due to implementation).	The option poses a risk to your existing production or product quality. Measures to avert the risk are needed before you proceed.
Time required for implementation (this is to establish a link between time necessary for implementation and working of the option and the target set for the objective of that option).	<p>The option is a good idea but has not been proven at a commercial level. You may need to phase its implementation or develop lab scale trials, pilot projects, etc. Is there an opportunity for sharing the cost of the trials with others to reduce the risk?</p> <p>Many times, options are undertaken on a pilot or demonstrative basis gradually shifting them to full-scale production.</p>
Benefits expected. Benefits are important as you can use them to judge the potential of the option in terms of resolving the problem and meeting the targets set. Benefits can be broadly divided into economic, environmental and social.	<p>If your company is very small, your analysis need not be onerous. You can provide a ranking to each of the benefit categories just as you can weight your screening criteria. Using numbers that give you a clear spread is helpful such as 1, 5, 9 where one is low, 5 is necessary and 9 means important. You can also assign the qualifiers as high, medium and low. It is helpful to note why you chose the rankings as you might find the logic is hard to follow at a later date.</p>

Keep documentation concise. Too many words merely consume time; too few leave the reader guessing what to do.

Begin with
the end in
mind.

Go back to Table 2.2 in Chapter 2 where you recorded your issues of concern. Use them to work through the exercise of identifying your priorities for objectives and targets.

There are a number of questions that you can pose to help conduct your evaluation.

- Which options will best achieve your objectives and targets?
- What benefits will you gain by implementing this option (e.g. production / yield, financial, compliance, pollution management, workplace safety etc.)?
- How would you classify the nature of technology needed to develop the option? Is it complex? Would it be expensive or difficult to control during operation?
- Are there any parallel adverse effects because of the option?

As much as possible, taking a proactive or anticipatory approach to your evaluation is a stance that should be adopted. It is worthwhile to look beyond the implementation of options and try to predict why and how they might fail and what the probability of this is. This can be part of a Brainstorming exercise. Evaluating and comparing the options can be done on the basis of technical, environmental and financial criteria, although you may apply others such as legal or other requirements imposed by contracts.

Options should be evaluated and compared on the basis of:

<i>Technical</i>	Nature of requirements to implement the option, e.g. space requirements, utilities, and operators necessary.
	Feasibility of Technology.
	Process modification necessary.
<i>Environmental</i>	How much environmental improvement (e.g. waste reduction) is expected from the option?
	What is the nature of the benefit (e.g. improved productivity, odour control, better health and safety)?
	Is the solution short term or long term (will it be easy to adopt to new regulations)?
<i>Financial</i>	What are the investment requirements?
	Is the option financially viable?
	What would be the source of investment and level of difficulty involved?

Weighted Sum Method

The Weighted Sum method is an effective way to rank the available options according to their importance based on defined criteria. In this method the criteria are first ranked according to significance by assigning weights. Each weighted criterion is used to rank

the options. The product of the criteria weight and the individual weight of an option for those criteria forms the score of that option. The scores of an option for each criterion are then summed to get a total score. The total scores of all options are then compared and the option with the highest total score is selected as the most suitable option for the given criteria.

Table 4-3 Weighted Sum Method

Criteria	Criteria Weight	Stop overflow at winch machines Weight (product)	Counter current rinsing in dyeing Weight (product)	Change from hypochlorite to H₂O₂ bleaching Weight (product)	Introduce softflow dyeing machine in place of winch Weight (product)
Cost of Action	10	5(50)	7(10)	8(80)	5(50)
Cost of Inaction	8	2(16)	5(40)	8(64)	6(48)
Time Required	5	9(45)	6(30)	3(15)	5(25)
Risk	6	8(48)	7(42)	8(48)	8(48)
Benefits	8	5(40)	9(72)	6(48)	10(80)
Technology or Complexity	4	4(16)	6(24)	6(24)	8(32)
TOTAL	10	215	278	279	283
Options (products)	—	Option 1	Option 2	Option 3	Option 4

A scale of 1 to 10 is used in the above example where 1 indicates the worst performance and 10 indicates the best performance.

Option 4, which has the highest score, is the Best Option.

Tools for Generation of Green Productivity Options: Introduction

As previously shown in this chapter, the generation of Green Productivity options requires creative thinking, thinking outside the box, freeing yourself of conventions. The use of Brainstorming is very useful in this situation. Brainstorming helps draw out the information available about the issue of critical importance to your business and the best available and feasible technology respective to the sector. Additionally, the matrix of Green Productivity Techniques also introduced earlier in this step, plays a critical role in the generation of options for enhancing your business. In this section, three more tools that can help you evaluate and prioritize your options will be introduced: Checklists, Cost Benefit Analysis (CBA) and Failure Mode Effect Analysis (FMEA). Keep in mind that these are not the only tools. You will most benefit when these tools are used in conjunction with other Green Productivity tools to progressively build on what you have learned.



Checklists

Checklists can be devised as pointers to delve into probable causes. Options are identified when the checklist is applied on field and other relevant data collected, and then brought forward in a Brainstorming exercise.

Checklists are widely used in Green Productivity in various steps. Primarily, a checklist is a simple, easy and low cost tool to list items of importance.

Checklists could:

- Address 'activities to be done' in a Walk Through exercise
- Summarize the key elements identified in your Eco-mapping activity
- Be used as pointers to generate new Green Productivity options
- Communicate work instructions to staff during the implementation of Green Productivity options
- Confirm the order of corrective or preventative action on the basis of your post-implementation report

Some of the common checkpoints are shared.

Monitoring and Maintenance

- How about more frequent inspection of records and supervision?
- What if a strict housekeeping program is initially supported by on the job training?
- Will the initiation of Total Productive Maintenance (TPM) help?

Changing equipment, processes and operations

- How about recycling or reusing some of the output streams?
- How about exploring the recovery possibilities from the various output streams?
- What might be the effect of reducing or increasing the batch size?
- Can a better job flow be sequenced to handle odd lots?
- Do you need this operation at all? Can this be skipped? (e.g. washing)
- Are there better technological options if production is slightly upscaled?
- Can two operations be combined to produce the same desired effect?
- Can the method itself be changed (i.e. ultra-sonic cleaning versus liquid cleaning) ?
- How about investigating the possibility of automating operations?

Using Checklists can generate new Green Productivity Options.

Materials and Inventory

- Is the inventory so excessive as to affect the raw material quality?
- Is the method of inventory and use in the First-in-First-Out (FIFO) manner or the First-in-Last-Out (FILO)?
- Could alternate materials be procured whose initial price may be marginally higher but can lead to more savings in terms of total productivity?

- How about eliminating toxic and hazardous materials from the purchase list, thus allowing you to obtain eco-labels for your products and reduce the cost of waste treatment and disposal?

Meeting environmental compliance

- Can the waste generated be properly contained and segregated to allow for recycling, reuse or recovery?
- Should all waste be combined and then treated? Or should it be treated separately, especially for some select waste streams that may be toxic?
- Does the treatment of waste lead to generation of more difficult to manage residues? Are there alternative methods of treatment that are more environmentally sound, as well as cost-effective, such as joint treatment of wastes with a neighbouring industry?

Training and Human Resource Development

- Training and instruction of workers is necessary as it is the *behaviours of people that must change* to make your business sustainable. What training do you need?
- Would your business benefit by a more global perspective? What about sending the middle level technicians abroad to get more experience?
- How about instituting a scheme of annual awards?

Cost Benefit Analysis (CBA)

The costs incurred and the benefits accrued to an organization that adopts the Green Productivity framework must be measurable; this applies to your business as well. Profitability analysis is the metric that is typically used to measure the impacts of Green Productivity on an organization's performance, which was introduced in Chapter 3. To refresh your memory, the three financial indicators are:

- Simple Payback
- Net Present Value (NPV)
- Internal Rate of Return (IRR)

These indicators can be used to evaluate Green Productivity options, and select the most economically feasible options. The profitability analysis can also form the basis of prioritization for implementation of the selected option. Alternative Green Productivity options to address the same problem can also be compared in terms of their economic feasibility through profitability analysis.

Simple Payback: A simple payback period is evaluated based on the annual savings and the initial investment. It simply indicates the time period required to return the initial investment.

$$\text{Payback} = \frac{\text{Capital Investment}}{\text{Annual Savings}}$$

Net Present Value (NPV): The present value of the future cash flow of an investment less the investment's current cost is called NPV. An investment is profitable if the NPV of the cash flow it generates into the future exceeds its cost, that is, if the NPV is positive.

$NPV = \{CF_1 / 1 + k\} + \{CF_2 / (1+k)^2\} + \{CF_n / (1+k)^n\} - I$ where: CF_1 is cash flow in period 1, CF_2 is cash flow in period 2, I is initial outlay or investment cost and k is cost of capital or discount rate.

Internal Rate of Return (IRR): This calculates the rate of return on investment during the life of the equipment by way of cash inflows. Obviously, this rate should be compared with the cost of capital (rate of interest on loans), which is to be paid at the inception of the project.

Case Study

An Example of CBA when there is no Capital Investment

Combined Scour-Bleach in a Cotton Textile Unit in Egypt

Savings in:	Conventional	Combined
Chemical Costs	(1.1)	107.0
Chemical Costs	3.8	0.0
Chemical Costs	16.5	0.0
Chemical Costs	3.4	0.0
Chemical Costs	9.0	0.0
TOTAL per ton	31.6	107.0
Annual Production	591 tons	591 tons
ANNUAL SAVINGS	18,622	63,249

Increased Productivity

The modified process considerably shortened the processing time thereby increasing production capacity. The processing time for bleach has been more than halved. Capacity was lifted by scheduling shifts.

Improved Fabric Quality

The whiteness and absorbency was improved with the modified process in the full bleach process at the mill.

Environmental Benefits and Improved Working Conditions

Sodium hypochlorite, a toxic and hazardous chemical, has been phased out of the bleaching process at the mill. As a result, safety and worker conditions have improved and the amount of halogenated organic hydrocarbons (AOX) in the final effluent has been minimized. Water and energy consumption has also been reduced.

Economic Benefits

Savings on operating costs	LE 71,496
Net benefit on increased production capacity	LE 95,803
Total Annual Benefits	LE 167,299

Most of the fabrics used in trials were sold. The cost for local consultants and expenses was LE 56,000 giving a payback period of just under 3 months.

The benefits and achievements included:

Electricity consumption reduced by:	27%
Steam consumption reduced by:	15%
Cost of Chemicals increased by:	NA
Water consumption reduced by:	88%
Cost of chemicals increased by:	18%
Processing time reduced by:	5 hours

The Net Results:

- Productivity improved.
- Fabric quality improved.
- Working conditions improved.

Case Study

An Example of CBA when there is Capital Investment

White Water / Fiber Reuse in Pulp and Paper Industry

Capital Costs

Saveall Equipment	\$345,985
Saveall and White Water Pump	
Materials	\$374,822
Piping, Electrical, Instruments and Structural	
Materials	\$397,148
Engineering	\$211,046
Contingency	\$140,403
Equipment Life	15 years
Borrowing Rate of Interests	15%

Total Capital Costs **\$1,469,404**

Annual Savings* **\$350,670**

Financial Indicators

Simple Payback Period	4.19 years
Net Present Value	
- Years 1-15	\$359,544
Internal Rate of Return -	
- Years 1-15	21%

**Annual operating cash flow before interest and taxes*

A pulp and paper mill generates considerable wastewater. A waste stream termed white water, contains a large amount of fibre that is wasted. This fibre can be recovered by floatation or other similar techniques. This example presents the economics of one such technology, called Saveall, considered as a Green Productivity option.

Financial Indicators:

Simple Payback period	4.19 years
Net Present Value - Years 1-15	\$359,544
Internal Rate of Return - Years 1-15	21%*

Annual operating cash flow before interest and taxes (tied to Figure).

The financial indicators were developed on the basis of the annual cash flows. A positive NPV suggests that the project is profitable. An IRR greater than the cost of capital indicates that the rate of return on investment is high. Overall the financial viability of the project could be said to be high.

Based on payback, the company can then decide whether a 4-year period is affordable to them or whether another option should be identified. NPV or IRR can also be used to detail out the analysis. A positive NPV and IRR greater than the cost of capital indicates a profitable situation.

Accounting of Costs and Benefits

Cost Benefit Analysis facilitates the comparison of alternatives in terms of the monetary cost involved and the benefits obtained. No matter how progressive a company is in terms of wanting to become sustainable, it still has to remain practical. A Cost Benefit Analysis allows you to analyze costs and benefits due to various investment measures. It can help you answer the typical questions that an investor, board member, bank loan officer or top management representative will ask.

- What would be the costs incurred by the organization for the option? (Including capital for technology, equipment, etc.) Remember to have the cost of inaction ready.
- What are the benefits expected from the option in monetary terms? How will you assign monetary figures to benefits?
- In Green Productivity there is a strong need to internalize intangibles and to the extent possible, intangible environmental costs (treatment, pollution prevention, training, etc.)

Effectively, Cost Benefit Analysis builds in monetary functions (cost and benefit) into conventional decision-making by reflecting bottom line performance.

Failure Mode Effect Analysis

In the context of Green Productivity, Failure Mode Effect Analysis (FMEA) can be used to assist in fool-proofing a Green Productivity option (design or a process or some equipment). The most significant advantage of Failure Mode Effect Analysis is that it is proactive in nature and allows preventive actions to be incorporated in the planning stage.

You can use FMEA while evaluating a Green Productivity option to investigate the possible causes of failure, or when examining a product or service to speculate what can go wrong.

Failure Mode Effect Analysis offers you a structure for thinking through the likelihood, intensity and detection of potential problems in a Green Productivity option.

Figure 4-21

Failure Mode Effect Analysis

GP Option	Direct use of dyebath	Restrict reuse only for disperse dyebaths	
Problems leading to failure	Shades not matching with standard	Shades not matching with standard	
Detection	9	9	
Likelihood of Occurrence	8	8	
Cost Liability Due to Failure	8	8	
Risk Priority Number	576	576	
Corrective Measure	Restrict reuse only for disperse dyebaths		

How to Use Failure Mode Effect Analysis

- Brainstorm on what can go wrong (if the Green Productivity option is a technology or process, the operating manuals might be of use here to reference troubleshooting). A list of potential problems attributing to the failure of the option should be generated.
- Estimate how likely it is for each potential problem to be detected if it is wrong. This is graded on a scale of 1-10 to show very high to remote detection.
- Estimate for each problem the likelihood of failure to occur. Again this should be graded on a scale of 1-10, with 1 indicating minimum likelihood and 10 indicating maximum likelihood.
- Finally, rank the cost liability of failure on a scale of 1-10 for each of the problems. Here a score of 1 indicates low cost and 10 indicates high cost.
- Multiply these three values to get your Risk Priority Number (RPN). This number would be anywhere between 1 and 1000.
- Rank the problems by their RPNs thus obtained. Any problem with an RPN above 700 is given a high priority and should be tackled first.
- Complete the process by designing and implementing suitable corrective measures to minimize the risk of failures of the potential problems, which were identified in the Failure Mode Effect Analysis.

You have made progress. By now you should have:

- Generated Green Productivity options for each objective
- Decided on your screening criteria
- Run your Green Productivity options through the screen
- Decided on the final selection of Green Productivity options to be evaluated
- Collected option-specific information
- Evaluated your Green Productivity options

Is there something that you still need to do for this step? Record it on a checklist – you can see how useful Green Productivity tools are. In the next step, you move from Planning to Doing. Congratulations!

4.6 Step 4: Implementation of Green Productivity Options

For every option you decide to implement, there needs to be a plan. An implementation plan serves three major purposes to:

- Act as a guideline to implement your selected Green Productivity options.
- Build awareness and assist with training.
- Serve as a means to review your progress and report to top management.

At the end of this step, you will have:

- Prepared an implementation plan for your selected Green Productivity option(s).
- Decided on sub-team responsibilities and contributions to implementation.
- Implemented your selected Green Productivity option(s).
- Trained your staff and developed competence on the operation of your Green Productivity option(s) and the monitoring and evaluation of your Green Productivity program.

Task 7: Formulation of Green Productivity Implementation Plan

For every option to be implemented, the implementation plan should include:

- Identification of the Department/location/points of application of the option.
- An explanation of the nature of the option (e.g. housekeeping, recycle, reuse, recovery, process/equipment modification, change in raw materials, end of pipe, etc.).
- Reference to option prerequisites or necessary conditions (referencing any linkages requiring the success of other options).
- A checklist of the resources necessary in terms of materials, equipment, information, expertise and finance.
- Identification of any procurement or acquisition requirements based on the resources identified as necessary for success. These may be internal (i.e. to be requested from other departments or divisions) or from external agencies.

- An outline of the timing and description of any staging or phasing methods for implementation (i.e. first lab scale, then pilot or direct full-scale implementation).
- Preparation of logistics in terms of the need to isolate testing of options from other processes, including plans to mitigate risk.
- Identification of support personnel necessary, along with any procedural requirements.
- Delineation of any insurance measures.
- Development of a responsibility matrix and task allocation.
- Outline of a monitoring program with performance indicators established (background or baseline must be recorded before implementation of the option).
- Establishment of milestones to be set at each phase in the implementation sequence.

All this information and other relevant instructions on implementation of Green Productivity options are included in the implementation plan. Supporting documentation may be in the form of guidelines, procedures, instructions, flowcharts, checklists, plans, standards and operating manuals.

Are you ready? When you see the detail that you have prepared in your plan contained on one page, or in a Gantt Chart¹⁰, it should help you to realize how prepared you really are.

Task 8: Implementation of Selected Options

There is a logical sequence to implementation, which is influenced by the scale at which you decide to implement your Green Productivity options.

Sequence	Rationale
Trial and small-scale implementation.	To reduce the impact of the existing system.
Regular meetings and trouble shooting sessions.	To ensure good communication among the people involved during implementation and to use resources of the team to problem solve quickly and efficiently.
Follow-up and Accountability.	To make sure that each team member understands his or her role and task assignments.
Allocate resources and schedule the pilot implementation.	To make sure that you have what you need when you need it – eliminate the waste of waiting.
Management support needed.	To ensure that you have the support and resources necessary for success.

Review and refinement of options.	To achieve progress as quickly as possible.
Capture information or take a photograph showing the 'before and after' situation related to the implemented option(s).	To highlight achievements during Management Review or GP promotional activities.

The Green Productivity Team may face difficulties like:

- Inadequate follow-up on actions by various parties
- Poor accountability
- Lack of resources like manpower, funds and time
- Lack of support from management
- Increases in production time causing insufficient time being allocated for implementation.

How can you avoid barriers to your implementation efforts? There are some preparatory activities that you can follow.

- Make sure that your funds are allocated.
- Check to make sure that any modifications, changes in operation or production patterns are scheduled to accommodate the option.
- Prepare engineering drawings if required. You can use them to track more subtle refinements during the implementation phase.
- Make sure that all the resources you required have been allocated (time, people, etc.).
- Check to make sure that the site is properly prepared – that you have sufficient power, security, etc.
- Ensure that you have adequate space for:
 - storage of existing equipment
 - room to experiment if you need it
 - a safe and secure disposal area
 - storing new equipment until it is installed
 - keeping your records on progress in a central location (if this is desirable)
 - enabling the team to meet and discuss problems in a conducive place

In the execution stage make sure that the equipment you ordered gets installed properly and that the systems you are adding to or subtracting from function properly. Make sure as well that if your Green Productivity option includes new equipment, that your operators receive the proper instructions and hands-on training. Make this knowledge transfer part of your agreement to purchase, especially if you are a small company.

Task 9: Awareness Building, Training and Developing Competence

Training is not a one-time activity. It is needed at all levels of the organization including external suppliers and customers. It is an essential part of Green Productivity for the reasons you read about in Chapters 1, 2 and 3.

Training is not a one-time activity; it's a process of keeping your organization fit. The process includes:

- Assessing training needs
- Selecting suitable programs, methods and material
- Preparing a training plan
- Implementing training programs
- Tracking and recording training programs
- Evaluating training effectiveness
- Improving training programs as needed

New employees need to be assessed for their training needs, without it they may pose a risk to your Green Productivity goals. A company that makes learning a daily event is one that will remain profitable and competitive. Stay ahead of your needs by planning and scheduling your training activities so that they do not interfere with your resource needs and productivity.

An important part of effective training is to have a dedicated training department or a person attached with training related responsibilities. In small firms this may form part of a single person's responsibilities.

There are many ways to learn about Green Productivity.

- Attend seminars and lectures on the benefits of Green Productivity.
- Participate in a workshop and share your success story with others.
- Use videos, poster displays in key areas to enthuse employees about participation in your Green Productivity goals, ensuring its effectiveness.
- Access on-the-job training opportunities by sector specialists and experts as well as managers and supervisors assigned with the training portfolio.
- Search for 'how to' manuals that can be used for on-line training. Have them translated into the local language for use by people on the shop floor who are involved in implementation of your Green Productivity option(s).
- Use implementation manuals and guidance documents to train people involved in your Green Productivity options on specific processes.
- Arrange field visits to other companies where Green Productivity has been successfully implemented.

Training can help you to:

- upgrade the skills of the people implementing the Green Productivity options;
- improve competence of the personnel involved in monitoring and evaluating the Green Productivity program;
- build awareness about the Green Productivity program in the organization and among suppliers and customers.

Why should you train? What are you trying to accomplish? Do you need to:

- Motivate your workforce?
- Explain the concept of Green Productivity and how it relates to your company's overall business vision/strategy?
- Ensure a common understanding of roles and expectations?
- Demonstrate management commitment?
- Monitor performance?
- Identify potential system improvements?

Maximize the value of learning from other companies. Information that can be collected during field visits provides insight on how these organizations manage:

- Integration of Green Productivity practices in their business
- Organizational structure for implementation of Green Productivity
- Problems faced by the industry
- Method(s) of problem identification
- Method(s) for generating Green Productivity options
- Difficulties in implementing Green Productivity options
- Ways of overcoming difficulties
- Tangible and intangible results
- Continuous improvement practices

A few last minute tips. Have you thought about:

- How you would manage training if your staff is illiterate?
 - In South Africa they have used industrial theatre to ensure that workers understood emergency procedures.
 - Use pictures, diagrams, posters and photographs to show what to do AND what not to do.
- Making Green Productivity training part of all new employee orientation processes?
- Formal training where a critical task requires a specific high-level competency? Hazardous materials require proper storage and handling of chemicals. Most toxic chemicals must have monitoring programs and good records management.
- Running training drills when production lines are down for servicing?
- Asking your suppliers what product training they provide?

- Splitting the cost of a specialized trainer with other industry members? Remember the motto of Responsible Care® - their efforts are only as strong as the weakest link. Is your reputation at risk because of another company?
- Joining or forming a quality circle as part of an ongoing Total Quality Management/Total Quality Environmental Management program? They can be a very good avenue for discussing problems and sharing solutions.
- Offering to share what you have learned with someone else internal or external to your company on an informal basis to improve the quality of your community?

You should feel very accomplished. You have now:

- Prepared an implementation plan for your selected Green Productivity option(s)
- Decided on sub-team responsibilities and contributions to implementation
- Implemented your selected Green Productivity option(s)
- Trained your staff and developed competence on the operation of your Green Productivity option(s) and the monitoring and evaluation of your Green Productivity program.

It's time to see what some, or all, of your results are.

4.7 Step 5: Monitoring and Review

What you measure will be managed. It's a simple truth. Throughout Chapter 4 you have been exposed to the details about the things you need to measure; you developed performance indicators specifically for this purpose. These measures all lead back to the primary objective of greening your productivity to help enhance your profitability and competitive advantage.

This section introduces the methodology that you can use to assess the performance of your progress against your overall Green Productivity program. It helps you compare the performance of the specific options that you have implemented against the targets that you established for yourself. This is a self-assessment of your improvement. If you find deviations from the actual plans or if you find that you have not met your targets, then you will need to design and implement corrective action – that is what continuous improvement is all about.

By the end of this step you will have:

- Monitored all of your implemented Green Productivity options according to their respective performance indicators, which you developed in Task 7.
- Evaluated and analyzed the performance of your Green Productivity Options.
- Reported the findings to your top management (if this is not you) for review in the form of a post-implementation report.

Is there something you learned that would enable you to prevent future problems?

Task 10: Monitoring and Evaluation of Results

What are you measuring? How will you evaluate your progress?

Once your Green Productivity options have been implemented, you need to check whether the options are producing the desired results including:

- Monitoring the parameters that affect the end results
- Determine progress against your performance indicators for each option
- Appraise the performance of each of your options against the targets you established

Management needs to be informed of the results of the monitoring and evaluation so that corrective action can be taken accordingly. Typical contents of a post-implementation report would cover:

- Results and observations of monitoring and evaluation
- Comparison of post-implementation performance indicators against the desired targets
- Identification of non-conforming options (complete or partial failure to achieve stipulated targets)
- Cause and Effect Analysis (identify problem area – an assessment outlining why targets have not been met)
- Corrective actions already taken

Some causes of typical problems requiring corrective action:

- Design of the option was faulty or was not anticipatory of all problems, including faulty or missing procedures
- Poor communication
- Equipment malfunction / lack of proper maintenance
- Insufficient or inappropriate training; i.e. operators or staff were not trained adequately on the operation of the options
- Option generation weak due to inadequate preparation
- Inaccurate planning in the implementation plan
- Unrealistic targets due to inadequate baseline data
- Conditions suitable to the working of the option were not provided
- Scale of the implementation was not appropriate

Questions to help you improve the performance of your Green Productivity options:

- How were the Green Productivity options implemented?
- What were barriers or constraints, if any, that you faced in implementation?
- How were they overcome?
- If they were insurmountable, what can you do to change your options – what are your alternatives?
- Where there were failures in implementation, do you know the root cause?

Task 11: Management Review

A management review involves checking to see whether the overall Green Productivity methodology is applied in the right direction and whether targets are being achieved as outlined in your implementation plan.

Generally, you need to understand:

- How effective was the implementation of your Green Productivity options?
- What are the tangible and intangible benefits?
- What financial savings were realized?
- What difficulties were faced in the application of the Green Productivity Methodology?
- What areas have been identified for future improvement?

What are the questions that you may be asked in the review process? Are you ready to answer?

- Are the implemented options in line with the objectives and targets of the Green Productivity program?
- Were there any deviations? Were these deviations recorded and documented?
- Why did they occur? How can they be solved?
- Did you modify your objectives and targets? How realistic are they?
- Have any alternative strategies been worked out to meet the new objectives and targets?
- What are the benefits of the implemented options?
- What is the improvement in productivity and environmental performance?
- Are these improvements in line with the envisaged benefits?
- What is the improvement to the bottom line?
- Has there been a system-wide reaction along the supply chain to support the desired changes?
- Has there been a reflection of the Green Productivity program in the market?
- What have been the main constraints or barriers?
- Has there been a strategy devised to overcome them? If so, what is it? If not, why not?
- What further resources are required (if any) for this?
- Has training and communication been effective?
- If not, what has been done to improve this?
- Is there anything else that you should share with the reviewers that is useful?
- Can you share any of your success with others outside the company? APO? An NPO?

Have you noticed how many of the tools have names that emulate nature or natural process? This will be discussed further in Chapter 5.

The key question that a management review seeks to answer is the one that addresses the bottom line. *“Is the Green Productivity program working?”* Is it really *suitable, adequate and effective* in improving the organization’s productivity and environmental performance?

The people who should be involved in the management review are those who have the right information and knowledge and those who are responsible and accountable for making decisions. The management review should assess how changing circumstances might influence the suitability, effectiveness or adequacy of the Green Productivity program. Changing circumstances may be internal to the organization (i.e. new facilities, changes in products or services, new customers, etc.), or they may be external factors (such as new laws, new scientific information, or changes in adjacent land use).

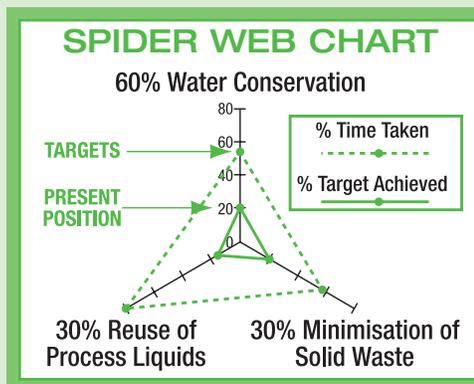
The frequency of the management review is a decision that you should make based on organizational needs – what is best suited for your Green Productivity goals. Management reviews are key to continuous improvement and to ensure that Green Productivity continues to meet the objectives and targets set earlier. If you are not top management, now is where their commitment to Green Productivity will be tested.

Tools for Group Work on Monitoring and Review

Most of the tools that will help you with this task have already been reviewed in this Chapter. One that you might not have experience with is the Spider Web diagram.

Spider Web Diagram

Spider Web diagrams show performance against a target when several criteria are being set. They provide a visible or graphic way of showing progress and performance against several targets at the same time. During Benchmarking, this tool can be used to show the current performance, the immediate objective, the average in class, or the overall best in class performance.



Case Study

This example illustrates the use of Spider Web Diagram for tracking the progress of options in a knit-fabric processing company. You can see from the diagram that the target of 30% reuse of process liquor was lagging behind its allotted time. Only 20% reuse of the process liquor was achieved in 80% of the time scheduled. This demonstrated a large gap between desired performance and actual. Hence, taking action to resolve this gap was a high priority to meet this Green Productivity option. The other two targets, minimization of solid waste and water conservation, appear to be well within their time frames.

Other Supporting Tools

You have already been introduced to some of the other support tools in this chapter that can also be applied to your current task.

Table 4-4 Monitoring and Review of Tools in GP Program

<i>Tools from previous steps, relevant in Monitoring and Review of GP Program.</i>		
Tool	Function in Previous Steps	Function in Monitoring and Review
Eco-maps	Identify problems on the layout for various themes.	Update eco-maps according to improvement after GP options.
Control Charts	Identify deviations from optimum in process parameters.	Check for reduction in deviations.
Failure Mode Effect Analysis	Anticipate failure modes in a process and prioritize.	Check with actual failure modes and implement corrective action.
Cost Benefit Analysis	Compare costs and benefits of a proposed GP option and conduct profitability analysis.	Determine actual NPV, IRR and determine profitability of GP option.

For example, Failure Mode Effect Analysis is useful during evaluation to predict the failure modes and plan corrective action. At this stage, Failure Mode Effect Analysis can be used to evaluate actual performance of your Green Productivity option(s), which would enable you to make the necessary corrections. A Cost Benefit Analysis, used in evaluation to assess the profitability of options, can now be applied to determine actual net present value (NPV), internal rate of return (IRR) and determine the profitability of your Green Productivity option(s).

Additionally, tools like control charts and Eco-mapping, used previously in problem identification and visualization, can now be used to update your improvements after the implementation of your Green Productivity option(s); the latter being especially useful for small companies.

You have come to the end of this step. You should have:

- Monitored all of your implemented Green Productivity options according to their respective performance indicators, which you developed in Task 7.
- Evaluated and analyzed the performance of your Green Productivity Options.
- Reported the findings to your top management (if this is not you) for review in the form of a post-implementation report.

It is now time to go to the last step. This next one is important to sustain your Green Productivity success.

4.8 Step 6: Sustaining Green Productivity

What behaviours do you have to encourage in your team members to maintain your Green Productivity process?

You and your Green Productivity team must be free from criticism that demeans your efforts. It is a courageous thing to experiment and take risks without fear of losing face.

To maintain your leadership as a catalyst for creativity that will sustain your Green Productivity efforts, keep the following tips in mind:

- Respect yourself and others -- this includes asking for help when you have reached your limitations. Asking for someone's help is a fundamental sign of respect.
- Actively listen – and confirm your understanding of the other person's ideas; this will save you time and reinforces mutual respect.
- Accept that you will make mistakes, and this will not be the end of the world. Solve the problems and move on. There is so much to do, and so little time in which to do it. Time is the most non-renewable resource of all.
- Avoid clichés or negative statements when someone brings you an idea that you do not first see the merit in. Ask them to explain it. This is related to 'don't shoot the messenger'. When someone brings bad news to you, strive to accept the information as a fact and work to solve the problem it presents. Do not punish the bearer.
- Be open to other people and new situations – be an explorer for new opportunities. The reward is a better bottom line.

By the end of this step you should have:

- Incorporated changes into your organization's core system of management.
- Taken corrective action identified in the post-implementation report.
- Established a system of identifying new problem areas and repeating the tasks outlined in steps 4 to 12 to ensure continuous improvement.
- Celebrated your success, learned from your mistakes.

Task 12: Incorporate changes into organization's system of management

Procedures are an element of the continual improvement process that enable you to manage change, whether they are written or not. They will need to be updated in light of the findings from your monitoring and evaluation efforts. This can include changes brought about by corrective actions or other changing circumstances in the company.

Corrective action is action required based on facts presented in the post-implementation report. Corrective action may be required because of internal or external reasons. Actions to correct a procedure could:

- be an action that directly intervenes in the operation of an option (an operating procedure is modified or equipment is changed);
- be a modification in the target, if it is found that the target set cannot be met with the present Green Productivity option;
- be a change in the objective itself. This might mean that the setting of objectives and targets was not conducted properly, review your criteria;
- modify an existing concern or generate a new concern;
- be a modification in the team structure and responsibilities.

Based on corrective actions, relevant sections of your existing documentation that would require updating include:

- operating manuals;
- targets for objectives;
- responsibility allocation of the staff concerned;
- training needs and activities.

Task 13: Identification of new/additional problem areas for continuous improvement

New problems appear for all kinds of reason, some within your control and some that you may have no control over. Factors include:

- changing prices and availability of resources
- formulation of newer products and newer markets
- new legislation, especially those related to environment, products, labour and packaging
- improvement in the operating norms and benchmarks
- increased competition
- lost markets
- change in the cash flow of the company

Note, when change is required it does not mean that you repeat steps 1 through 6 to incorporate improvement. The cycle loops back to different steps in the methodology for Green Productivity depending on the various GP options, the findings of the monitoring and evaluation of results, and the corrective action chosen and approved by the management. For example, it is possible that following the management review, corrective action is limited to modification of your objectives and targets. In this situation, the relevant Green Productivity team goes back to Step 2, i.e., the Planning Step, rather than back to Step 1. The principle of continuous

Do you practice continuous or continual improvement? In your mind there may be no difference. Culturally, western businesses (especially in the US) tie their improvement efforts to stages, an example of which would be a quarterly report. Whereas in Asia, there tends to be more references to continuous improvement: a thoughtful, planned yet fluid process.

improvement has been woven into the methodology for Green Productivity to optimize your improvement efforts through intelligent feedback and corrective and preventative actions.

Congratulations, with this step you've completed one full cycle of improvement.

4.9 Summary of this Chapter

Here are all the things that you have learned in this Chapter.

Summary of Steps to Success in Six

Getting Started

- decided on the members and formed the GP team(s)
- contacted external consultants if required
- selected GP team leader
- decided on responsibilities
- prepared time schedules for regular meetings to discuss progress
- conducted Walk Through
- collected baseline information

Planning

- identified problems and causes
- set objectives and targets
- identified performance indicators
- decided on the sub-teams which would be involved in the generation of GP options of each objective

Generation and Evaluation of GP Options

- generated GP options for each objective
- decided screening criteria
- screened GP options
- decided the final selection of GP options to be evaluated
- collected option specific information
- evaluated GP options
- prepared an implementation plan for the selected GP options
- decided on sub-team responsibilities and contributions to implementation

Implementation of GP Options

- implemented the selected GP options
- trained the staff and developed competence on the operation of the GP options and the monitoring & evaluation of the GP program

Monitoring and Review

- monitored all implemented GP options according to their respective performance indicators developed earlier
- evaluated and analyzed the performance of GP options
- reported the findings to the management for review in the form of a post-implementation report

Sustaining GP

- incorporated changes into the organization's system of management
- taken corrective action as per the post-implementation report
- established the system of identifying new problem areas and cycling through tasks 4 to 12 to ensure continuous improvement

Summary of Tools to the GP Methodology

STEP 1: Tasks	STEP 1: Getting Started
<ol style="list-style-type: none"> 1. Form a GP team 2. Walk Through Survey and information collection 	<ul style="list-style-type: none"> - Checklists, Tally charts - Plant Layout - Flowcharts and Process Flow Diagram - Material Balance - Benchmarking
STEP 2: Tasks	STEP 2: Planning
<ol style="list-style-type: none"> 3. Identification of problems and causes 4. Setting objectives and targets 	<ul style="list-style-type: none"> - Brainstorming - Cause and Effect Analysis (Ishikawa) - Critical Path Analysis - Eco-mapping - Gantt Chart
STEP 3: Tasks	STEP 3: Generation and Evaluation of GP Options
<ol style="list-style-type: none"> 5. Generation of GP options 6. Screening and evaluation of GP Options 7. Preparation of implementation plan 	<ul style="list-style-type: none"> - Brainstorming - Cost Benefit Analysis - Eco-mapping - Failure Mode and Effect Analysis - Pareto Charts - Program Evaluation Review Technique (PERT)

STEP 4: Tasks	STEP 4: Implementation of GP Options
8. Implementation of selected options 9. Training, awareness building and developing competence	- Training Need Analysis - Team briefing - Responsibility Matrix - Critical Path Method - Gantt Chart - Spider Web Diagrams
STEP 5: Tasks	STEP 5: Monitoring and Review
10. Monitoring and evaluation of results 11. Management review	- Solution Effect Analysis - Eco-mapping - Failure Mode and Effect Analysis - Charts (control, Tally etc.)/Spider Web Diagrams
STEP 6: Tasks	STEP 6: Sustaining GP
12. Incorporate changes 13. Identify new/additional problem areas for continuous improvement	- Some of the tools are repeated here, since the activities are looped back to previous steps

Through this chapter, you have substantially built on your knowledge of Green Productivity by developing an understanding of the value of methodology that is available through Deming's Plan-Do-Check-Act process and the spirit of continuous improvement embodied in KAIZEN.

Please indicate your new level of knowledge concerning Green Productivity methodology and its PDCA and KAIZEN roots where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of the methodology is at this level: 1 2 3 4 5

Please indicate your new level of skill in obtaining the commitment of top management to adopt Green Productivity where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My level of skill at negotiating is: 1 2 3 4 5

Please assign a value to the importance of you being able to continuously improve using Green Productivity to enhance your business where:

1 (not important) 2 (slightly important) 3 (average importance)

4 (a core business concern) 5 (a critical business tool)

The continued importance of Green Productivity methodology to my bottom line is: 1 2 3 4 5

4.10 Questions

1. In a world where change is a constant, your resilience to change can be increased by adapting to life-long learning. What resources, other than your NPO or the APO, can you list that you could call upon to help with your GP program?
2. Many of the GP tools shared with you in this chapter are geared toward the development of new ideas. Why is that?
3. List three tools that could help you develop new ideas against one of your current challenges. Which one has the greatest potential? Why?
4. There are three ways of learning: by accident, through mistakes, or with humour. Of these three, from which ones have you gained most benefit? Why?
5. Draw a map of your plant or office layout. Using the techniques outlined in Eco-Mapping identify what your top three issue areas are. (Noise, Waste, Air, etc.)
6. Of the three top issues you've identified as being critical areas for improvement, choose a GP tool that will help you select which issue you should focus on first.
7. Often the benefits of improvement opportunities are not exclusive to one organization. Identify who else in your supply chain would benefit by the results of questions 5 and 6. Go talk to them about it.

4.11 Point to Ponder

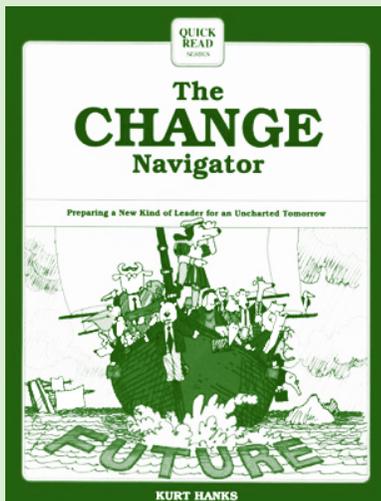
Change Navigators

What do you think the future will be? Do you know what will happen in the year 2050? No? Few of us have crystal balls that give us the power of precognition. If this were true we could all be wealthy as we could play the stock market and cash in on bull market opportunities.

Yet some people have taken steps that have dramatic impacts on their future and on others.

- In October 1944, a family successfully escaped Budapest on the last train before the city was devastated in a bombing. Most residents stayed behind and were killed in the bombing or starved to death in the months following.
- In 1947, Sony President Akio seeing the potential of the transistor acquired the license from Bell Laboratories for a paltry \$25,000. By the early 1950s, Sony, a previously unknown name in the international marketplace, captured the US market for inexpensive radios.
- In 1492, Christopher Columbus, the Italian navigator, convinced Queen Isabella of Spain to finance his sailing venture. When conventional knowledge saw the world as being flat, he sailed west to find a route to the Far East.

History is littered with stories of this kind. What do these stories have in common? Each tale has a very different setting, yet they share the same underlying pattern. People stepping away from conventional thought to chart new waters. They made choices based on a vision that was unique and they acted upon it to get what they wanted. Their perception of the changing world was vastly different than their peers or society.



The Change Navigator: Preparing a New Kind of Leader for an Uncharted Tomorrow, Kurt Hanks

Our collective and individual future will evolve from dramatic and unexpected change. How you view the events and things in your world will determine your reaction to that future. These reactions will prove prophetic – resulting in the difference between mere survival and the opportunity to thrive. Your traditional perception of what is really happening will increasingly fail you. Therefore you need to fundamentally change your mindset, to improve your ability to discern information.

Sometimes you can face substantial inertia to your idea of starting Green Productivity. Decision-makers may be entrenched in a traditional approach. Your company may be serving what appears to be a conservative market, unreceptive to change. The status quo is comfortable for many. Yet there is a nagging thought in your mind that if you do not take action, change will be made for you. Who can you talk to in order to see the world in a different light? Who is good at discernment?

Three groups that are good at discernment include children, cartoonists and comedians. Good comedians have a talent for looking at everyday life and providing us with an alternate view. Cartoonists are skilled at taking pen and paper and providing us with an image that emphasizes the flaws in our world. Children are often relentless in their pursuit to know why things are the way they are. Visit a classroom and explain to a few children what the problem is (in non-technical terms). It can be a productive time.

If you are the one responsible for leading a GP team in your organization, you may wish to spend some time learning how to lead change. Kurt Hanks wrote an excellent book in a QUICK READ series called “The Change Navigator: Preparing a New Kind of Leader for an Uncharted Tomorrow”. It was published in 1994 by Crisp Publications of Menlo Park, California.

Part of the challenge you will have to address to support GP is to break existing and outdated mindsets. Hanks outlines in an illustrative and humorous way the tools and techniques you can use to map existing mindsets and then create new ones to meet your goals.

An excellent example of one of the challenges you may face in your GP efforts is the mindset that human law takes precedence over the laws of nature. While legislation and regulations are not trivial issues, knowing what it is you do or have in your company that creates a significant environmental impact is important.

For example, imagine the situation where your factory is built on a floodplain. You acquired the necessary permits from the authorities to build an extension, met building code requirements. You have the legal right to expand on that location.

The spring after you complete your expansion, there is a horrendous storm and the foundations of the new section are washed away, taking equipment and washing barrels of solvent into the river. Equipment is damaged. Toxic material is released into the receiving waters that service the local community. Was this really a good idea? Or did the fact that you were given a permit to do something blind you from using better judgement?



*Don't let what you think
get in the way
of what you see.*

*Don't let what others think
prevent you from making
a better decision.*

Be a change navigator.

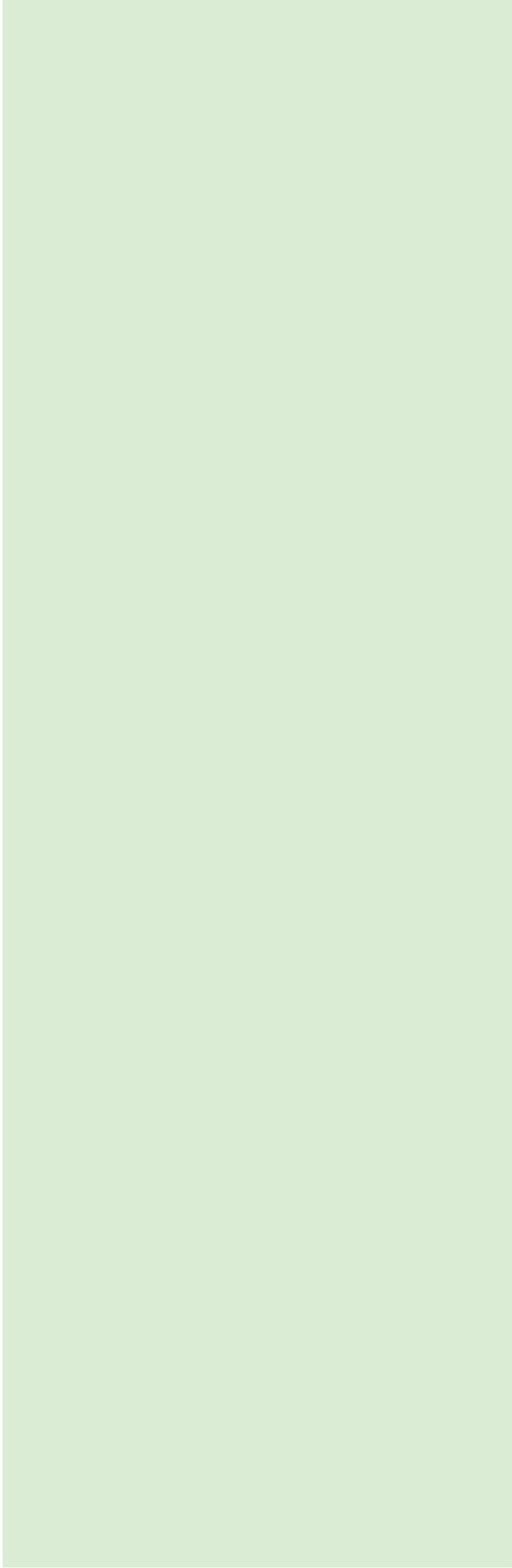
Source: Adapted from The Change Navigator - Preparing a New Kind of Leader for an Uncharted Tomorrow
by Kurt Hanks

Imagine if ...

Mother Nature was President of the Whole Earth Corporation with sole control over all resources, including air, water, energy, land, plants, etc. To be able to use any of these resources you would have to negotiate a contract with her.

What would her contract look like? Would you be able to meet her terms and conditions now? If not, what do you need to change today to ensure you maintain a continuous flow of these resources? What would she do if you ignored her terms and conditions?

Think about the changes you would need to make and how GP can help you make these changes.



CHAPTER 5

Management Systems and Programs

CHAPTER 5

Management Systems and Programs

CHAPTER 5 MANAGEMENT SYSTEMS AND PROGRAMS

5.1 Purpose of this Chapter - The value of a systems approach to manage Green Productivity

“A stable system is one whose performance is predictable. It is reached by removing, one-by-one, the special causes of trouble, best detected by a statistical signal.” - W. Edwards Deming

Who was Deming, and why does his name continuously appear as being the godfather of quality?

W. Edwards Deming¹ was an American statistician who was invited to Japan by the Union of Japanese Scientists and Engineers (JUSE) after General MacArthur's staff identified that the quality problems prevalent in Japan were based on outmoded management practices.

His experience grew out of working with industries to teach them how to use statistical methods to improve the quality of military production.

It is said the pivotal moment in Deming's career was at a dinner meeting with 45 leading industrialists in Tokyo. At that time national productivity was not providing Japan with the returns it desired. However, Deming is reported to have indicated that if Japan redesigned its products, and then bring its processes under control, it would rebuild productivity to the point where people would be demanding their products within five years.

The Japanese proved Deming wrong, they did it in four. And the rest, as they say, is history.²

Are you ready to make history?

The purpose of this chapter is to show you why a systems approach to Green Productivity is fundamental to sustaining your success. This chapter will explore the foundation of change that the quality management evolution established. In particular, Deming's System of Profound Knowledge will be outlined. It will be discussed in terms of its critical value to Green Productivity and to your success in initiating change, implementing your Green Productivity options and sustaining the change.

In addition, this chapter will introduce the tools of globalization that are bringing conformity to businesses from all economic regions, including:

- An explanation of the history of Total Quality Management: variations on its core principles and its natural application to the environment
- Other statistical tools that will prove useful
- International standards for management systems enabling a 'one-world' marketplace
- Barriers to success

- Approaches to overcome these barriers
- The opportunity for equal access to a growing green global marketplace (presently not a level playing field)

Where are you now?

The first four chapters of this book have taken you through a journey of learning about the importance of greening your business processes. This is a journey that does not end here. This is merely the beginning.

Where are you in your journey to enhance your knowledge, skills and attitude concerning the need to align your business system with natural systems?

Please indicate your current level of knowledge of management systems and other system tools where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of system and system tools is: 1 2 3 4 5

Please indicate your current level of skill in applying a systems approach to management where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My skill level is: 1 2 3 4 5

Please assign a value to the importance of a systems approach as a means to sustain your Green Productivity options where:

1 (not important) 2 (slightly important) 3 (average importance)
4 (a core business concern) 5 (a critical business tool)

I think the level of importance of this approach is: 1 2 3 4 5

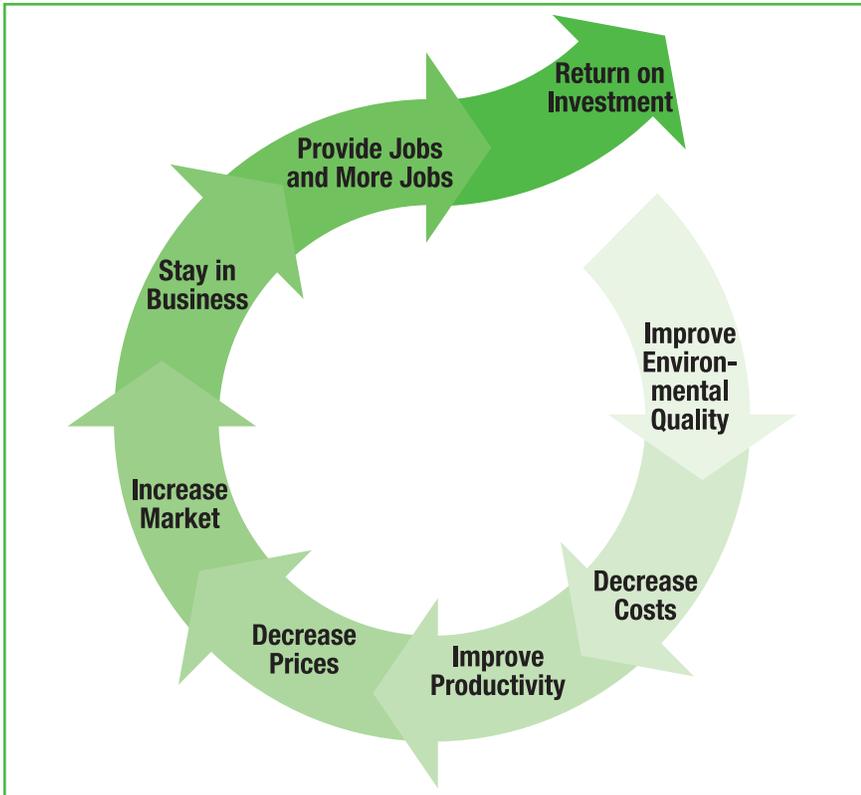
5.2 Quality Management - The Foundation of Change

There is no question that Deming's approach to change was radical for its time; it continues to stand firm against traditional thinkers who demonstrate rock logic and those whose minds are closed to improvement.

Deming, Ishikawa and quality – thinking before doing

One of the most fascinating aspects of Deming's teaching, one that radically departs from conventional thinking is his holistic approach based on the relentless pursuit of quality; an elusive concept to many. Yet his systems approach has been proven over and over again. By focusing on the improvement of quality, there is a chain reaction.

Figure 5-1 Deming's Chain Reaction Applied to GP



When quality is increased by improving processes, not by expanding inspection, productivity improves. Better productivity lowers costs, which lowers prices. Customers respond to better quality and lower prices, increasing the market share. The company stays in business, perhaps even creating more jobs. The result of this chain reaction is greater return on investment – an enhanced bottom line. Keep this sequence in mind; you will need to revisit it shortly.

Just as Deming's adherence to a systems approach was critically important for changing the economic fortunes of Japan, there had to be someone willing to risk all to accept the change. That person was Ichiro Ishikawa, the first president of JUSE³ and chairman of Keidanren at that time. Ishikawa arranged a one-day conference at a mountain retreat in Hakone for forty-seven executives from key Japanese industries. That meeting propelled quality control from a lower staff function to a key management tool. One of the essential lessons that the Japanese learned early on in their adoption of quality is that there is **NO SUBSTITUTE** for careful planning. Thinking through a problem before doing is critical. The number of tools that exist for generating new ideas reinforces this fact, as you learned in Chapter 4.

It is important to understand how Deming's systems approach works. The PDCA cycle was alluded to in Chapter 1; here you will learn just how valuable it is in detail.

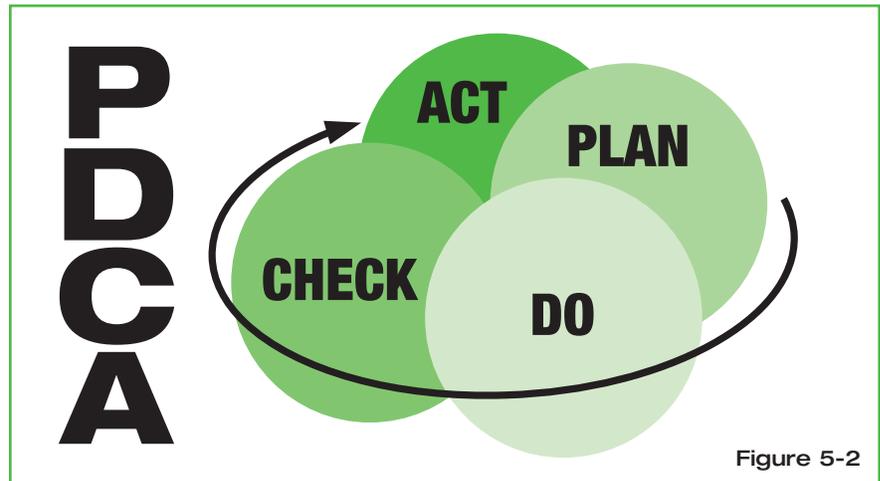
An organization **Plans** to do something.

It **Does** it.

It **Checks** the results, and

puts it (the plan) into **Action** or

Adjusts, resulting in continual improvement.

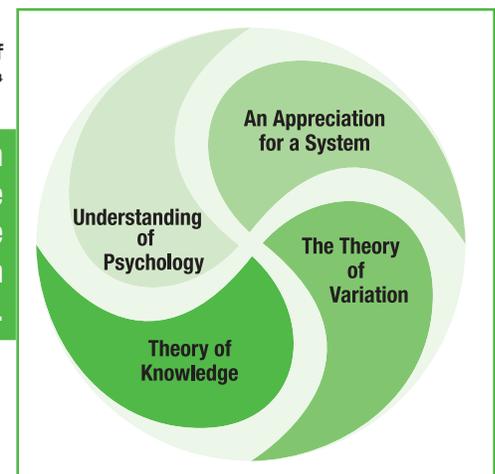


This four-step cycle was further explained through what Deming referred to as a **System of Profound Knowledge**. This was a framework for applying best efforts to the right tasks, which includes:

- An appreciation for a system (in which you operate)
- The theory of variation (which will be discussed further below)
- Theory of knowledge (really understanding the design needs, work process required and the cost of operating), and
- Understanding of psychology (motivating people to work to their full potential)

Figure 5-3 Deming's System of Profound Knowledge⁴

These are the four system conditions for quality; they are interdependent, and cannot be separated, nor used in isolation.



For these system conditions to be used, Deming created a theory of management embodied in fourteen points for the creation of change. Initially called Deming's 14 Points, he evolved them to be described as Obligations. He recognized that change does not come smoothly or easily. Blocking progress is what Deming referred to as the Seven Deadly Diseases, and a myriad of obstacles. Of the two, diseases could end an organization if not cured; they have to be fought directly. While obstacles are damaging, they are not fatal but need appropriate attention. Unattended obstacles continuously drain the organization of its resources, as a chronic illness or cancer.

Fourteen Obligations⁵

1. Constancy of Purpose
2. Adopt the New Philosophy
3. Cease Dependence on Mass Inspection
4. End the Practice of Awarding Business on the Basis of the Price Tag Alone – Instead Reduce Cost by Reducing Variation
5. Continual Improvement
6. Training for a Skill
7. Leadership
8. Drive Out Fear
9. Break down barriers between staff areas
10. Eliminate Slogans, Exhortations, Arbitrary Targets
11. Eliminate Numerical Quotas for the Workforce
- 12A. Remove Barriers to Pride of Workmanship
- 12B. Drop the Annual Merit Review
13. Education and Growth
- 14A. Take Action to Accomplish the Transformation
- 14B. An Example (Caution – Do Not Use Without Theory)

The Seven Deadly Diseases

1. A lack of constancy of purpose to plan product and service that meet or exceed customers needs and expectations. Without this, the organization will not pass the test of fitness, and the company will fail and jobs will disappear.
2. An emphasis on short-term profits. This is generated by short-term, linear thinking (just the opposite from the constancy of purpose required to stay in business). It is fed by a fear of unfriendly takeovers, and pushed by bankers and owners chaffing for dividends.
3. An individual review system, regardless of how it is termed, the effects of which are devastating. Where management by objective is isolated from a process to achieve improvement, it becomes a self-fulfilling prophecy for extinction.

4. **Job hopping;** the “white knight syndrome”. Parachuting someone in to affect a quick turnaround, for which they receive a pat on the back or a bonus check creates prima donnas. It does not reinforce the team work (think of one-year supply contracts) necessary to keep the process going for the long-term. And these individuals high-tail it out before the department/product line/company crashes. (When have you heard the statement “it was running fine when I was there – so and so came in and dropped the ball”.)

5. **Managing on the basis of only what you do know;** the visible numbers leave you with no company and no figures: It is important to know what the numbers mean, not just what they are. How do they fit into the process? Where do they fit? Figures are important to meet payroll, pay suppliers or taxes, calculate depreciation and fund contingencies. However, it’s the things you don’t know that can close the company. For example, if your accounting department kicks out all the companies that do not pay within 45 days, you may lose your key accounts that pay within 60, which are responsible for significant business and have been with you for many years. Sound impossible? Well, don’t laugh, it has happened.

6. **Excessive Medical Costs:** It may surprise you that the Pontiac Motor Division acknowledged that Blue Cross was their second largest supplier, with costs of \$400 US per car. Six months later Blue Cross overtook steel as the largest supplier. That was not the end of it: additional medical costs were embodied in the steel that went into the car.

7. **Excessive Legal Costs:** How many times is a lawyer required to arbitrate in a twenty-year relationship based on trust, pride and a handshake? How fast can a contract be broken when a lawyer is hired? Which situation would you rather be in?

7 QC Tools – The Basis of Quality Control

Control in the context of quality does not mean inspection, supervision, analysis and reports to find fault. Control means knowledge, especially the knowledge of variation and processes, continual education and having joy in your work⁶. In companies where there is a commitment to improve productivity by using quality control, the tools used to accomplish this have been referred to as the seven quality control (7QC) tools. These methods are dependent upon you being statistically literate. You can refer back to Chapter 4 for more details on most of these tools⁷. A brief description of each follows.

1. Cause and Effect Diagrams

This diagram, also called a Fishbone or Ishikawa Diagram, is used to associate multiple possible causes with a single effect. Thus, given a particular effect, the diagram is constructed to identify and organize possible causes for it.

The primary branch represents the effect (the quality characteristic that is intended to be improved and controlled) and is typically labelled on the right side of the diagram. Each major branch of the diagram corresponds to a major cause (or class of causes) that directly relates to the effect. Minor branches correspond to more detailed causal

factors. This type of diagram is useful in any analysis, as it illustrates the relationship between cause and effect in a rational manner.

2. Pareto Diagrams

Pareto charts are extremely useful because they can be used to identify those factors that have the greatest cumulative effect on the system, and thus screen out the less significant factors in an analysis. Ideally, this allows you to focus attention on a few important factors in a process.

They are created by plotting the cumulative frequencies of the relative frequency data (event count data), in descending order. When this is done, the most essential factors for the analysis are graphically apparent, and in an orderly format.

3. Check Sheets

The function of a Check Sheet is to present information in an efficient, graphical format. This may be accomplished with a simple listing of items. However, the utility of the Check Sheet may be significantly enhanced, in some instances, by incorporating a depiction of the system under analysis into the format.

4. Graphs/Flowcharts

Flowcharts are pictorial representations of a process. By breaking the process down into its constituent steps, flowcharts can be useful in identifying where errors are likely to be found in the system.

5. Scatter Diagrams

Scatter Diagrams are graphical tools that attempt to depict the influence that one variable has on another. A common diagram of this type usually displays points representing the observed value of one variable corresponding to the value of another variable.

6. Histograms

A Histogram is a specialized type of bar chart. Individual data points are grouped together in classes, so that you can get an idea of how frequently data in each class occur within the data set. High bars indicate more points in a class, and low bars indicate less points or a lower value.

The strength of a Histogram is that it provides an easy-to-read picture of the location and variation in a data set. There are, however, two weaknesses of Histograms that you should bear in mind. The first is that Histograms can be manipulated to show different pictures. If too few or too many bars are used, the Histogram can be misleading. This is an area that requires some judgment, and perhaps some experimentation, based on the analyst's experience. The second weakness is that Histograms can also obscure the time differences among data sets. For example, if you looked at data for #births/day in Japan in 1996, you would miss any seasonal variations, e.g. peaks around the times of full moons. Likewise, in quality control, a Histogram of a process run tells only one part of a long story. There is a need to keep

7 QC Tools help you to better manage your work process and achieve higher quality products and services as an outcome.

Cause and Effect Diagrams

Pareto Diagrams

Check Sheets

Graphs/Flowcharts

Scatter Diagrams

Histograms

Control Charts

There is not consensus on what the 7 QC Tools include. Some list Run Charts instead of Check Sheets, and others post Stratification. What is most important is that the tools you use address your needs.

reviewing the Histograms and Control Charts for consecutive process runs over an extended time to gain useful knowledge about a process. Hence, a Histogram is not a tool to use on its own.

7. Control Chart

A Control Chart is the fundamental tool of Statistical Process Control, as it indicates the range of variability that is built into a system (known as common cause variation). Thus, it helps determine whether or not a process is operating consistently or if a special cause has occurred to change the process mean or variance.

The bounds of the Control Chart are marked by upper and lower control limits that are calculated by applying statistical formulas to data from the process. Data points that fall outside these bounds represent variations due to special causes, which can typically be found and eliminated. On the other hand, improvements in common cause variation require fundamental changes in the process.

The 7 QC tools listed above are ideally utilized in a particular methodology; hence you can see how adaptable they are into Green Productivity. Ishikawa's basic seven tools of quality do not fix problems, they merely point out trouble. However, as discussed, other methodologies may need to be developed to allow for sufficient customization to a specific process.

Furthermore, it is important to note that the mere use of the quality control tools does not necessarily constitute a quality program. Thus, to achieve lasting improvements in quality, it is essential to establish a system that will continuously promote quality in all aspects of its operation.

If you are not familiar with these statistical tools, or if you do not have a person on your Green Productivity team who is quite knowledgeable about statistical analysis, you should probably include this as one of your training needs. Statistical literacy is an important knowledge base for Green Productivity.

Total Quality Management (QFD/DOE/PD (Hoshin Kanri)/SPC)

What do all these acronyms mean?

ACRONYM	EXPLANATION
QFD stands for Quality Function Deployment (also called Quality Factor Development).	QFD refers to a system that identifies the needs of the customer and gets that information to all the right people so that the organization can effectively exceed competition in meeting the customer's most important needs thereby increasing market share.
DOE stands for Design of Experiments.	DOE is used initially as the best way to solve chronic quality problems in production. Later DOE is moved upstream

	to prevent quality problems at the design stage of a product or process. You can see how DOE and DfE may have some synergies.
PD stands for Policy Deployment.	PD is one English translation for Hoshin Kanri. It is used to improve on an existing TQM system.
Hoshin Kanri is the Japanese name for Hoshin Planning.	In Japanese, Hoshin Kanri means, “shining metal” and “point direction”. This refers to a shining light from the metal of a compass needle to show the way forward.
SPC stands for Statistical Process Control.	SPC is not a problem-solving tool. It is useful as a monitoring technique only after chronic quality problems are solved.

Total Quality Management or TQM

The idea of TQM started in the United States around 1945 in the form of statistical training. The term covers a multitude of management practices or styles that are also referred to as TQC; total quality control. Generally, TQM refers to a management system in which the focus is shifted to the customer. Hence, the spirit of TQM is found in corporate activities designed to create products and services that are attractive to consumers, competitive in markets and safe from the stage of new product planning⁹. All departments improve or maintain quality, cost, yield, procedures, and systems to give customers a product or service that is most economical, useful, and of the best quality. While TQM had its birth in the US, its growth as a tool for innovation occurred in Japan, and was adopted by other Asian nations. A successful TQM system is one where business processes are standardized under quality control in order to make use of cross-functional ways of managing and apply this to daily practices following the PDCA cycle in conjunction with basic quality tools.

As many as seven critical factors can be singled out for the successful implementation of TQM. They are:

- The unflagging commitment of top management
- Human resources development at all levels within the organization (turn your organization into one that continually learns and stays active)
- Use of information technology
- Implementation of business processes
- Active involvement of stakeholders including shareholders and the local community
- Obsession with customer satisfaction
- Recognition of TQM as an imperative corporate strategy⁹

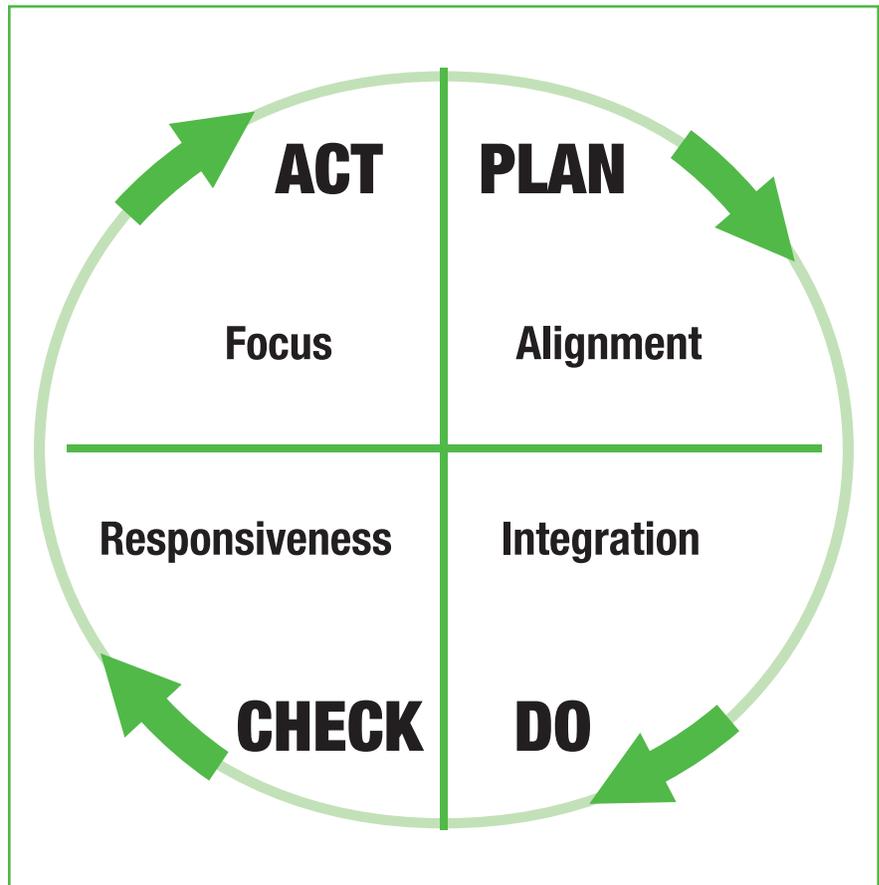
How does Hoshin Planning fit in with TQM?

Hoshin Planning appeared in the early 1960s as a tool to aid in the transition from statistical quality control (or Statistical Process Control) and TQM into an integrative form of organizational management, which was called TQC. A key stimulus of this evolution was the inclusion of policy and plan as an audit item.

Hoshin Kanri helps to control the direction of the company by orchestrating change within. The key to Hoshin Planning is that it brings the total organization into the strategic planning process, from both the top-down and bottom-up. It ensures that the direction, goals, and objectives of the company are rationally developed, well defined, clearly communicated, monitored, and adapted based on system feedback. TQM does not start with Hoshin Kanri; rather Hoshin Kanri is a tool for improving on an existing TQM process. One of its key values is to improve the linkage between top management's goals with TQM initiatives at the operational level.

There are four phases to a Hoshin Planning cycle (FAIR - Focus, Alignment, Integration, Responsiveness) that are captured in Figure 5-4 showing its relationship to Deming's PDCA.

Figure 5-4 Hoshin Planning and PDCA



There are four phases to Hoshin Planning. Hoshin Planning may be useful after you have established your Green Productivity process and need to concentrate on improving it.

PHASE	DESCRIPTION
Focus	There is a corporate vision statement that concisely establishes the values and long-term goals of the corporate entity, and a mid-term plan, which translates vision into objectives usually for no more than three years ahead. These are considered along with the current and anticipated needs of customers. This is often done as directly as possible so that the 'voice of the customer' is heard. Notice how well this could fit in with Green Productivity's QEP outlined in Chapter 1.
Alignment	A Hoshin is a combination of a statement of strategy (an objective) plus a statement of how performance will be monitored (a target). A Hoshin is passed from one level to another in which the subsequent level translates it into an activity that merges into their level of Hoshin; this has a cascading effect that is referred to as "catchball". The process is cross-functional, and requires managers to take ownership.
Integration	When the catchball process is finished and the Hoshins have been agreed to, detailed implementation plans are drawn up. Where a Hoshin does not seamlessly integrate into a daily process, a special project team is required. Again, you can see where this could fit in with Green Productivity's teamed approach.
Responsiveness	The phase involves the routine management or control of processes, which can be accomplished through Statistical Process Control (SPC). The information accumulated can be used to report to management, revise Hoshins and the policy, if required. This is the feedback loop that starts the process anew.

What is Statistical Process Control (SPC) and how can it help in your Green Productivity efforts? Statistical Process Control is not a problem-solving tool. It is the application of statistical techniques for measuring and analyzing the variation in processes. SPC will help you find the problem and define it. While this may seem trivial, an accurate description of a problem is sometimes difficult. Statistical Process Control has been widely used in the manufacturing companies using Control Charts, which were discussed in Chapter 4.

TQM can be seen to cover a range of approaches, which shows how the concept and practices required to attain quality have been embraced by different cultures. This is not negative, as Deming himself warned business leaders about trying to mimic the competition. Making change based on the reflection of someone else's quality evolution is not a strategy for success; quality is not transmitted by osmosis. You cannot clone someone else's quality program. It doesn't last. When a shortcut is used under the banner of TQM, the company initiates a process of change without

See Greening on the Go: A Pocket Guide for Green Productivity for more explanation on these types of diagrams.

embracing the commitment that Deming’s vital core philosophy of quality requires, it fails. These attempts in Western cultures are tarred with the expression “flavour of the month”.

Does quality work? There is no question that the Japanese were successful at TQM; in a four-year period they moved as a nation from a country producing poor quality to one where their products were preferred. Japanese cars, as an example, are rated very highly in other regional economies.

Matrix/Affinity/Relations/Tree/Arrow/Process Decision Diagram

All of these diagrams are useful for problem solving. They help you generate ideas or work with ideas. The following table provides a brief explanation of each one.

TYPE	DESCRIPTION
Matrix	This tool helps compare the efficiency and effectiveness of alternatives based on the relationship between two criteria, for example performance and cost. It also is a useful way to set priorities, compares elements, or spot outlying data or extreme areas.
Affinity	Affinity Grouping is a Brainstorming method in which participants write down their ideas, organize them, and identify common themes. This tool helps generate, then organize ideas or concerns that are numerous, complex, or not easily organized.
Relations	Relations Diagrams are drawn to show all the different relationships between factors, areas, or processes. Why are they worthwhile? These diagrams make it easy to pick out the factors in a situation that identify the ones that are driving many of the other symptoms.
Tree	A Tree Diagram is an organized list that shows all possible outcomes of an event; this can help you calculate the probability of events.
Arrow	An Arrow Diagram is a graphic description of the sequential steps that must be addressed before a project can be completed. It is another term for a PERT (Performance Evaluation Review Technique) or CPM (Critical Path Method) chart.
Process Decision	A Decision Tree can help identify what would happen under a variety of standardized alternative future scenarios. You can identify potential flaws and areas where more research may be needed. Adding the probability of outcomes helps give participants an overall view of what may happen under each alternative. As Decision Trees list all the alternatives being considered and their outcomes, they are also useful to keep the process on track. Participants can clearly see what the decision revolves around.

Standardizing Change – the Rise of ISO

ISO stands for the International Organization for Standardization. 'ISO' means equal.

International standardization began in the electrotechnical field; the International Electrotechnical Commission (IEC) was created in 1906. The International Federation of the National Standardizing Associations (ISA), which was set up in 1926, carried out pioneering work in other fields. The emphasis within ISA was laid heavily on mechanical engineering.

ISA's activities ceased in 1942 due to the Second World War. It resumed following a meeting in London in 1946, at which delegates from 25 countries decided to create a new international organization "the object of which would be to facilitate the international coordination and unification of industrial standards". The new organization, ISO, began to function officially on 23 February 1947¹⁰.

While the next few decades focused on more technical and engineering standards, the need for common measures in other fields started to emerge. Why? Standards are documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose. International Standards contribute to making life simpler, and to increasing the reliability and effectiveness of the goods and services used.

Globalization is clearly pushing standardization to provide commonality around the world, not to reduce competition, but to ensure that your products and services are universally accepted and applicable in all markets. The existence of non-harmonized standards for similar technologies in different countries or regions can contribute to so-called "technical barriers to trade". Export-minded industries have long sensed the need to agree on world standards to help rationalize the international trading process. This need drove the establishment of ISO.

International standardization is well-established for many technologies in such diverse fields as information processing and communications, textiles, packaging, distribution of goods, energy production and utilization, shipbuilding, banking and financial services. It will continue to grow in importance for all sectors of industrial activity for the foreseeable future.

The main reasons are:

- Worldwide progress in trade liberalization
- Interpenetration of sectors
- Worldwide communications systems
- Global standards for emerging technologies
- Developing countries

Industry-wide standardization is a condition existing within a particular industrial sector when the large majority of products or services conform to the same standards. It results from consensus agreements reached between all economic players in that industrial sector - suppliers, users, and often governments. They agree on specifications and criteria to be applied consistently in the choice and classification of materials, the manufacturing of products, and the provision of services.

The aim is to facilitate trade, exchange and technology transfer through:

- enhanced product quality and reliability at a reasonable price;
- improved health, safety and environmental protection, and reduction of waste;
- greater compatibility and interoperability of goods and services;
- simplification for improved usability;
- reduction in the number of models, and thus reduction in costs;
- increased distribution efficiency, and ease of maintenance.

Customers and consumers have more confidence in products and services that conform to International Standards. Assurance of conformity can be provided by manufacturers' declarations, or by audits carried out by independent bodies.

ISO 9000 - Quality Management Systems

The ISO 9000 series, standards for Quality Management Systems emerged in 1987. ISO 9000 is primarily concerned with "quality management". Like "beauty", everyone may have his or her idea of what "quality" is. In plain language, the standardized definition of "quality" in ISO 9000 refers to all those features of a product (or service) that are required by the customer. "Quality management" means what the organization does to ensure that its products conform to the customer's requirements. ISO 9000 represents the documented, controlled, understood, standardized approach to managing quality. Despite the proficiency of the Japanese and other Asian countries in adopting quality management, Western nations forced the adoption of a standardized approach. Without the benefit of embracing Deming's System of Profound Knowledge as a precursor to starting down the road of quality, many western companies acknowledged the need for a standardized approach.

The application of quality to the ecology

One of earliest literary references of a quality tool applied to the environment occurred in a document in the 1970s, applying SPC to biological control in a laboratory. The discussion focusing on the application of quality to the management of the environment did not start until the mid 1980s. The movement formally got its introduction at the WICEM II conference in Rotterdam when a group called the Global Environmental Initiative (GEMI) presented it.

One of the most compelling reasons for the application of quality to ecology is the concept of a systems approach. This did not occur by accident. Gregory Bateson¹¹ had said "most of our problems arise from the difference between the way man thinks and the way nature works." In the 1997 keynote presentation to the Deming

Institute, the presenter noted that Shewhart had couched his early explanation of Statistical Process Control in terms of the way nature works. Indeed, the opening chapters of his book ground the discussion of variation in the ideas of early-20th century scientists concerning the probabilistic nature of reality in the universe. Clearly, Shewhart's ideas affected Deming. The presenter espoused that Deming was trying to get people to realize that a human process becomes more robust to the extent that it emulates nature by being allowed to manifest through its variation a unique voice that blends, resonates, and harmonizes with the voices of other interrelated processes¹².

The marriage of quality and ecology was by design, not arranged by serendipity.

Total Quality Environmental Management (TQEM)

It was not until the late 1980s when business started to apply quality management approaches, philosophy and tools to the environmental issue. GEMI was an industry coalition of 21 companies formed in 1990; the goal of the coalition is to develop strategies and standards for corporate environmental performance. The term 'TQEM' was formally introduced at the WICEM II conference¹³ following which business started to make the formal connection between quality management and the environment. The merits of this approach were itemized as being:

- an alignment with business strategy
- continuous improvement with measurable results and
- a customer and supplier alignment

According to GEMI's 'TQEM Primer', there are four basic elements of TQEM:

- Customer identification: in TQEM, environmental quality is determined by customer preferences. Buyers, the local community, environmental groups and the general public are considered external customers, while a company's employees represent the internal customer group.
- Continuous improvement: a company's management and employees should work systematically towards the improvement of environmental performance. Company-wide employee involvement in TQEM is a key to success.
- Doing the job right first time: TQEM supports the elimination of environmental risks. Employees should seek to identify and eliminate potential environmental problems.
- A systems approach: it is important to design all components of the TQEM system so that they function together and support each other in achieving desired goals.

The following year at the Earth Summit in Rio, the need to have a common approach to management of the environment was tabled¹⁴. This led to industry leaders approaching ISO with the mandate to start a consensus process for a standardized management system.

The sad truth is that we do not have enough "A" companies; we have millions of "B" companies.

ISO 14001 outlines **what** you need to do, not **how**. GP offers the **how**.

ISO 14001 – Environmental Management Systems (EMS)/EMAS

In 1993, member countries in ISO started to work on a standard for environmental management systems that were first published in the fall of 1996. ISO 14001 is a tool for establishing a business process, which is applicable to any organization, regardless of size, sector, geographic location or economic region. Its purpose is to enable an organization to manage its own site –specific environmental impacts and influence on those outside its boundary of control using a common approach. ISO 14001 contains only those requirements that can be objectively audited.

ISO 14001 is a management system standard, and due to its voluntary nature, is intended to prevent the imposition of artificial borders, such as trade barriers.

ISO 14001 is a process standard, not a performance standard, with three caveats. It demands a **commitment** to continual improvement, a **commitment** to prevention of pollution, and a **commitment** for the organization to comply with relevant environmental legislation and regulations, and other requirements to which it subscribes. These commitments are noted in the environmental policy.

*“The usefulness of standards is embodied in a simple axiom: **when everybody else is doing A, it is not such a good idea to do B.**”¹⁵*

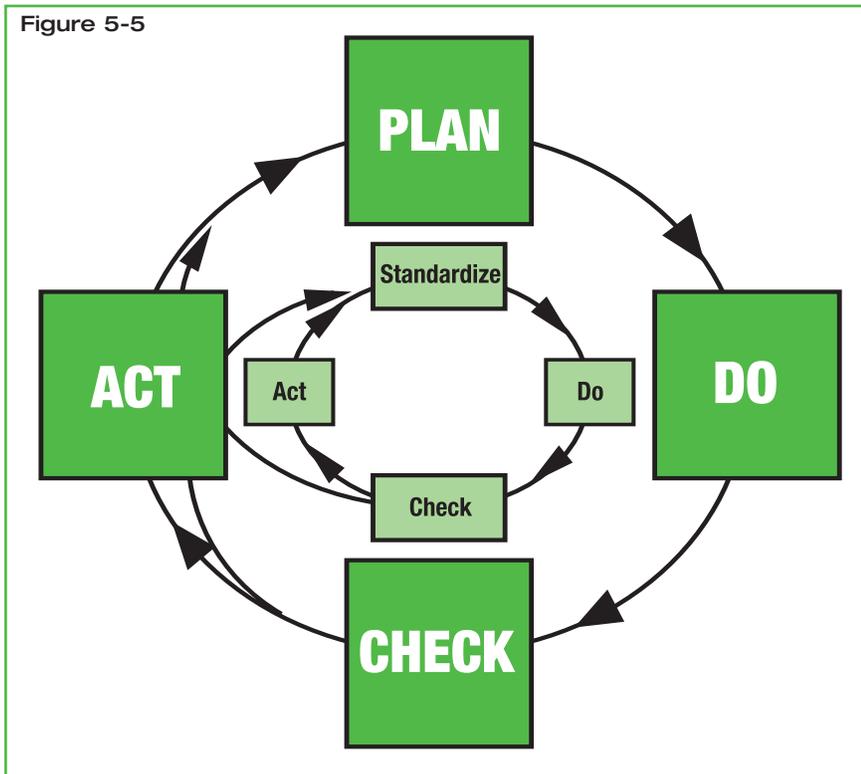
If “A” is the adoption of an EMS using ISO 14001 as the better idea and “B” categorizes a company as not managing environmental issues effectively or by using an approach that is unique but lacks consistency, transparency, comparability or reproducibility, which one is going to be accepted by interested parties? Are those that take option “B” going to be viewed as being credible by investors, loan managers, government bureaucrats, and perspective trading partners, customers or their community?

The need for an internationally accepted business tool is also reinforced by the reality of globalization. Business today is not just about selling a product or service to a customer around the corner. Whether it is food, durables, clothes, industrial equipment, paper or flowers, the trend is to source goods and services from a world market. Any company today operates as part of a global network with direct and indirect customers, people who are affected by an organization’s activities, products or services.

An EMS for an individual organization can be more robust in its elements than what ISO 14001 requires. Green Productivity enables this as it acknowledges ISO 14001, but goes far beyond the framework of the standard. ISO 14001 is a tool, not a technique. The standard outlines what an organization should have as the elements over which the frame of an EMS is shaped. But ISO 14001 does not share how to implement it, nor when to address the requirements. Again, Green Productivity is far more comprehensive than ISO 14001, or ISO 9001, for that matter. Green Productivity is not limited in its development process whereas ISO standards are reviewed every five years and revised if the market need is identified. ISO 14001 has been through its first revision cycle and a new version was published late in 2004. There are some changes to the requirements of the standard, which can be acquired through your national standards body, or by purchasing a copy of the standard on-line.

Figure 5-5 shows the potential distinction between an individual EMS and the ISO 14001 standard.

Figure 5-5



As with ISO 9001, ISO 14001 does not apply to product. Hence it is not acceptable to use ISO 14001 on labels to infer a “green” or “environmentally friendly” product. No product label, advertisement or other promotional material should infer that a product is “ISO 14001 certified” or “ISO 14001 registered”. Nor can an organization use the ISO logo; it is a registered trademark and unauthorized use would likely result in legal consequences¹⁶.

Eco-Management and Audit Scheme (EMAS)

The aim of the Eco-Management and Audit Scheme (EMAS) is to promote continuous environmental improvements. It is a voluntary scheme for organizations willing to commit themselves to evaluate and improve their environmental performance. The scheme was launched in April 1995 and revised in 2001 to incorporate ISO/EN ISO 14001 (International/European Standard for Environmental Management Systems) as its environmental management system component. EMAS goes beyond ISO/EN ISO 14001 in a number of ways. It requires organizations to:

- undertake an initial environmental review;
- actively involve employees in implementing EMAS;
- make available relevant information to the public and other parties.

EMAS in under revision again
(2006).

While EMAS is an obligation of nation states within the EU, it is still voluntary for the organization adopting it.

EMAS is a regulation, developed to meet the needs and expectations of governments, citizens and consumers in the European Union (EU) Member States. Because EMAS is incorporated into the laws and regulations of the Member States, it can take a more prescriptive approach to environmental issues. The ISO 14000 standards, by contrast, rely on voluntary acceptance by all interested parties, and therefore must maintain a balance between the needs and expectations of each of these parties. Another important difference is that EMAS currently applies only to manufacturing industry and certain approved pilot schemes. The ISO standards apply to all types of organizations - even those not considered "businesses," for example, government offices. EMAS applies to those countries in the EU and the European Economic Area (including Norway, Iceland and Lichtenstein). Other European countries are scheduled to support EMAS when they enter into the EU.

EMAS is an EU tool promoted through EC policy. The infrastructure for verification and validation does not exist outside the EU. ISO 14001 is the more commonly used standard based on the number of certified systems in the world. The value for you is in knowing whether your customer base is interested in ISO 14001 or is particularly keen on the additional requirements in EMAS from a supply chain perspective.

Merging ISO 9000 and ISO 14000 – The Two Series of Standards for Quality and the Environment

ISO 14001 and ISO 9001 are the requirement standards for which there are companion guidance documents. Both series are based on a process approach. This is the way in which an organization goes about its work, and not directly the result of this work. In other words, they both concern processes, and not products – at least, not directly. Nevertheless, the way in which the organization manages its processes is obviously going to affect its final product. In the case of ISO 9000, it is going to affect whether or not everything has been done to ensure that the product meets the customer's requirements. In the case of ISO 14000, it is going to affect whether or not everything has been done to ensure a product will have the least harmful impact on the environment, either during production or disposal, either by pollution or by depleting natural resources.

However, neither ISO 9000 nor ISO 14000 are product standards. The management system standards in these families state requirements for what the organization must do to manage processes influencing quality (ISO 9000) or the processes influencing the impact of the organization's activities on the environment (ISO 14000).

In both cases, the philosophy is that these requirements are generic. No matter what the organization is or does, if it wants to establish a quality management system or an environmental management system, then such a system has a number of essential features that are spelled out in ISO 9000 or ISO 14000.

Both ISO 9001 and ISO 14001 are voluntary standards. Hence you can use the requirements in part or in whole. You may only use certain clauses to improve a specific part of your organization's management system; that is fine. However, you may not state conformance to the standard unless you embrace all the requirements.

The interest in ISO 14001 is growing, and the demand for your organization to implement it will grow over the next few years. As with other programs under the umbrella of Green Productivity, the implementation of ISO 14001 (or ISO 9001 for that matter) is not an overnight activity. The adoption of a management system should be planned carefully to ensure success by striving to do first things right as with all Green Productivity tools.

OHSAS 18000 OHSMS

OHSAS 18001:1999 is an Occupation Health and Safety Assessment Series (OHSAS) for occupational health and safety (OH&S) management systems to enable an organization to control OH&S risks and to improve performance. OHSAS 18001:1999 was released in April 1999. OHSAS 18002:2000 is the Occupational Health and Safety Management Systems Guidelines for the implementation of OHSAS 18001.

Occupational Health and Safety Management Systems is a specification standard developed by the British Standards Institute. Historically, the control of safety and health has been driven by occupational health and safety regulations. Health and safety programs arose from the need to protect workers from occupational hazards and to ensure a productive workforce. It was restricted to those issues that arose within the workplace.

The growing number of regulations concerning impacts that take place beyond the factory gate meant that environmental issues needed to be incorporated into operational practice. Companies are under pressure to expand their existing health and safety policies and procedures to include the outside or natural environment. OHSAS is not an ISO standard.

The perceived value in implementing an OHSAS is to help you:

- Meet regulatory requirements
- Address emerging marketing requirements
- Increase your vendor rating status
- Potentially reduce your insurance premium
- Reduce the risk of accidents and occupationally related health issues
- Reduce lost time through employee illness and injury
- Indicate to employees that the company is concerned about their welfare

There is interest in the standards community to evolve the current management systems standards into one generic management system. This will take a few years to negotiate amongst the many different countries involved in ISO standards.

5.3 Approaching Management Systems Successfully

Green Productivity offers an excellent milieu in which to develop and implement any of these management systems. Just as Green Productivity requires the commitment of top management, so too does the integration of a standard as a tool under the umbrella of Green Productivity.

Barriers to Success

There are barriers to success in the adoption of management system standards. Some of these include:

- A lack of awareness
- The perception that unless you certify, your system is of no value (ergo, if you cannot afford to certify, don't start)
- The valuation of certification based solely on price of the registrar
- Lack of human resources (knowledge and time)
- Documentation requirements that exceed the use of core documentation in an SME
- The perception that it is a certificate activity managed by ISO in Geneva. ISO does not give out certificates. Accredited registrars provide the appropriate confirmation of a system; they give the certificate. National standards bodies accredit the registrar.

Traditionally, market drivers around ISO 9001 pushed users of the standard to obtain independent verification of their integration. An organization would therefore seek to be certified¹⁷ by a third-party process by an accredited registrar.

Both standards, as voluntary initiatives, allow you to self-declare. However, this option was seldom used in reference to ISO 9001 as it was strongly tied through contractual obligations. External validation is not a requirement of the standard; it may be of your client. In the case of ISO 14001, the people that are interested in seeing you implement a standardized system for managing your environmental aspects¹⁸ go beyond the historic business-to-business relationships. Those that may take an interest in your performance in this area include customers, investors, governments, your community and special interest groups that may live in another economic region. You may be pressured to adopt ISO 14001 for a whole newly defined 'customer'; one that may not have any direct business dealings with your company. Yet, they may be able to have a profound effect on the viability of your business should you choose to ignore them.

The challenge with ISO 9001 and ISO 14001 for Micro-enterprise and Small-to-Medium Sized Enterprise (SMEs)

There is a myth that these standards are not useful to smaller enterprises, or public sector organizations. As both standards outline the elements of what is required, not how these requirements are met, by design ISO 9001 and ISO 14001 fit any sized

organization, whether they are for or not-for profit, from any economic region in the world. The myth has been created by a number of challenges; some of which include:

- The expectation from larger companies, who have different resource needs than SMEs,
- The presuppositions of some registrars,
- A lack of knowledge of the original intent behind quality management (i.e. the absence of a System of Profound Knowledge),
- The assessment of value of registration based on a good Cost Benefit Analysis,
- The cost of registration (and the market influences affecting pricing),
- The focus on ISO 9001 or ISO 14001 being interpreted as a race to get a piece of paper (the certificate) versus a process for continual improvement and unrelenting commitment to quality including environmental quality.

Some of these challenges are the same barriers to success that larger organizations face; some are specific to SMEs. The net result is that there is the perception that ISO standards only serve the larger companies. This perception is not an isolated thought, and it is unfortunately perpetuated by the passively received information on adoptions using certification/registrations as the universal measuring stick.

With the rising importance of having a standardized approach to EMS, the market has started to respond with other methods for demonstrating the adoption of ISO 14001. There is a web-site¹⁹ that allows companies that self-declare against the standard to post alongside other methods for demonstrating conformance to the standard, including the traditional certification approach. Additionally, the market has started to develop other approaches for validation²⁰.

Self-declaration: Self-declaration means that an organization makes an assertion or claim that it has met all the requirements for achieving conformance with ISO 14001. The organization conducts its own internal audit of its environmental or quality management system, reporting to top management that all requirements are met or exceeded (ISO 14001 or ISO 9001). The burden of proof remains with the organization to prove that it conforms if challenged.

Second party: This term refers to a person or persons within the client's organization, or it can be a reference to a supplier, or trade association. It is generally used in reference to conducting audits of its suppliers, subcontractors or potential subcontractors. The purpose of these audits is to determine whether the supplier or subcontractor's EMS meets the requirements set forth by the organization performing the audit. An obvious goal of this audit is to determine whether the supplier or subcontractor has had the requisite training where their work may create a significant impact on the environment. The key issue is that whoever performs the assessment is in a position to do so impartially and objectively.

Which approach to demonstrating your conformity to ISO management system standards is best for you?

You decide. Third party certification is not a requirement. Your market can help you decide.

ISO 14001 provides more information on the options it officially recognizes (see page 5-23)

Self-declaration is not an "ISO-light" approach, you still need to include all the requirements, which is the same for all four options articulated in ISO 14001.

Second party audits may be used, including the attestation option; you decide if this is appropriate for your marketplace.

To help small business with ISO 14001 and EMAS, Eco-mapping has also been evolved into an ISO Easy and an EMAS Easy approach.

The EnviroReady Report[©] option references Eco-mapping specifically, both as an entry level tool and as ISO Easy.

Attestation²¹: An independent team of auditors from an accredited registrar witnesses that the management system is consistent with the intent and meets the requirements of the internationally accepted ISO 14001 environmental management system standard.

Self-declaration plus recognition: An EnviroReady Report[©] refers to a process whereby specific audit procedures are applied to verify evidence of the existence of the requirements of an Environmental Management System identified in ISO 14001. A specially trained professional accountant conducts the report process annually, once the professional accountant receives a Certificate of Recognition. The process was designed to help SMEs gain market recognition for their robust and credible 14001 EMS²².

Clustered Registration Audits: This is a normal registration audit that is applied to a group of companies as opposed to an individual organization²³.

Registration/Certification: This term refers to a procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements²⁴.

Overcoming Barriers

It is critical to ensure that international standards are applied as they were intended – to be a common measuring stick for any organization. While challenges do exist, the method of overcoming them is not to lower the quality of the standard, but to lower or eliminate the barriers to adoption. Green Productivity offers methods on how to overcome barriers, as outlined in earlier chapters, especially Chapter 4. Key to overcoming barriers is the support of top management and the commitment to a learning organization. Eco-mapping is an excellent entry tool for micros and SMEs to gain an understanding of their on-site environmental concerns and serves to help meet one of the important requirements – the identification of significant environmental aspects.

Equal Access To A Growing Green Global Marketplace

It is important to keep in mind that ISO standards are specifically not performance based. The logic of this mirrors the reasoning that Shewhart passed on to Deming – that of a need to understand how to have a stable system, not one that eliminates all variance. That is simply contrary to the laws of nature and will result in a consistently unsuccessful strategy.

What ISO management system standards do engender is equal access to a growing global marketplace where quality and environmental quality are echoed by the voices of customers around the world. The umbrella of Green Productivity makes access to the playing field easier.

5.4 Summary of this Chapter

Globalization will no doubt continue to drive market interest in standardized management systems. Demand will grow as customers look for a way to reduce risk through procurement and streamline or optimize their supply chain. When certification is used as the measuring stick, Japan leads with the highest number of adoptions. In terms of regions, the EU leads adoption as the largest single economic market. While the US is the single most powerful economic nation, its trade efforts are largely intra or inter-state. Standards are not as widely embraced in the culture of the country. However, markets are in continual fluctuation. When Asia's leadership in this area starts to become a market advantage, other markets will come around. Green Productivity is a powerful tool that could be used by any country to assist in establishing trading partners with a common goal – improved productivity leading to a sustainable future. Just as Japan led the powerful shift enabled by its adoption of quality management, these other countries will awaken when they feel the loss of market share to those that have already embraced Green Productivity.

Where are you in your journey to enhance your knowledge, skills and attitude concerning the need to align your business system with natural systems?

Please indicate your new level of knowledge of management systems and other system tools where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of system and system tools is: 1 2 3 4 5

Please indicate your new level of skill in applying a systems approach to management where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My skill level is: 1 2 3 4 5

Please assign a value to the importance of a systems approach as a means to sustain your Green Productivity options where:

1 (not important) 2 (slightly important) 3 (average importance)

4 (a core business concern) 5 (a critical business tool)

I think the level of importance of this approach is: 1 2 3 4 5

5.5 Questions

1. As Japan had quality ensconced prior to the emergence of ISO 9001, Japanese firms initially refrained from its adoption. However, Japan now leads the world in ISO 9001 and ISO 14001 certifications. Why?
2. Which level of verification against ISO 14001 is appropriate to your company?

In Clause 1 of ISO 14001:2004, which pertains to the Scope of your EMS, you have four options for demonstrating conformity with the International Standard:

- 1) making a self-determination and self-declaration, or
- 2) seeking confirmation of [your] conformance by parties having an interest in the organization, such as customers, or
- 3) seeking confirmation of [your] self declaration by a party external to the organization, or
- 4) seeking certification/registration of [your] environmental management system by an external organization.”

Source: ISO 14001: 2004

Remember that ISO 14001 does not require certification. Its intent is to promote a robust and credible EMS that helps you better manage your organization's impact on the environment, which can be positive as well as negative. It also can help you minimize the negative impact the environment may have on your business.

Option 3) refers to a confirmation process referred to as an EnviroReady Report© provided by specially trained professional accountants (see www.14000registry.com <<http://www.14000registry.com>> for details).

Option 4) refers to accredited registrars. For one in your area contact your national standards body or your NPO for help.

Which option is appropriate? This is your decision, with input from your market.

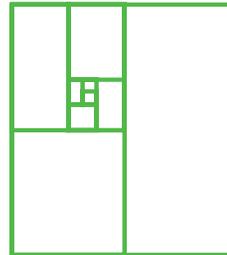
3. How did you determine which level of verification you needed?
4. Can you identify your single most important supplier?
5. How would the use of 7 QC tools help you in monitoring the performance of your GP program?
6. The basis of quality management emanates from the study of variance in nature. What three aspects of quality management or quality tools would you use to explain this to your GP team?
7. There are many environmental management programs in existence. What is the value in using ISO 14001 as the one that you adopt?

5.6 Point to Ponder

Emulating Nature – Fibonacci's Golden Mean



Source: Carandell, Vivias, El Temple de la Sagrada Familia, Triangle Postals



Source: Mario Livio, The Golden Ratio, Broadway Books

What common element is depicted in these images that relates to the goal underlying GP? These three images are all based on a common formula. The staircase on the left is in Gaudi's Temple in Barcelona, the structure on the right is the skeleton of the nautilus, and a diagram of Fibonacci's golden mean is in the centre. The common feature is the golden mean.

The golden ratio 1.618034 is the constant connection between these three images. Nature relies on this innate proportion to maintain balance using it as a fundamental function for the building blocks of nature. Further analysis of financial markets also seem to conform to this 'golden ratio'.

Nautilus pompilius, the chambered or pearly nautilus is a member of the cephalopod class of the mollusks. The nautilus is a "living fossil" whose close relatives date back hundreds of millions of years into geologic history.



© James B. Wood

Why is this creature so attractive as an icon for sustainability?

Beauty is in the eye of the beholder; but what is most intriguing about this strange looking creature is what lies beneath. The structure of the nautilus is one of the more fascinating applications of consistency in nature known as the golden spiral. The structure maintains its form without change as it is made larger and larger regardless of the size of the initial square with which

the process is launched: form is independent of growth.

This phenomenon was explained by an Italian mathematician, Fibonacci, around 1202 and has been applied to a variety of predictions, especially about the stock market, and in the measurement of risk. Other examples of this application include the Parthenon, the proportions of the General Assembly Building at the UN in New York, playing cards and credit cards.

In Barcelona, Spain, the towers of Gaudi's Temple de La Sagrada Família, an impressive structure by any measure, was designed to mimic the shell of the nautilus, providing strength in both form and character. The nautilus design and a staircase from the Sagrada specifically is used for its social connotation, its efficiency in design, and its strength as a symbol for sustainability.

"The great golden spiral seems to be nature's way of building quantity without sacrificing quality." William Hoffer, journalist

How would you apply this to your GP program?

The Ultimate Supply Chain

Can you identify the world's most important supplier?

The sun is the single source of supply upon which all activities and products on the Earth, natural and constructed, are made.

Whether you recognize this or not, all contracts are subject to the laws of nature. How would you interact with Mother Nature, if she ran the planet as a corporation? What would a contract with Mother Nature look like?

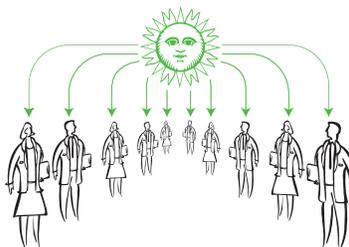
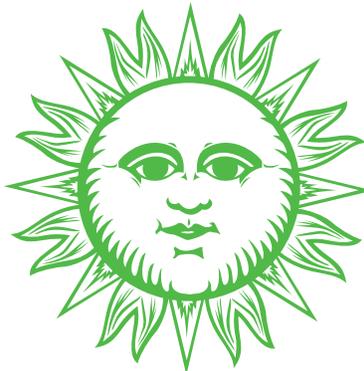
There are five key principles for you to keep in mind.

One, everything you do has an impact, **nothing** happens in this world without affecting something else, so conduct yourself to minimize the impact of each and every step you take.

Two, ultimately you have ONE supplier, the SUN, (no replacements, no substitutes, no alternatives), hence do nothing to weaken your supplier agreement.

Three, you have to deal with the distribution network - called photosynthesizers. They have an iron clad contract with your supplier that union leaders would be envious of, it cannot be dropped or circumvented.

Photosynthesizers are the distribution network; they convert solar energy into chemical energy.



Only green plants can do this.

Four, all products and services are customized; hence there are many distributors within the network to ensure the customer gets what he or she needs.

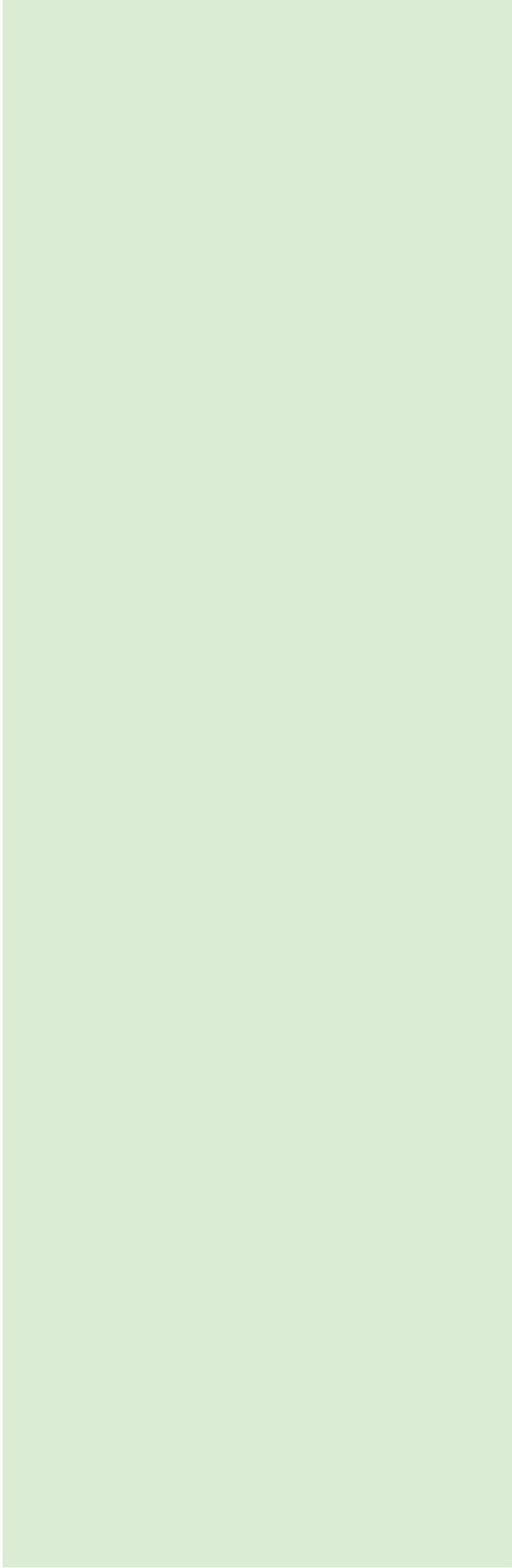
This is why biodiversity is important; maximize your supply chain options.

Five, all production is based on **energy** which comes from your one supply source. There are two sub-clauses.

1. Energy is neither created nor destroyed, it can only change form. Ergo there is NO SUCH THING AS "THROW IT AWAY", because there is no "away".
2. No transformation is 100% efficient, so plan your production process to utilize every iota of energy, waste not a BTU or a Joule.

How would you change your contract negotiations knowing this?





CHAPTER 6

Sustaining Progress to Meet Your Green Productivity Strategy

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Sustaining Progress to Meet Your Green Productivity Strategy

CHAPTER 6 SUSTAINING PROGRESS TO MEET YOUR GREEN PRODUCTIVITY STRATEGY

6.1 Purpose of this Chapter - Tips for Sustaining Progress

Your success in transforming your business to become sustainable will start when everyone in the system in which your organization operates, works to bring their processes into harmony with natural ones. The power of Green Productivity will enable this transformation.

This chapter will outline:

- tips and the tangential evidence that will help you progressively move towards sustainability
- the need and means to continually bolster your confidence and the confidence of your Green Productivity team to support your constancy of purpose
- references for sources of support that you can enlist to help sustain your progress

What is your overarching goal for your Green Productivity program? Do you feel confident in moving towards sustainability?

Start with indicating your current level of knowledge of sustainability as your where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of sustainability is: 1 2 3 4 5

Please indicate your current level of skill in moving towards sustainability using Green Productivity where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My skill level is: 1 2 3 4 5

Please assign a value to the importance of providing rewards and recognition to sustain your GP efforts where:

1 (not important) 2 (slightly important) 3 (average importance) 4 (a core business concern) 5 (a critical business tool)

I think the level of importance of this approach to me is: 1 2 3 4 5

“Most of our problems arise from the difference between the way man thinks and the way nature works.”¹

Gregory Bateson

Quality will be defined by life. Anything that threatens natural life processes is non-quality.

Any business that ignores its true dependency on nature will retain a level of inefficiency that may ultimately cause its failure.

How can you evolve your business to be sustainable? Wallace, a peer of Darwin, explained evolution in terms of the governor that regulates the speed of a steam engine by maintaining constancy in the angular velocity of a flywheel. Bateson built onto Wallace’s idea “the job of evolution is to maintain the constancy of something – specifically the survival of the entire system comprised of all species and the environment”².

What was Deming’s first obligation? Constancy of purpose.

What is Green Productivity’s symbol for leveraging the connection between environmental protection and productivity enhancements? Three cogwheels.

Figure 6-1 Green Productivity’s Relationship to Sustainable Development and Continuous Improvement

Figure 6-1



What is the value of a systems approach moving towards a sustainable business? Synchronizing your business system with nature affords you more opportunity for success than a purely mechanistic linear approach. Natural systems are amazingly resilient, providing opportunities for experimentation and discovery with ever improving odds of success. In this way, Green Productivity merges the management science of parts and the integration of these parts. The question now becomes how does one maintain these practices and methodologies? How do you keep your enthusiasm for Green Productivity? What do you need to do to continually support the efforts of your Green Productivity team and be able to impart the enthusiasm and good will to top management?

6.2 Recognition and Rewards

"Errare humanum est, ignoscere divinum." (To err is human, to forgive divine.)
Marcus Tullius Cicero

Despite strong commitment from top management, a solid understanding of customer needs and wants, the best-made plans, excellence in implementation, a proud and confident workforce, not everything you try will result in success.

There are two aspects of human nature that can upset your progress. First, emotion can destroy the self-control that is essential for rational decision-making. Second, people are often unable to understand fully what they are dealing with. The combination can lead to decisions that limit progress.

At the heart of this problem is the sampling on which people make decisions. Nature is so varied and so complex, that humans have a hard time drawing valid generalizations from what they observe. Sometimes people use shortcuts that lead to erroneous perceptions, or interpret small samples, as being representative of what larger samples should show.

Green Productivity recognizes that these situations are part of the evolution from a mechanistic organizational approach to a living learning organization. With its hierarchy of tools, techniques, methodology and overarching strategy, Green Productivity offers the "science of the parts" under a strategy of the whole.

There are certain behaviours that humans display, which exist because of the evolutionary state of the brain. You are 'hot-wired' to respond a certain way. As a result, people make decisions on occasion that appear to be inconsistent with rational behaviour. This is true, even when variables such as culture or economic regions change. "The major driving force is loss aversion. It is not so much that people hate uncertainty – but rather, they hate losing."³

Deming's 8th Obligation, drive out fear, is a way to lesson the fear.

In a living, learning organization, the spirit of the organization recognizes success on an ongoing basis, thereby instilling pride of workmanship, yet another aspect of one of Deming's obligations. This is not to infer that praise should be constant as then it becomes worth less.

People are affected by their environment far more than some realize. According to Pierce J. Howard, Director of Research for the Center for Applied Cognitive Studies⁶, there are thirteen "switches" that can turn on the learning portion of your brain. These are:

1. A sense of danger, interest or opportunity
2. Muscular activity
3. Time of day on the circadian clock
4. Sleep bank balance
5. Ingested nutrients and chemicals
6. Environmental light
7. Environmental temperature and humidity
8. Environmental sound
9. Environmental aroma
10. Recency of stressful episodes
11. Recency of aerobic exercise
12. Environmental negative ions
13. Degree of one's self-perception as being in control.

If you used this as a checklist for evaluating the degree to which workplace fosters mental alertness, how would your business rate. Is there something you could do to enhance the overall effectiveness of your business by addressing one of these "switches"?

Deming was not a fan of monetary rewards as in merit pay. This is a difficult behaviour to change once it is established. If you are used to being compensated for doing the right thing, this will shape your future behaviour to always expect it, and to not perform when compensation is not offered.

The Benefits and Costs of Deposits

Deposit systems for refillable beverages create the same problem in community waste management programs. While it reinforces the desired behaviour to keep materials from entering the landfill, it can prove to be a disincentive to expand other community action such as recycling other materials unless the consumer receives direct compensation for their behaviour.

In contrast, the province of Ontario established the blue box program for recycling which enables householders to participate voluntarily in waste diversion for the common good. A very convenient process, householders in the province have demonstrated for more than a decade the pride they have in their program. Polite peer pressure exists to encourage neighbours who fail to participate, to join in the weekly or bi-weekly line-up of blue boxes along the curb.

How should you deal with failure? Again, Green Productivity offers its hierarchy of support. Deming in particular spoke to the issue of being positive and removing the fear of retaliation by management. Learning by other people's mistakes is also a very powerful improvement process.

The Case of the Biosphere 2⁴

In the early 1990s, humanity learned a lesson – a practical and profoundly revealing lesson – in the difficulty of constructing and managing complex ecosystems. It unfolded at Biosphere 2, an ensemble of buildings resembling a huge futuristic greenhouse in the Sonora Desert of Arizona. Built with US\$200 million from the Texas billionaire Howard Bass, the structure covered 1.3 hectares and enclosed a volume of more than 200,000 cubic metres. Biosphere 2's designers wanted to create within this space an artificial and materially closed ecosystem – a miniature version of the material and life cycles of Earth, which they labelled Biosphere 1. On September 26, 1991, with great fanfare, four men and four women, who called themselves "Biospherians" were sealed inside for a two-year period.

Things did not go well from the start. The litany of error and mistakes kept expanding. On several occasions external resources (oxygen for example) had to be infused to avoid a medical emergency.

The original eight Biospherians, hardy, healthy but considerably thinner, emerged from Biosphere 2 in September 1993. They were greeted with recriminations from project staff, officials and outside experts. Columbia University eventually took over the complex and developed a series of more cautious and controlled ecological experiments. Other reviewers were more charitable on the heroic efforts of the 8 to keep their world liveable. As a leading geochemist said, "Anybody else would have made equally bad blunders, but different ones."

Nevertheless, Biosphere 2 had revealed some sobering truths about the limits of our understanding of complex ecosystems. “Despite the enormous resources invested in the original design and construction...and despite a multi-million-dollar operating budget, it proved impossible to create a materially closed system that could support eight human beings with adequate food, water and air for two years. The management of Biosphere 2 encountered numerous unexpected problems and surprises though almost unlimited energy and technology were available to support Biosphere from outside.

The conclusion: “At present there is no demonstrated alternative to maintaining the viability of Earth. No one yet knows how to engineer systems that provide humans with the life-supporting services that natural systems produce for free.’

Despite these problems, a second team entered only three months after the first had left. Their tenure in Bio2 was even less successful, however, and the second team was pulled out only six months after they had gone in.

What was the per capita price of this learning experiment based on construction costs alone? US\$34,246.58 per day. Biosphere 2 proved to be the most expensive hotel room in the world.⁵

The most important lesson that the failure of Biosphere 2 demonstrates is that there is no alternative to nature. Therefore, learning how to work with nature, to adopt water logic, to pattern business processes after energy flows is critical. While Green Productivity is in its formative years, it can provide you with a powerful tool for change. There is every reason to start the journey now. The only person holding you back is you.

6.3 Sources of Support and Information

Asian Productivity Organization (APO)

In 1994, the APO created the Office for the Environment (OfE) to spearhead its Green Productivity work and assist member countries to integrate environmental concerns into productivity enhancement. Now converted to Environment Department, its task is to implement the Special Program for the Environment under a special grant from the Japanese government. The Green Productivity Program consists of three core activities:

- Promotion that includes awareness building, identification of Green Productivity opportunities and Green Productivity partners
- Demonstration, which is designed to empirically demonstrate that environmental protection and productivity improvements could be profitably harmonized even in small and medium sized enterprises.
- Dissemination, to diffuse the benefits of Green Productivity derived in demonstration projects through workshops, seminars, publications, factory visits and observational study missions.

More details on the APO are found in Appendix A.

National Productivity Organizations (NPOs)

Each member country designates a national body to be its National Productivity Organization (NPO). These organizations are either agencies of the government or statutory bodies entrusted with the task of promoting productivity in their respective countries. They serve as the official bodies to liaise with the APO Secretariat and to implement APO projects.

Each year the APO organizes a Workshop Meeting of the Heads of the NPOs (WSM) to evaluate the previous year's projects, deliberate and formulate the APO's rolling Five-Year Plan and annual programs, and exchange experiences on productivity movement. The Workshop Meeting of the Heads also discusses productivity perspectives, guidelines for future programs, and the emerging needs of member countries.

A list of National Productivity Organizations is included in Appendix D.

International Green Productivity Association (IGPA)

The International Green Productivity Association (IGPA) is an independent, non-profit, international organization devoted to promoting the Green Productivity concept in the Asia-Pacific region. Its headquarters were established in Taipei to serve as a central support for promotional efforts across the region. The IGPA encourages Green Productivity professionals to form country and/or local-level Green Productivity associations. Their purpose is to:

- coordinate Green Productivity activities in the country,
- communicate with counter-part organizations around the region, and
- disseminate ideas, experiences, and technologies useful to its members.

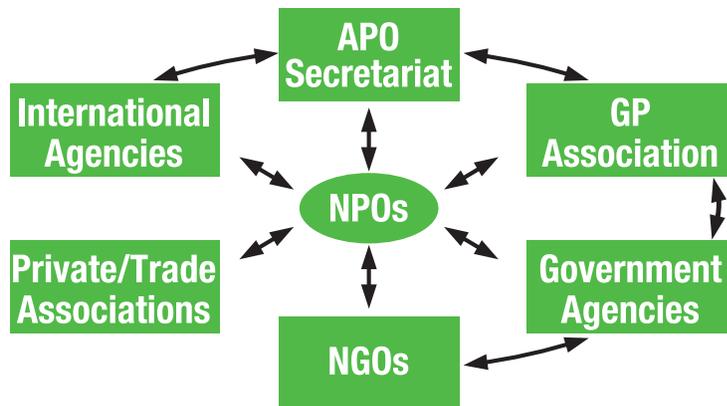
The long-term vision is of a community of Green Productivity experts working on projects relevant to their nation or local community with the support of a regional network of resources and experiences. The International Green Productivity Association serves to coordinate the flow of information amongst parties. However, its success is based on the partnership of national- and local- Green Productivity associations, organization and individual members to maximize its effectiveness. Participation in the association is a good way to be able to maintain ties with like-minded individuals and organizations. You may also find it useful to establish a formal association in your country to help take the Green Productivity program to its next level of development. Promoting Green Productivity is an important task as it helps strengthen your effort to green your supply chain.

Green Productivity Resources

Partnerships with other organizations that address environmental and productivity issues are vital to the success of the Green Productivity program. Involvement in this program provides such organizations - whether local, national or international - a number of significant benefits:



Between the APO and its partnering entities, there are many Green Productivity resources that you can access. These include information in the form of textbooks, web-based data; references to these are available in Appendix C.



6.4 Summary of Chapter

Commerce must not only mirror nature, it must run according to the same principles that scientists observe in natural systems if it is to operate profitably.

There is no question that you will encounter resistance to the ideas shared in this book. Resistance is a powerful force – it is a universal human phenomenon called homeostasis. “Homeo” means ‘same’ and “stasis” means ‘lack of motion’. This term describes the ability of living systems to maintain tight operational control and high

efficiency despite some extremely harsh conditions. It is a metaphor for the goal of a sustainable organization whereby it could be ten times more efficient than:

- even the most advanced automobile engine,
- a current work process,
- an existing product with fewer by-products for every aspect of the process.

To summarize this chapter:

1. There is an ingenuity gap – rethink your business process to generate revolutionary products and services
2. Creative problem-solving can be practiced in five stages:
 - Fact-finding
 - Problem-finding, in which one defines issues, trying to see them in a new light
 - Idea-finding, wherein one generates options as stimulated by the problem as it is now freshly viewed
 - Solution-finding, in which one exerts judgement to evaluate the meaning and the positive and negative consequences of the ideas that have been produced
 - Acceptance-finding, wherein one develops the best ideas as fully as possible and uses a process to test them in the real world

You have been introduced to a powerful change mechanism. Green Productivity offers you a structured approach, well-defined methodologies, tools to use and techniques for improving efficiency and evolving towards sustainability.

All you have to do is start.

Are you ready?

Please indicate your new level of knowledge of sustainability where:

1 (none) 2 (little) 3 (some) 4 (knowledgeable) 5 (specialist)

My knowledge of sustainability is: 1 2 3 4 5

Please indicate your new level of skill in using Green Productivity where:

1 (none) 2 (little) 3 (some) 4 (proficient) 5 (specialist)

My skill level is: 1 2 3 4 5

Please assign a value to the importance of providing rewards and recognition to sustain your GP efforts where:

1 (not important) 2 (slightly important) 3 (average importance)

4 (a core business concern) 5 (a critical business tool)

I think the level of importance of this approach to me is: 1 2 3 4 5

6.5 Questions

1. How would you explain sustainability as it pertains to your organization?
2. What evidence would you use to convince top management (your top 3 suppliers, your local community leader) of the need to move towards sustainability?
3. What help do you think your NPO or APO could provide to help you with your GP program?
4. Have you contacted your local chapter of IGPA? If there is not one, have you thought about starting a chapter?
5. What kind of reward and recognition program do you think would best help to garner the continued enthusiasm of your employees? Suppliers? Customers?
6. What success have you had to date with your GP program?
7. What is the biggest challenge that remains with your GP program?

6.6 Point to Ponder

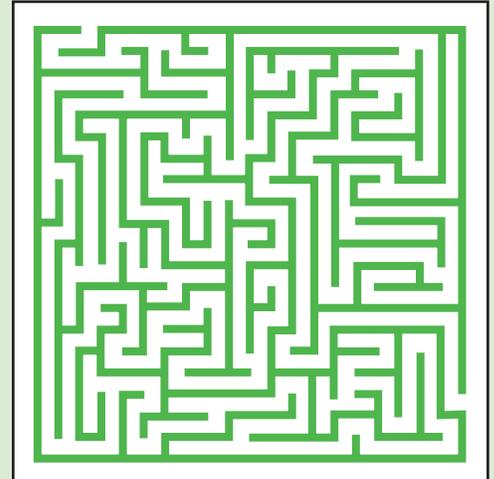
You are challenged to solve a puzzle⁷.

To help your organization break away from rock logic, the mindset that will prevent your success in leveraging your GP efforts to move towards sustainability, you need to take a role in filling in the ingenuity gap. You can improve your environmental performance by the efforts you apply within. But to make your GP program evolve towards sustainability you need to have others outside your company grow with you. Your community must change its behaviours before ingenuity can be said to be fully applied.

Ingenuity is defined as ideas for new technology, innovation, or application of existing technology to new situations, and ideas for better institutions and social arrangements. The ingenuity gap is a way of thinking about the chasm that exists between the very real problems that humans face and the lagging attention to solve them. One company can be innovative and create a product or process idea, but to solve an environmental problem the ingenuity gap must be closed. Therefore, the community in which you operate must support the idea. This effort may include your supply chain, but it will require local institutions to change their mindsets and processes.

Draw a mindmap that outlines the boundaries of your community. Using various GP tools outline the players from a whole systems perspective that you need to see a change in behaviour from to support your own GP progress towards sustainability.

It is all too easy to get pulled back to a homeostatic position, and slip back into old habits. Deming's System of Profound Knowledge challenges you to break these old mindsets and embrace change as a constant factor.



Here is your challenge. Write today's date here: _____

Within the next 7 hours write down seven names of people with whom you will share your Green Productivity learning experience.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

Within 7 days introduce the concept of Green Productivity to them; (write that date here _____). Share this handbook with them – if you are their boss, get them each a copy.

Within 7 weeks share what each of you learned about Green Productivity Tools and Techniques, Methodology and Strategy (including Deming's System of Profound Knowledge), and encourage them to learn more with you (by _____).
insert date

Within 7 months your GP Team (which may be inside your company, members along your supply chain, or peers within your sector) should have developed one project under your Green Productivity Program, with an objective and target(s) (set the date now, record it here _____). At the end of that day, share the results with APO, the International Green Productivity Association and your National Productivity Organization. Then each one of your seven-team members should continue the cycle of sharing with seven new and different people. Follow the same procedure (7 hours – identify 7 names, 7 days to talk to them, 7 months to accomplish one project under your Green Productivity Program. Remember that a Green Productivity Program is a comprehensive examination of the operations in an enterprise with the goals of optimizing productivity and environmental compatibility.)

Within 7 years you personally will have made a profound difference to Asia if you keep to this schedule. How many people will you have contacted directly at the end of 7 years?

Write the number here _____

How many people will you have influenced in that time?

The results are exponential so do not be surprised by how many will be affected by what you do. You can see how powerful a tool this becomes!

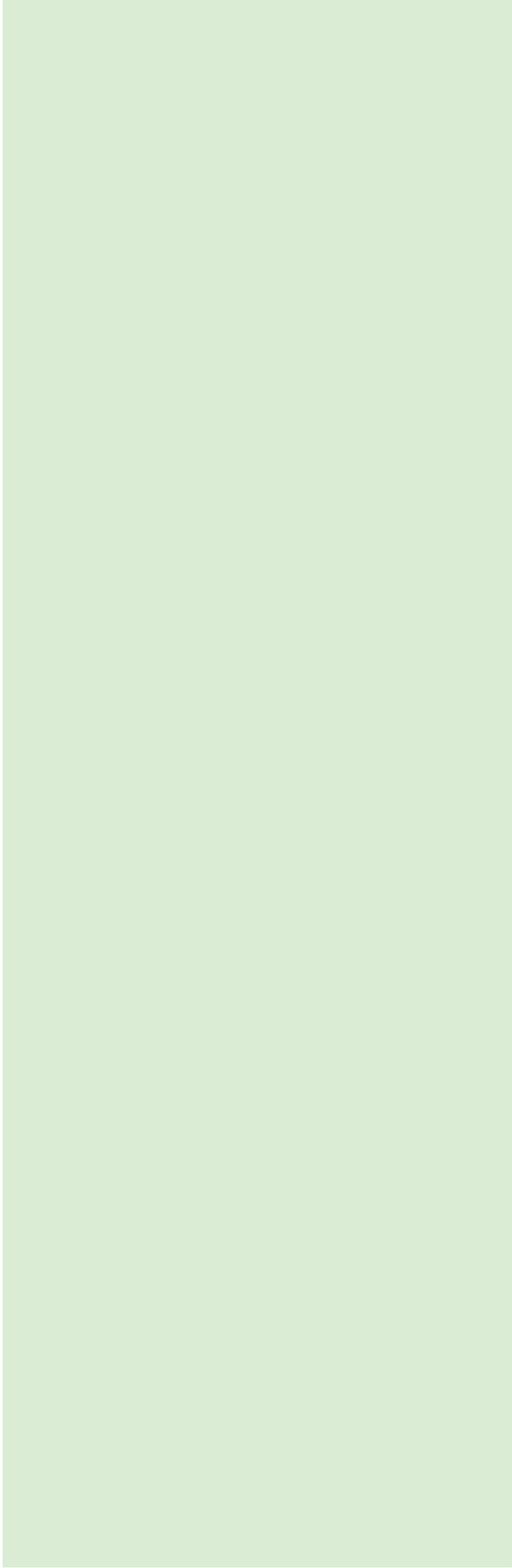
Share the results of your Synergy of Seven efforts with the APO.

While this is the last chapter of this handbook, GP never ends. If you are just starting GP now, good luck. If you are revisiting the handbook for ideas on how to improve your GP understanding or your program, welcome back.

Just as nature starts over every year with the first blush of colour when flowers bloom, your adherence to GP will continue to bring vigour into your company. GP just means that you will get better and better while all the time reducing your use of resources. Let the competition take note!

One small action can trigger a number of positive reactions. That is the great value in GP.

Good luck with your GP efforts!



ENDNOTES

ENDNOTES

ENDNOTES

Introduction

¹Apel, Heino and Camozzi, Anne. 1996. *Adult Environmental Education: A Handbook on Context and Methods*. Bonn: IIZ/DW Supplement to Adult Education and Development No.47.

²Ponting, Clive. 1991. *A Green History of the World*. London: Sinclair-Stevenson Ltd

³Nisbett, Richard E. 2003. *The Geography of Thought: How Asians and Westerners Think Differently ...and Why*. London: Nicholas Brealey Publishing.

Chapter One

¹De Bono, Edward. 1993. *Water Logic*. Toronto: Viking

The difference between water and rock logic were articulated by Edward de Bono, who is credited as being an expert in teaching thinking techniques and tools. *Water Logic: The Alternative to I am Right You are Wrong* aligns well with GP as a way to apply it strategically. The discussion here is adapted by the author. De Bono, Edward. 1993. *Water Logic*. Toronto: Viking

²Adapted from the City of Nanaimo, British Columbia, with input from Anita Wolfe (Environment for Change); http://www.city.nanaimo.bc.ca/c_economic/strategy_circle.asp

³Source: <http://indexes.dowjones.com>

⁴Elkington, John. 1998. *Cannibals with Forks*. Gabriola Island, BC: New Society Publishers.

⁵This programme was started in Sweden under the leadership of the charismatic Dr. Karl-Henrick Robert, an oncologist. The number of children diagnosed with unusual cancers motivated him to solve this heartbreaking situation and led him to develop through consensus, a learning process on systems. Some organizations use it to guide them in developing their systems thinking in the planning step.

⁶Hawken, Paul, Lovins, Amory and Lovins, L. Hunter. 1999. *Natural Capitalism: Creating the Next Industrial Revolution*. Boston, Massachusetts: Little, Brown and Company. Paul Hawken is the author of "The Ecology of Commerce". Amory Lovins is known for his work in developing the hyper-care.

⁷On-line purchases can be made through <http://www.newsociety.com/>

⁸Rothschild, Michael. 1990. *Bionomics: Economy as Ecosystem*. New York: Henry Holt and Company, Inc.

⁹KAIZEN means gradual, unending improvement, doing "little things" better; setting and achieving ever higher standards. It is the opposite of complacency.

¹⁰Legal instruments can include acts or statutes, regulations, mandated standards or performance, etc.

¹¹Just as the words infer, the concept of polluter pays means that those that generate the waste or pollutant should pay for the required clean-up and restoration of the environment. This is a hard sell for companies. It is much easier to budget funds for future benefit than to assign funds to clean up past mistakes.

¹²This term supports the idea of taking care up front in planning and design to avoid the problems that polluters find themselves in. Granted the term could be made more appealing to business and still get the point across.

¹³Deming is known as the godfather of quality. The PDCA cycle is an iterative process of planning, doing, checking and acting.

¹⁴KAIZEN means improvement. Moreover it means continuing improvement in personal life, home life, social life and working life. It applies to all in the workplace to ensure success.

¹⁵APEC refers to the Asia Pacific Economic Cooperation.

¹⁶SME Guide 2000, APEC Source: <http://www.actetsme.org/apecsme/guide2000/>

¹⁷Details on support programs for SMEs sponsored by APO are outlined in Appendix A.

¹⁸The earliest version of Eco-mapping© was a shareware tool created by Heinz-Werner Engel of Belgium, which can be found in the Library section at www.14000registry.com. It allows the user to map the location of environmental problems and inefficiencies. Within minutes a small business can see the value of Green Productivity. Another source of Eco-mapping© is www.inem.org.

¹⁹Why are increasing amounts of carbon of concern to you in your business? Carbon is a naturally occurring element that is commonly discussed in terms of carbon dioxide. Humans have many uses for CO₂. It's the agent that makes soft drinks and beer fizzy. Its release from baking powder or yeast makes cake batter rise. Some fire extinguishers use it as it is denser than air. All this is positive. CO₂ is a greenhouse gas, and in the rapidly escalating amounts that human processes are releasing will lead to about 50% to 60% of the increase of global warming. The challenge with this is that global warming is associated with frequent and wild changes in weather. This can lead to crop damage and loss in productivity. Asia is already subject to more challenges with natural disaster than other parts of the globe. This additional burden will not help. Hence any action you can take or influence to reduce greenhouse gas emissions is important.

²⁰Critical Masses; The Global Population Challenge by George D. Moffat, New York: Penguin Books, 1994.

Chapter Two

¹ A Green History of the World, by Clive Ponting, London: Sinclair-Stevenson Ltd., Page 397

² Chlorinated hydrocarbon (organochloride) insecticides, solvents, and fumigants are widely used in the US. These compounds can be highly toxic and some agents, such as DDT, have been banned in the US because of their unacceptably slow degradation and subsequent bioaccumulation (accumulation in biological systems). The toxicity of these agents varies according to their molecular size, volatility, and effects on the central nervous system (CNS). In general, they cause either CNS depression or stimulation, depending upon the agent and dose.

An estimated three million cases of severe pesticide poisoning and two hundred and twenty thousand deaths occur each year worldwide. Organochlorine poisoning accounts for only a small fraction of pesticide poisoning. Approximately 95% of fatal pesticide poisonings occur in developing countries. GP may prove useful to train employees how to properly manage contact with this chemical.

³ Source: <http://onlineethics.org/moral/carson/7-silentspring.html>

⁴ <http://environment.about.com/library/weekly/blcoast17.htm>

⁵ Source: <http://www.unu.edu/unupress/unupbooks/uu211e/uu211e09.htm>

⁶ For more details on the concept of natural capital refer to "Natural Capitalism: Creating the Next Industrial Revolution" written by the team of Paul Hawken, Amory Lovins and L. Hunter Lovins.

⁷ A simultaneous famine and population explosion in India in the 1960s led Stanford biologist Paul Ehrlich to write a blunt and controversial book, The Population Bomb, which catapulted the environment into a cause and Ehrlich to instant celebrity. Speaking to an Earth Day rally at Iowa State University in 1970, Ehrlich proclaimed, "We have the world's largest, the world's weakest and the world's densest population. There are more hungry people today than there were in 1875."

⁸ The Club of Rome's mission is to act as a global catalyst of change that is free of any political, ideological or business interest. The Club of Rome contributes to the solution of what it calls the "world problematique", the complex set of the most crucial problems – political, social, economic, technological, environmental, psychological and cultural - facing humanity. It does so taking a global, long term and interdisciplinary perspective aware of the increasing interdependence of nations and the globalization of problems that pose predicaments beyond the capacity of individual countries.

⁹ The Global 2000 Report (1980) emphasized that the world will have to solve the staggering problems of population growth; depletion of fossil fuel; decrease of arable lands; shortages of fresh water; deterioration of agricultural soils; atmospheric concentrations of carbon dioxide and ozone-depleting chemicals; extinctions of plant and animal species; and significant loss of primeval forests. Failure to address these challenges would lead to ecological imbalance and with that the destruction of delicate ecosystems.

¹⁰ The Brundtland Commission was established in 1983 by the General Assembly of the United Nations. Dr. Gro Harlem Brundtland, then Prime Minister of Norway, led world input that culminated in a report entitled “Our Common Future”. Officially titled as the World Commission on Environment and Development, it was charged to formulate a global agenda for change with four key tasks.

¹¹ Agenda 21 is a blueprint for sustainable development into the 21st Century. Its basis was agreed during the “Earth Summit” at Rio in 1992, and signed by over one hundred and seventy Heads of State and Government. In Rio an undertaking was given that local councils would produce plans specific to their area - a Local Agenda 21. This would involve consulting with the community, because it is the people in the area who have the local knowledge needed to make sensible decisions for their future.

¹² The United Nations Conference on the Human Environment was held in Stockholm, Sweden in 1972. The Stockholm Conference heralded the beginning of environmental awareness in the international community. When it was convened, the environmental movement itself was new. To the extent that any countries recognized environmental problems, they were primarily the industrialized ones. The problems that they identified were generally the correctable by-products of industrialization, including water pollution and smog.

¹³ Worldwatch Institute, Vital Signs. 1995. NY: W.W. Norton.

¹⁴ Source: “Take It Personally: How to make Conscious Choices to Change the World” by Anita Roddick, Founder of the Body Shop, 1992.

¹⁵ Matis Wackernagel and William Rees developed the term “ecological footprint”. It relates to an accounting tool that enables you to estimate the resource consumption and waste assimilation requirements of a defined human population or economy in terms of a corresponding productive land area. For more details visit <http://www.ire.ubc.ca/ecoresearch/ecoftr.html>

¹⁶ GDP is an economic term meaning Gross Domestic Product. It is a measure in the change in the market value of goods, services and structures produced in the economy. It is considered an important measure as it represents the actual pace at which the economy is growing or shrinking — especially as it relates to expectations – and frequently drives markets. GDP also includes a key inflation measure called the price index for gross domestic purchases. It measures the price of everything, including imports, which you buy. Personal consumption expenditures typically account for roughly 68% of GDP. Investment, government spending and net exports account for the rest.

¹⁷ After the Second World War, several institutions intended to co-ordinate and regulate international economic co-operation were formed. They are referred to as the Bretton Woods institutions, known today as the World Bank and the International Monetary Fund. The original intention was to create a third institution to handle international economic co-operation: the International Trade Organisation (ITO). This body was never created, but during the preparatory process, several countries started negotiations on customs tariff reduction and binding. This package of trade rules and tariff concessions accepted provisionally became known as the 1947 General Agreement on Tariffs and Trade (GATT) and entered into force in January 1948.

¹⁸ From 1948 to 1994, in the absence of any other regulating multilateral body, the GATT provided rules for much of world trade. Until the World Trade Organisation (WTO) replaced it in 1994, the GATT was a provisional agreement and organization. During this period the GATT's basic legal text remained much as it was in 1947. There were additions in the form of “multilateral” agreements as well as “plurilateral” ones (i.e. voluntary membership concerning only a certain number of contracting parties). Efforts to reduce custom duties and other barriers to trade continued. Much of this was achieved through a series of eight multilateral negotiations known as “trade rounds”, the most recent being the Uruguay Round. While the GATT no longer exists as an ad hoc organisation, the GATT Agreement lives on. The old text is now called GATT 1947; the updated version incorporated into the new WTO agreements is called GATT 1994. Source: http://www.unesco.org/culture/industries/trade/html_eng/question7.shtml#7.

¹⁹ Latzko, William J., and Saunders, David M., *Four Days with Dr. Deming: A Strategy for Modern Methods of Management*, Reading, Massachusetts, Addison-Wesley Publishing Company, 1995.

²⁰ The Uruguay Round was quite simply the largest trade negotiation ever, and most probably the largest negotiation of any kind in history. Details about this can be found on the WTO website at http://www.wto.org/english/thewto_e/whatis_e/tif_e/fact5_e.htm

²¹ UNCTAD was established in 1964 as a permanent intergovernmental body. UNCTAD is the principal organization of the United Nations General Assembly that deals with trade, investment and development issues. Its purpose is to maximize the trade, investment and development opportunities of developing countries and assist them in their efforts to integrate into the world economy on an equitable basis.

²² World Economic Forum's Global Competitiveness Report, source: <http://www.weforum.org/site/homepublic.nsf/Content/Initiatives+subhome>

²³ Chlorofluorocarbons (CFCs), along with other chlorine- and bromine-containing compounds, have been implicated in the accelerated depletion of ozone in the Earth's stratosphere.

²⁴ The bacteria *E. coli*, *Salmonella*, and *Shigella* can cause diseases like Gastroenteritis, Salmonellosis, and Shigellosis. These bacterial diseases can cause vomiting, diarrhoea and dehydration. Viruses such as Adenovirus, Hepatitis A, and Norwalk agent will also cause diseases. These are often very harmful illnesses like infectious hepatitis, gastroenteritis, and respiratory disease. Some effects of these diseases include meningitis, vomiting and diarrhoea. Pathogens can cause harm to those that swim in polluted waters or eat shellfish that came from these waters. Parasites and Protozoans also may cause infections. Some of these pathogens occur naturally in the environment while others are due to pollution. Parasites such as Schistosomes can cause swimmers itch, a skin infection that may result due to exposure to this waterborne pathogens. Protozoan such as *Giardia* and *Cryptosporidium* may also cause skin, ear, eye or respiratory infections when exposed to these waterborne pathogens. It is important to keep in mind that seawater typically contains about one billion bacteria and one trillion viruses that are not pathogenic to humans.

Pathogens may enter waters through point and non-point sources, while others may occur naturally in the environment. Some point sources are wastewater treatment facilities and combined sewer overflows. Non-point sources include land and road runoff, human sewage from recreational boats, and septic systems. The major sources of bacterial contamination are due to the point sources. Treatment facilities have greatly reduced the number of pathogens that are released into the environment through disinfectant processes. However, treatment is not always 100% effective and breakdowns in facilities sometimes occur. During heavy rains, there may be too much water for the sewage treatment plants to handle, and some untreated or partially treated water can enter a watercourse. Wildlife, domestic animals and birds may also contribute pathogens to the environment. Source: Adapted from <http://omp.gso.uri.edu/doee/policy/orga1.htm>

²⁵ OECD stands for the Organization for Economic Cooperation and Development. See http://www.oecd.org/about/0,2337,en_2649_201185_1_1_1_1_1,00.html for details.

²⁶ Keystone species are regarded as providing central or pivotal roles in an ecosystem, without their participation the habitat changes significantly, which triggers the loss of other resident species, resulting in a domino effect.

²⁷ Dan Rubenstein, "Lesson of Love," *Opinions*, Vol. 9, No 3, Office of the Auditor General Ottawa, Canada, p 9 – 12.

²⁸ Reference: Georg Winter, *Business and the Environment: A handbook of industrial ecology with 22 checklists for practical use*, Europe, McGraw Hill, 1989.

²⁹ Garrett, Laurie, *Betrayal of Trust: The Collapse of Global Public Health*, New York: Hyperion, 2001.

³⁰ Located in Niagara Falls, New York, Love Canal, now infamous in the environmental community, was an empty canal, used as a chemical disposal site in the 1940s and 50s. After hazardous chemicals were dumped in the canal, it was filled in and given to the city of Niagara Falls by Hooker Chemical Company. The city used the land to build housing and an elementary school. By the late 1970s, hazardous chemicals were leaking from the canal and rising to the surface. Families were evacuated from the area in 1978, and by 1980, "Love Canal" (formerly known as the LaSalle region of Niagara Falls) was considered a national emergency by President Jimmy Carter. Source: <http://egj.lib.uidaho.edu/egj12/fortunato1.html>

³¹ Source: The Independent, U.K., October 11, 2000.

³² Source:

http://www.mhhe.com/biosci/pae/environmentalscience/olc_linkedcontent/cunningham06es/cs6_19.htm

³³ Source: <http://www.cnie.org/pop/pai/water-21.html>

³⁴ Source: <http://www.china.org.cn/english/2002/Feb/27490.htm>

³⁵ Source: <http://www.cs.albany.edu/~amit/ganges.html>

³⁶ Source: <http://www.cleanganga.com/articles/mar4.php>

³⁷ Exxon is affiliated with Esso Mobile and is related to Imperial Oil in Canada.

³⁸ Source: <http://www.guardian.co.uk/Archive/Article/0,4273,4216146,00.html>

³⁹ The world's first eco-labelling program, Blue Angel, was created in 1977 to promote environmentally sound products, relative to others in the same group categories. Seventy-one product groups have been identified, with over 4000 products approved by the Umweltbundesamt (German Environmental Protection Agency), the official assessment agency. The criteria for awarding the Blue Angel includes: the efficient use of fossil fuels, alternative products with less of an impact on the climate, reduction of greenhouse gas emission, and conservation of resources.

⁴⁰ The Eurobarometer is the website for the Public Opinion Analysis sector of the European Commission. Since 1973, the European Commission has been monitoring the evolution of public opinion in the Member States, thus helping the preparation of texts, decision-making and the evaluation of its work.

Source: www.tradeforum.org

⁴¹ Source: <http://www.tradeforum.org/>

⁴² Source: E2M, Report on WICEM II, 1991

⁴³ UNOTEC was an asset management company owned by Dr. Stephan Schmidheiny.

⁴⁴ Stephen Schmidheiny, A Personal Note in "Changing Course", (The MIT Press) 1992

⁴⁵ See <http://www.ccpa.ca/english/who/rc/GlobalRCPartners.html>

⁴⁶ A parallel concept to this is referred to as industrial ecology. Kalenburg, Denmark is perhaps the most public example of an industry park that was created based on the interplay of material flow between a select group of companies. This is also called an eco-industrial park development.

⁴⁷ Source: <http://indexes.dowjones.com>

⁴⁸ For more details go to <http://www.cepaa.org/>

⁴⁹ WBSCD, 1992.

Chapter Three

¹ For more details read "A Road Map for Natural Capitalism, by Amory B. Lovins, L. Hunter Lovins and Paul Hawken, in Harvard Business Review, May-June 1999.

² MFP may appear in literature as Total Factor Productivity, although its exact definition may vary from the one established by APO.

³ McDonough, William, and Michael Baumgart. 2002. Cradle to Cradle: Remaking the Way We Make Things. New York: North Point Press.

⁴ Steele, Paul, Murphy, J. and Russill, R. 1995. It's a Deal: A Practical Negotiations Handbook. London: McGraw-Hill Book Company Europe.

⁵ Sustainable Sourcing© by Lynn Johansson, APO Productivity Journal, 2001.

⁶Source: www.rtica.com

⁷Source: Finn, Sheila, Personal Communication with, and Scheuing, Eberhard E., 1998, Value-Added Purchasing: Partnering for World-Class Performance. Menlo Park, California, Crisp Publications.

⁸The world's first eco-labelling program, Blue Angel, was created in 1977 to promote environmentally-sound products, relative to others in the same group categories. Seventy-one product groups have been identified, with over 4000 products approved by the Umweltbundesamt (German Environmental Protection Agency), the official assessment agency. The criteria for awarding the Blue Angel includes: the efficient use of fossil fuels, alternative products with less of an impact on the climate, reduction of greenhouse gas emission, and conservation of resources.

⁹Unlike Singapore or Texas, litter management has remained a low priority in Canada.

¹⁰Source: <http://www.indigodev.com/Kal.html>

¹¹Activity-based Costing (ABC) is another method.

¹²APO has been a significant leader in the development of training programs that have focused on training individuals to be local champions in their own economic region.

¹³There are more on-line training programs being developed constantly that provide generic training on a topic in the convenience of your office. Individual modules average around twenty to forty minutes so the time away from the business day can be kept to a minimum.

¹⁴Apel, Heino and Camozzi, Anne. 1996. "Adult Environmental Education: A Handbook on Context and Methods". Bonn: IIZ/DWV Supplement to Adult Education and Development No.47.

¹⁵As you have no doubt already noticed, this textbook employs Adult Learning techniques to help you focus on what it is that you want to learn from each chapter.

¹⁶APO or one of its national affiliates may be a source of information on which organization you may wish to contact.

¹⁷Source: UNEP, France

¹⁸The 5S's, Five keys to Total Quality Environment by Takashi Osada, is available through the Asian Productivity Organization, published in 1991. In The 5S's: Five Keys to a Total Quality Environment, Takashi Osada explores the basic philosophy behind the 5S campaign, explains how every workplace can benefit from its use, discusses how a company can mount a successful 5S movement, and delves into each of the 5S's in detail. A thorough examination of the role the 5S's play both on the shop floor and in the office environment is also included.

¹⁹<http://et.nmsu.edu/~etti/fall97/manufacturing/tpm2.html> more details on TPM are found in an article by Jack Roberts of the Texas A&M University; including references to other sources.

²⁰In North America, waste management policy outlines four R's. Reduce being the first option – i.e. do not buy or use the material at all. Re-use is the second option such as in the case of refillable containers and durable plastic bins that are used repeatedly to transport product between a supply and a customer. Recycling means remanufacturing, such as the use of post-consumer glass containers to make new container glass. Recovery is aimed to extract energy from materials that do not have value apart from a fuel or where the technology and cost prohibits other options.

²¹A highly controlled exchange is available through <http://www.bisnetindia.com/usaepindia/6.htm>; a more open process is available at <http://grn.com/> Another example is found at <http://www.owe.org>.

²²As of 2002, there were 45 Responsible Care members which included Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Czech Republic, Denmark, Ecuador, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Peru, Philippines, Poland, Portugal, Singapore, Slovak Republic, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan ROC, Thailand, Turkey, United Kingdom, United States, and Uruguay. More information can be found at <http://www.icca-chem.org/>

²³Check with APO or one of its national affiliates to see what assistance is available for your Green Productivity efforts.

²⁴Azoic dyes are also referred to as Napthal dyes, an organic chemical.

²⁵Characteristics of acetic acid are available on-line in Material Safety Data Sheets. Some companies have made access to this information easy for smaller businesses, see <http://www.jtbaker.com/msds/a0326.htm>

²⁶Source: <http://www.europeansealing.com/workinggroups/fugemm.htm>

²⁷COD refers to the quantity of oxygen used in biological and non-biological oxidation of materials in water; it is a measure of water quality. BOD refers to the amount of oxygen used for biochemical oxidation by a unit volume of water at a given temperature and for a given time. BOD is an index of the degree of organic pollution in water. For definitions of other environmental terms see <http://glossary.eea.eu.int/EEAGlossary>

²⁸pH is a measure of acidity and alkalinity. On a scale of 1-10, 7 represents neutrality, lower numbers indicate increasing acidity and higher numbers increasing alkalinity. Each unit of change represents a tenfold change in acidity or alkalinity. Balance is the key.

²⁹Aerobic wastewater treatment facilities require aeration, which means that electricity is consumed in transporting large quantities of air. Anaerobic treatment requires very little electricity except for the pumps to feed in the water. It therefore contributes to significant energy savings. The composition of the wastewater needs to be considered when determining the option used.

³⁰Volatile Organics (VOCs) are compounds with relatively low boiling points. Therefore these materials have a strong tendency to evaporate when heated. Many of these compounds are industrial solvents.

Chapter Four

¹SME Guide 2000, APEC Source: <http://www.actetsme.org/apecsme/guide2000/>

²Assistance may come from an NPO representative or even APO.

³Composite sampling is a strategy in which multiple individual or "grab" samples (from different locations or times) are physically combined and mixed into a single sample so that a physical (rather than mathematical) averaging takes place. Thus, for a well-formed composite, a single measured value should be similar to the mean of measurements of the individual components of the composite. The analysis results from multiple composite samples can be used to perform the statistical calculations described in Chapter Nine. Multiple composite samples can provide improved sampling precision and reduce the total number of analyses required compared to non-composite sampling. This strategy is sometimes employed to reduce analysis costs when analysis costs are large relative to sampling costs.

Source: http://www.epa.gov/epaoswer/hazwaste/test/faqs_faqs_sampl.htm#Composite

⁴A sample which is taken from a source (of water, a waste stream, material) on a one time basis with no regard to the flow in the waste stream and without consideration of time. Grab sampling is commonly used to determine worst case conditions and/or identify emission source locations of "hot spots." This method involves the use of a hand-operated bellows, or piston-type pump, and contaminant-specific detector tube. Detector tubes are available for most gas or vapor phase contaminants. Common contaminants sampled using this method include ammonia, carbon dioxide, carbon monoxide, hydrogen chloride, and nitrogen dioxide.

⁵Enthalpy is a thermodynamic concept that addresses the movement of energy into and out of a system.

⁶SI refers to 'International System of Units'. The SI is founded on seven SI base units for seven base quantities assumed to be mutually independent; <http://physics.nist.gov/cuu/Units/units.html>

⁷Phthalic anhydride released to the atmosphere could result from its manufacture and use in many products and its use in the manufacture of other commercial materials, polyester resins, and alkyd resins, phthaleins, phthalates, benzoic acid, synthetic indigo, artificial resins (glyptal), synthetic fibers, dyes, pigments, pharmaceuticals, insecticides and chlorinated products. It is released from industrial plants which produce phthalic anhydride by oxidation of xylenes and naphthalene; from the incineration of industrial refuse and water sludges and slurries from plastic products and other manufacturing processes. Phthalic anhydride has been detected in leachate from municipal and separate industrial wastes containing plastics. If phthalic anhydride is released to soil, it will not be expected to adhere to the soil. It is expected to hydrolyze in moist soils. If it is released to water it will not be expected to bioconcentrate in aquatic organisms, absorb sediments, or evaporate. Hydrolysis will be a major fate process based on an estimated half-life of 1.5 minutes. If it is released to the atmosphere it may be susceptible to direct photolysis. The estimated vapor-phase half-life in the atmosphere

is about 32 days as a result of ring addition of photochemically produced hydroxyl radicals. Exposure to phthalic anhydride result mainly from occupational exposure involving the inhalation of contaminated air. Source:<http://www.speclab.com/compound/c85449.htm>

⁸ Maleic Anhydride is a highly reactive chemical intermediate with present and potential uses in practically every field of industrial chemistry. It is essential to the production of a multitude of resins and plastics, agricultural chemicals, petroleum product additives, wetting agents and textile chemicals. Its biggest single use is in the manufacturing of unsaturated polyester resins.

⁹ Learning from other people can be a cost-effective approach. UNEP TIE's International Cleaner Production Information Clearinghouse (ICPIC CD-ROM Version 1.0) contains more than 600 Cleaner Production Case studies. Visit <http://www.uneptie.org>

¹⁰ A Gantt chart is a horizontal bar chart developed as a production control tool in 1917 by Henry L. Gantt, an American engineer and social scientist. Frequently used in project management, a Gantt chart provides a graphical illustration of a schedule that helps to plan, coordinate, and track specific tasks in a project. Gantt charts may be simple versions created on graph paper or more complex automated versions created using project management applications such as Microsoft Project or Excel. A Gantt chart is constructed with a horizontal axis representing the total time span of the project, broken down into increments (for example, days, weeks, or months) and a vertical axis representing the tasks that make up the project (for example, if the project is outfitting your computer with new software, the major tasks involved might be: conduct research, choose software, install software). Horizontal bars of varying lengths represent the sequences, timing, and time span for each task. Using the same example, you would put "conduct research" at the top of the vertical axis and draw a bar on the graph that represents the amount of time you expect to spend on the research, and then enter the other tasks below the first one and representative bars at the points in time when you expect to undertake them. The bar spans may overlap, as, for example, you may conduct research and choose software during the same time span. As the project progresses, secondary bars, arrowheads, or darkened bars may be added to indicate completed tasks, or the portions of tasks that have been completed. A vertical line is used to represent the report date.

Gantt charts give a clear illustration of project status, but one problem with them is that they don't indicate task dependencies - you cannot tell how one task falling behind schedule affects other tasks. The PERT chart, another popular project management charting method, is designed to do this. Automated Gantt charts store more information about tasks, such as the individuals assigned to specific tasks, and notes about the procedures. They also offer the benefit of being easy to change, which is helpful. Charts may be adjusted frequently to reflect the actual status of project tasks as, almost inevitably, they diverge from the original plan. http://whatis.techtarget.com/definition/0,,sid9_gci331397,00.html

Chapter Five

¹ Deming in turn credited Dr. Walter Shewhart as the man that taught him that there were two ways of doing things: the old way and the new way. Essentially, the bottom line to their collective message is ~ you can do it right, or you can do it over again, and again and again... and over again, until you get it right.

² See Further Readings in Appendix B under Scholtes, Peter, The Team Handbook.

³ JUSE stands for the Japanese Union of Scientists and Engineers.

⁴ Figure 5-3 from E2M's presentation at the APO Workshop on The Application of Total Quality Environmental Management Tools for Green Productivity, May 14-18 2001, Malaysia.

⁵ If you are interested in going into more detail on Deming's obligations and his Seven Deadly Diseases, there are many books in press that can add to your system of Profound Knowledge. There is also a web site that has been established in honour of Deming at <http://www.deming.org>

⁶ Source: Dr. Deming by Raphael Aguayo, see Further Readings in Appendix B.

⁷ Or refer to Greening on the Go©

⁸ TQM Concepts and Practices, APO, 1999.

⁹ Ibid

¹⁰Source:<http://www.iso.org/iso/en/aboutiso/introduction/index.html#two>

¹¹ *A Different Perspective on Quality: Bringing Management to Life*® H. Thomas Johnson's Keynote keynote presentation to The Deming Institute Fall 1997 Meeting

¹²Ibid.

¹³Referred to in Chapter 1.

¹⁴This Summit was introduced in Chapter 1.

¹⁵ *The Economist* July 29th 2000

¹⁶Guidance on how to use or market your organization's adoption is available in a document entitled "Publicizing your ISO 9000 or ISO 14000 certification" (1998, 20 p., ISBN 92-67-10278-8) through ISO Central Secretariat.

¹⁷ Certification is also referred to as registration, particularly in North America. The process of verification by design is the same.

¹⁸ Environmental aspects have a defined presence in ISO 14001. Simply they are the things you do or the things that you have that are the sources of environmental impact.

¹⁹ Organizations that implement all the requirements of an EMS and have completed one full cycle of the PDCA process outlined in ISO 14001 may post their corporate profile on the site. The baseline for the site is ISO 14001. Other standards and organizational specific information may be included. The burden of proof of conformity remains with the organization. www.14000registry.com

²⁰All statements of conformity, including registration/certification are based on the company self-declaring. These other approaches build on the company's base efforts as the intent of both standards is on the concept of managing self-improvement.

²¹The approach used by Imperial Oil. Source: <http://www.imperialoil.ca/>

²²Source: http://www.cica.ca/index.cfm?la_id=1&ci_id=1367&highlight_keywords=14000registry%2Ecom This process is copyrighted and is known in the marketplace as the EnviroReady Report®. Professional accountants wishing to provide the service must receive a Certificate of Recognition by successfully completing a learning process offered on-line through www.14000registry.com

²³The Living Wineries are a good example of how this approach benefited a group of like-minded small businesses.

²⁴Source: ISO Central Secretariat, visit www.iso.ch

Chapter Six

¹Gregory Bateson, as quoted by H. Thomas Johnson's Keynote presentation to The Deming Institute Fall 1997 Meeting

²Ibid

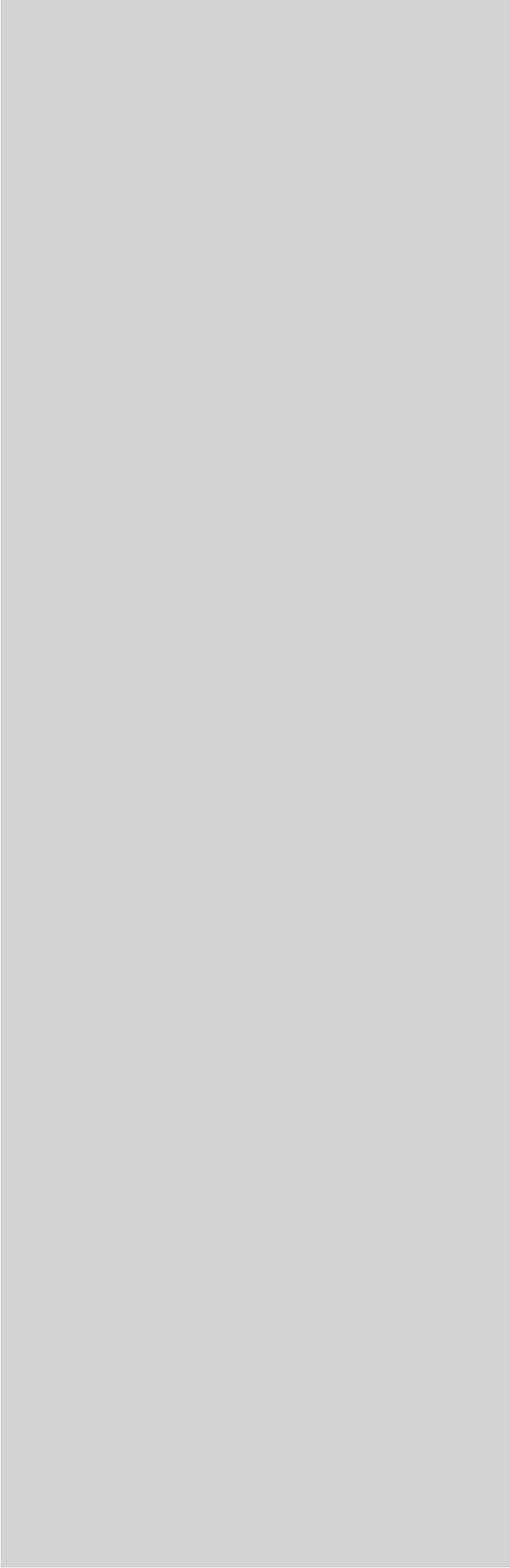
³Tverksy p 274 , Against the Gods.

⁴The Ingenuity Gap, Can We Solve The Problems of the Future? By Thomas Homer-Dixon, 2001.

⁵To learn more about the ongoing experiments visit <http://www.bio2.edu/>

⁶Howard, Pierce J. 2000. *The Owner's Manual for the Brain: Everyday Applications from Mind-Brain Research*. 2nd Edition. Atlanta: Bard Press.

⁷Send your puzzle solution to the author at etwom@inforamp.net and APO at <http://www.apo-tokyo.org/> so that it can be shared with others



APPENDICIES

Appendix A: The Asian Productivity Organization (APO)

*Appendix B: Manila Declaration on Green Productivity 1996
and Manila Statement 2002*

Appendix C: Further Reading and Online Resources

*Appendix D: National Productivity Organizations (NPOs)
Contact Information*

APPENDICIES

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APPENDIX A

The Asian Productivity Organization (APO)

OBJECTIVE

The Asian Productivity Organization (APO) is an inter-governmental regional organization established in 1961 to contribute to the socio-economic development of its member countries and improve the quality of life of their people through productivity enhancement in the spirit of mutual cooperation among its members. It is non-political, non-profit making, and non-discriminatory.

MEMBERSHIP

APO members are: Bangladesh, Cambodia, Republic of China, Fiji, Hong Kong, India, Indonesia, Islamic Republic of Iran, Japan, Republic of Korea, Laos, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, and Vietnam.

KEY ROLES

The APO seeks to realize its objective by playing the roles of think tank, catalyst, regional adviser, institution builder, and clearinghouse for information on productivity.

ORGANIZATION

The supreme organ of the APO is the Governing Body. It comprises one Director from each member country designated by their respective governments. The Governing Body decides on policies and strategies of APO programs and approves its budgets, finances, and matters relating to membership.

Each member country designates a national body to be its national productivity organization (NPO). NPOs are either agencies of the government or statutory bodies entrusted with the task of spearheading the productivity movement in their respective countries. They serve as the official bodies to liaise with the APO Secretariat and to implement APO projects hosted by their governments.

The Secretariat, based in Tokyo, Japan, is the executive arm of the APO. It is headed by the Secretary-General. The Secretariat carries out the decisions, policy directives, and annual programs approved by the Governing Body. It also facilitates cooperative relationships with other international organizations, governments, and private institutions.

The APO Secretariat has six functional departments: Administration and Finance; Research and Planning; Industry; Agriculture; Environment; and Information and Public Relations.

THRUST AREAS

The Governing Body has designated five thrust areas to be given emphasis when planning APO activities: Knowledge Management (KM); Green Productivity (GP); Strengthening Small and Medium Enterprises (SME); Integrated Community Development (ICD); and Development of NPOs (DON).

PROGRAMS AND ACTIVITIES

APO programs cover the industry, service, and agriculture sectors, with special focus on: socio-economic progress; strengthening of SMEs; KM; total quality management; general management; technology, information technology, and innovation; GP; ICD; DON; agriculture development and agro-industry; resources and technology; and agricultural support systems.

The activities of the APO include basic research studies, surveys, symposia, study meetings, workshops, training courses, seminars, study missions, demonstration projects, technical expert services, information dissemination, and training videos.

Visit <http://www.apo-tokyo.org> for more information about the APO.

APPENDIX B

APO World Conference on Green Productivity, 1996

For the movement of Green Productivity to be successful, it was recognized that all efforts would have to be pooled by calling for mutual cooperation at transnational and global levels.

A three-day conference was organized to promote Green Productivity as a strategy that signified a new model of socio-economic development aimed at the pursuit of economic and productivity growth while protecting the environment. With over 450 participants from 32 countries, it was a well-attended success. Attendees included:

- senior government officials responsible for productivity and environmental management
- representatives from the United Nations agencies
- other international organizations,
- non-governmental organizations,
- industry, agriculture, labour unions, academia and the mass media.

At the conference, the representatives of four factories that participated in the APO's Demonstration Factory/Farm Program presented their findings of their green productivity practices at actual work sites. The factories were located in the Republic of China, Hong Kong, India and Thailand. Their experiences empirically confirmed that productivity improvement and environmental protection can be profitably harmonized, even in small to medium sized enterprises.

During the APO World Conference on Green Productivity in Manila in December 1996 the "Manila Declaration on Green Productivity" was issued and endorsed by the conference delegates.

The Manila Declaration on Green Productivity, 1996

Convinced that Green Productivity, being a concept of integrating socio-economic aspirations and a means to harmonize environmental protection and economic development, is the key to sustainable development for enhancing people's quality of life, the Asian Productivity Organization, in collaboration with the Development Academy of the Philippines, organized this APO World Conference on Green Productivity in Manila, the Philippines from, 4 to 6 December 1996. The participants deliberated on the concept and current status of Green Productivity practices, discussed related issues and problems and adopted strategies for promoting the Green Productivity Movement in the Asia-Pacific region and worldwide.

SUBSCRIBING to the principles adopted at the Rio Earth Summit in 1992 that sustainability must be the basic consideration for overall socio-economic development of the world and the consensus reached at the World Summit for Social Development in Copenhagen in 1995 that equity and justice in all respects must be the primary goal of our society;

REALIZING that the Asia-Pacific region is home to over half the global population and that, while the remarkable economic development in the region in recent years has been facilitating the improvement of living conditions of the majority of its vast population, it has also been causing deterioration of natural environment and depletion of non-renewable resources;

REALIZING that promotion of sustainable economic development with concrete measures for the Asia-Pacific countries will not only contribute to achieving greater employment opportunities and steady improvement of people's life in the region and to forestalling global environmental degradation, but will also serve as an important model for the other countries in the world; and **NOTING** that concerted efforts for balanced and equitable socio-economic development require fundamental changes in people's attitudes, perspectives, and lifestyles as well as reorientation of ways to produce goods, render services and use natural resources.

This Conference resolves that:

- Industrial development should be pursued more vigorously by promoting technology development and availing of technological advancement, with emphasis on building indigenous capacity for development and adoption of green products and green production processes to conserve natural resources;
- Service industries should ensure that the provision of service to society is bereft of damage to environment and is in consonance with environmental conservation concepts;
- Agricultural development should be reoriented towards applying environment-friendly methods and practices to ensure sustainable food and nutrition security for the growing population and improve employment opportunities as well as welfare and amenities in the rural areas;
- Due heed should be given to the need for ISO 14000 standards to be effectively applied to all levels of economic activities especially in the industry sector, as such standards will have a significant bearing on the promotion of Green Productivity practices;
- Comprehensive market-based instruments should be instituted to enhance regulatory approaches in order to accelerate the shift to Green Productivity;
- Key industries having substantial contribution to national income and employment generation should provide the lead in demonstrating efficient implementation of Green Productivity concepts and practices;
- In order to realize sustainable and equitable socio-economic development as a whole, priority should be given to the needs and requirements of developing countries and their small and medium enterprises, in particular. For successful implementation of Green

Productivity practices in small and medium enterprises, consideration should be given to introducing, at the initial stage, low-cost improvement measures before taking up sophisticated technologies. Good house-keeping and good engineering practices can be the starting point for pollution prevention, as such measures could bring about substantial savings of resources and reduction in wastes; and

- Cooperative labour-management relations should be forged for introducing and operating cleaner technologies.

To realize these resolutions, therefore, this Conference urges:

GOVERNMENTS to institute macro-level frameworks and systems such as national development policies, legislation, regulations and economic measures and implement them effectively along with complementary micro-level systems to promote Green Productivity and encourage creation of green product alternatives through various measures including taxation, financing and human resource development;

AGRICULTURE, INDUSTRY AND SERVICE SECTORS to adopt and implement Green Productivity policies and practices, particularly environmental management systems, cleaner production and, as a supplementary measure, the use of end-of-pipe treatment;

INTERNATIONAL, REGIONAL AND NATIONAL INSTITUTIONS to collaborate with relevant agencies, support the concept of Green Productivity and have it reflected in all their development activities, provide special supporting funds for projects having significant components of Green Productivity, and make constant efforts to create favourable environment towards Green Productivity enhancement;

THE ASIAN PRODUCTIVITY ORGANIZATION, as a regional productivity organization spearheading productivity promotion efforts in the Asia-Pacific region, to embrace the concept of Green Productivity, integrate it in all its program of activities on human resources development, technical assistance and information dissemination and continue extending its activities aiming at SMEs to help them apply cleaner production systems, upgrade their absorptive capabilities for ISO 14000 standards and take steps to set up networks for the effective promotion of the transfer of technology and south-south cooperative activities;

THE NATIONAL PRODUCTIVITY ORGANIZATIONS to place a high priority on Green Productivity in all of their activities such as surveys, fora; seminars, training and consultancy services, and information exchanges and act as Green Productivity promotion centres in order to promote and coordinate all the Green Productivity-related activities at the national level;

NGOs AND COMMUNITY-BASED ORGANIZATIONS to propagate ideas and techniques of Green Productivity, particularly at the grass-roots level,

encourage people's participation in community development projects and render extension services to raise social awareness and promote income-generating activities;

ACADEMIA to lay special emphasis on research and education in Green Productivity which should also be included as an essential element of all environment-related education and training;

MASS MEDIA to focus on Green Productivity in order to increase public awareness of environmental issues and establish fora for free exchange of views and ideas on all matters related to Green Productivity, particularly in publishing successful Green Productivity showcases;

TRADE AND BUSINESS ASSOCIATIONS to strengthen their functions as clearing houses of information in order to bring home to their members the clear message that they have a social responsibility to adopt Green Productivity practices in their operations and that such practices will enhance their own productivity; and

ALL STAKEHOLDERS to promote awareness and mutual cooperation in Green Productivity by actively participating in networking of complementary activities, exchanging of ideas and experiences, disseminating information, and encouraging the involvement of everyone in the Green Productivity Movement as the strategy for better quality of life for all.

6 DECEMBER 1996
MANILA, THE PHILIPPINES

2nd World Conference on Green Productivity (GP) 2002

Manila, Philippines, December 9 – 11, 2002

The Asian Productivity Organization in cooperation with the National Productivity Organizations,

Partnering Organizations and other participants congregated at this conference to engage in the relentless pursuit to innovate towards sustainability through Green Productivity.

The first conference in 1996, "In Pursuit of Better Quality of Life", brought together more than 450 participants from 32 countries including senior government officials responsible for productivity promotion and environmental management, representatives of United Nations' agencies, other international organizations, non-governmental organizations, industry, agriculture, labour unions, academia and the mass media. At the closing, the Manila Declaration on Green Productivity was adopted, casting the seeds needed to sprout green innovation.

It was at this important event where the roots of progress, the measurements and stories of GP success were shared.

The conference addressed four key objectives, it:

1. Reviewed the GP concept, principles, methodology, and tools as a practical approach to both global competitiveness and the environmental problems on the occasion of Rio+10 Conference;
2. Assessed the opportunities for enhancing the GP concept, methodology, and the tools and techniques by incorporating other modern concepts and trends;
3. Identified new and innovative approaches to strengthen and sustain GP practices within NPOs and other organizations, as well as at the national level; and
4. Networked with like-minded national as well as international organizations to bring about synergistic effects in regional activities on GP promotion and dissemination.

Information on the outcomes of the conference can be found at <http://www.apo-tokyo.org/speceven/arc0013.0statement.htm>.

A formal statement was issued at the end of the conference which summarized the APO's ongoing commitment to GP and its progress with other stakeholders.

Statement on Green Productivity 2002

Appreciating that the Asian Productivity Organization (APO) launched the Green Productivity (GP) program in Asia and the Pacific in 1994, in response to the Rio Earth Summit of 1992, with special funding from the Government of Japan, as a strategy to create a paradigm shift among the stakeholders for productivity enhancement in harmony with environmental protection;

Having due regard to the Manila Declaration on Green Productivity adopted during the First APO World Conference on Green Productivity held in the Philippines in 1996, the Johannesburg Declaration adopted during the World Summit on Sustainable Development (WSSD) in the Republic of South Africa in 2002, and further to the International Declaration on Cleaner Production of the United Nations Environment Program in 1998 and the Millennium Development Goals, 2000;

Recognizing that the Green Productivity is a holistic approach to realize the APO's vision as expressed in the International Productivity Declaration adopted during the International Productivity Conference held in Singapore in October 2001 for strengthening competitiveness, protecting the environment, and attaining social fairness;

Emphasizing that sustainable development continues to be a critical issue that must be addressed with a sense of urgency by all and that the Green Productivity program has shown, with its many successful cases, to be a practical and effective means for attaining sustainable development;

Noting that under its Green Productivity program, the APO has extensively and successfully promoted and publicized the Green Productivity concept to all the stakeholders in the government, public, and economic sectors in the region; and that it has endeavored to build the Green Productivity capabilities of the National Productivity Organizations (NPOs);

This Second World Conference on GP:

- 1.** Confirms that the Green Productivity program should be the driving force to achieve the Millennium Development Goals and sustainable development;
- 2.** Stresses that in future plans for the APO's Green Productivity program, the outcome of the WSSD should be given due consideration, especially with regard to issues related to the management of natural resources, sustainable production and consumption, and eradication of poverty;
- 3.** Agrees that the Green Productivity concept and practices should be integrated in the industry, agriculture, and service sectors as well as communities;
- 4.** Urges the governments and businesses as the primary stakeholders in governance to infuse the Green Productivity concept in development policies and corporate strategies, respectively;
- 5.** Calls on all stakeholders to extend, in the spirit of partnership, their assistance and cooperation to the Green Productivity program; and
- 6.** Recommends that the APO:
 - Encourage all concerned, particularly decision makers in the public and private sectors, to contribute to Green Productivity practices proactively through all possible means including the greening of supply chains with a view to changing unsustainable production and consumption patterns;
 - Further strengthen collaboration with national and local governments, enterprises, labor unions, financial institutions, academia, trade and professional associations, media, civil society, and international organizations in implementing the Green Productivity program with shared responsibilities for sustainable development;
 - Promote the incorporation of the Green Productivity concept and approaches in the formal and informal education systems;
 - Develop indicators at various levels for measuring the results of Green Productivity practices to share with others for effective Green Productivity implementation and promotion;
 - Urge the NPOs to enhance their capabilities and capacity in planning, implementing, monitoring, and evaluating the Green Productivity program, and also in disseminating its successful cases to contribute to national development goals; and
 - Contribute to further promotion of the concept and practices of Green Productivity as a key to poverty alleviation in conjunction with the Integrated Community Development program in line with the Partnership Initiative accepted at the WSSD.

Manila, 11 December 2002

APPENDIX C

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On-line Resources

The following are some of the on-line resources available on Green Productivity. There are others that can be found by visiting the APO site, or one of the National Productivity sites, identified in the GP Resources On-Line.

I. International GP Association (IGPA)

www.igpa.ema.org.tw

The IGPA has a mission is to enhance information flow, support human resources development, and strengthen public/private partnerships to stimulate the implementation of GP strategies and technologies in the Asian/Pacific region. It publishes a quarterly newsletter electronically.

II. American Council for an Energy-Efficient Economy

www.aceee.org

The American Council for an Energy-Efficient Economy (ACEEE) is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection.

Based in Washington, D.C., ACEEE works closely with the U.S. Department of Energy, U.S. Environmental Protection Agency, and other federal agencies. We also work with a wide range of states, utilities, and international organizations.

ACEEE is a leading source for energy efficiency analysis, policy and program advice, and information. The contents of the site are divided into following sections.

- Consumer Information
- Press releases
- Energy efficiency related web sites
- Mini reports
- Business case for energy efficiency and pollution prevention

The section on "Business case for energy efficiency and pollution prevention" includes 18 case studies. These case studies show how a range of industries have implemented projects or overall corporate strategies that profit from the synergies of energy efficiency, pollution prevention, process efficiency, and increased productivity.

ACEEE site also contains a list of other web sites that concern energy efficiency under the section "Energy Efficiency-Related Web Sites".

III. Environmental Integration Initiative

www.turi.org

Better, Faster, Cheaper, and Cleaner Manufacturing in Massachusetts is a collaborative project involving the Massachusetts Manufacturing Partnership, the Massachusetts Office of Technical Assistance, the Toxics Use Reduction Institute, and the Department of Environmental Protection. Conceived in 1995 as a means of streamlining available services to small and medium-sized businesses, this

project is focused particularly on assisting manufacturers in the metal products and electronics. A major goal of the project is to demonstrate for companies how reducing environmental impacts of operations has direct links to increases in cost savings, productivity, and competitiveness.

This site contains a manual for manufacturers aiming to provide demonstrations and resources for manufacturers who are interested in increasing cost savings, productivity, and competitiveness by reducing environmental burden.

This manual was prepared during a collaborative project involving the Massachusetts Manufacturing Partnership, the Massachusetts Office of Technical Assistance, the Toxics Use Reduction Institute, and the Department of Environmental Protection. Conceived in 1995 as a means of streamlining available services to small and medium-sized businesses, this project is focused particularly on assisting manufacturers in the metal products and electronics. A major goal of the project is to demonstrate for companies how reducing environmental impacts of operations has direct links to increases in cost savings, productivity, and competitiveness.

The manual focuses on implementation cleaner production aspects such as incentives and barriers, laws and regulations, information sources and management tools such as, Toxics Use Reduction, Design for the Environment, Total Cost Accounting, and Environmental Management Systems. The case studies included in the manual focuses on Toxic waste reduction.

The links and contacts have been listed to complement and build on the information provided in this manual.

Cleaner production clearinghouses are special libraries that focus on alternative industrial process and alternative technical information:

- A.** Technology Transfer Center (TTC) located at the *Toxics Use Reduction Institute* at the University of Massachusetts Lowell; call - Anne Berlin Blackman at 508/934-3124.
- B.** Northeast Waste Management Officials Association (NEWMOA) in Boston; contact Lisa Regenstein 617/367-8558.
- C.** EPA Research Library for Solid and Hazardous Waste in Boston; contact Fred Friedman at 617/571-9687.
- D.** EPA Region 1 Main Library in Boston; call 617/565-3300.

The manual also provides list and brief description of various Internet sites, which provide information on various aspects of cleaner production and toxic waste reduction.

- E.** *P2Gems* Internet search tool for facility planners, engineers and managers who are looking for technical and process or materials management information on the Web. Over 300 sites with information valuable to TUR planning have been selected and catalogued for easy use. P2Gems are accessed by keywords that are organized into product, process, chemical, or management technique categories.

- F. **P2 Experts:** Designed to help companies overcome P2 informational barriers, P2 Experts provides a quick and easy way to locate individuals with specific P2 expertise, industrial experience, or process knowledge. P2 Experts also provides an opportunity for members to promote their P2 skills, cultivate business connections, and establish government contacts.
- G. **EPA EnviroSense:** EnviroSense is an integral part of the U.S. Environmental Protection Agency's web site. It attempts to provide a single repository for pollution prevention, compliance assurance, and enforcement information and databases. Included are pollution prevention case studies, technologies, points of contact, environmental statutes, executive orders, regulations, and compliance and enforcement policies and guidelines.
- H. **Pollution Prevention Resources:** from the Great Lakes Information Network, includes archives of the P2TECH Email List.
- I. **FEDWORLD:** Gateway to US Government sites and information.
- J. **EcoWeb:** University of Virginia hub for ecological sites.
- K. **NBEN Online:** Northeast Business Environmental Network, private sector resource for companies of all sizes and sectors who seek to improve their environmental performance and profitability.

IV. The Eco Efficiency and Cleaner Production Home Page

www.deh.gov.au/industry/corporate/eeecp

EnviroNET Australia is maintained by the Environment Protection Group.

Environment Protection Group

Environment Australia, PO Box E305
KINGSTON ACT 2604
AUSTRALIA

The site provides information on the following aspects.

- A. What are cleaner production and eco-efficiency?
- B. Examples and case studies

The case studies could be searched by industry sector, or location. Also the search engine facilitates search based on any keyword typed by user.

- C. Application to particular industries

In this part of the Home page, Environment Australia provides an information forum for developments in eco-efficiency and cleaner production in particular industries. Suggestions can be posted on this page.

- D. Tools, resources and links contains following topics:
 - Life cycle assessment
 - Public environmental reporting
 - Environmental Indicators

- Industrial ecology
 - Codes of practice
 - Cleaner production
 - Environmental audits
 - Environmental management systems
 - Environmental accounting
 - Design for environment
 - Environmental labeling
 - Performance based contracting
 - Eco-efficiency
 - Environmental Taxes
- E.** Publications and research papers
- F.** Cleaner production handbook for local government
- Cleaner Production Handbook for Local Government Fact Sheet - April 1997
 - Getting Ahead of the Game: an Anticipatory Approach to Environmental Management - July 1996
- G.** Fact sheets
- The EcoRedesign Project
 - The EPG and Cleaner Production
 - Industry Education Project
 - National Materials Accounting Strategy
 - Environment Health and Hospitals

V. Internet Resources on Cleaner Production in Industry

www.marietta.edu/~spilatr/cIn_prod.html

Web sites have been divided into four divisions.

- A. Cleaner Production:** These are sites that provide a wide range of information of cleaner production activities, programs sponsored by the EPA and private organization. Many have links to case studies, technologies, and corporate home pages.
- B. Corporate Home Pages:** This section has links to corporations with histories of strong environmental programs. Some of the pages have features that allow searching of key words --one good way to track down relevant environmental information
- C. Environmental Technology:** This section has links to information about cleaner production technologies.
- D. Other Useful Sites:** Here you will find links to cleaner production case studies, more information about corporations and cleaner production

technologies, the EPA and its resources, databases of environmental information, and other general environmental resources. These sites can provide information about environmental legislation and policy, risk and life-cycle analysis, emissions databases (including TRI), professional organizations, etc.

VI. EnviroSense

www.epa.gov/envirosense

This site is a part of the U.S. EPA's web site, which provides as a repository for pollution prevention, compliance assurance, and enforcement information and databases.

VII. World Business Council for Sustainable Development

www.wbcsd.ch

The site contains details of the "Eco-efficiency - European Eco-Efficiency Initiative (EEEI)" program. The site is divided into following sections.

- Concept Background
- Eco-Efficiency Metrics and Reporting
- European Eco-Efficiency Initiative
- **Eco-Efficiency Case Study Collection**
- By-Product Synergy

"Eco-Efficiency Case Study Collection" links to the success stories of various companies for improved environmental performance, significant cost savings, risk management, and business expansion. Each case study, though specific to a particular industry, contains lessons valuable to most of the industrial sectors. The case studies convey both ecological and economic benefits that can be achieved through eco-efficiency. The guidelines developed and applied are also given. The site facilitates submission of new case studies. Additionally the case studies can be searched by key words.

VIII. EMAS Tool kit for SMEs

www.inem.org/new_toolkit/

The EMAS Tool Kit for SMEs brings together a set of tools proven effective in helping small companies introduce an environmental management system and attain EMAS registration.

It is the result of co-operation among 14 European organizations, which have experience in working with small and medium-sized enterprises (SMEs) and in implementing environmental management.

The site contains freely downloadable pdf files.

(c) International Network for Environmental Management 1998.

Site developed by Ecotopia

The site contains information, which may be useful to the small and medium enterprises for implementing cleaner production program. The site is structured in following sections.

Introduction

Section 1: Introduction to EMAS

Section 2: What are the benefits and costs of EMAS?

Section 3: How to get started?

Plan

Section 4: How to develop an environmental policy

Section 5: How to carry out an initial environmental review

Section 6: How to develop an environmental programme

Do

Section 7: How to structure an environmental management system

Check

Section 8: How to control and monitor environmental performance and management systems

Act

Section 9: How to review an environmental management system

Section 10: How to communicate and report on environmental performance

Section 11: How to get official recognition

IX. Environmental Sites on the Internet

www.lib.kth.se/kthbeng/kthb.html

This site provides links to various aspects of environmental management. The links include general information such as conferences, journals and newsletters, directories etc. Specific information is arranged in a alphabetically arranged subject index. Some of the subjects include:

Alternative Technology;

Benchmarking;

Eco Products;

Eco Rating;

Environmental Labeling;

Environmentally Friendly Products;

LCA;

Recycling;

Solvent Alternatives.

X. United Nations Environment Programme (UNEP)

www.unep.org

The web site contains profile of UNEP, State of global environment, Information on Environmental Issues, Products and Services provided by UNEP, Environmental Conventions, various Environmental links.

UNEP's activities include promotion of,

- Safer production programme (APELL) aimed at improved accident prevention, community awareness and emergency preparedness.
- Cleaner Production as a strategy for preventing pollution, applied to processes, products and services.
- Industrial Pollution Management in Mining, fertilizer production, oil and gas, industrial estates, contaminated land, hazardous waste management.
- Assessing technologies from an environmental perspective (under Environmental Technology Assessment Program).
- Stimulating dialogue between stakeholders and promoting the use of environmental management tools.
- Policies and tools for environmentally sound tourism.
- Sharing information to design or improve energy-efficient systems.
- Need-based clearinghouse services to assist developing countries phase out their use of ozone depleting substances under the Multilateral Fund (OzonAction).

XI. Product Oriented Environmental Management Links

www.bbt.utwente.nl/en/index.html

The site is maintained by:

Frank de Bakker

Ph.D. candidate

Department of Legal Aspects of Business Administration

Faculty of Technology and Management

University of Twente

P.O. Box 217, 7500 AE Enschede, The Netherlands

This site contains over 175 links on eco-design, business and the environment and related issues. Most links concern product-oriented environmental management (POEM). Various related links (greening business, concurrent engineering, environmental links) are included.

XII. Tellus Institute

www.tellus.org

Tellus Institute is a non-profit research and consulting organization that promotes equitable and sustainable resource management. Tellus projects address policy and planning issues in such areas as energy, water, waste, and land use.

Using state-of-the-art methods, Tellus analyzes evolving problems and evaluates

options for technological and institutional change. The Institute develops and disseminates decision-support tools to strengthen capacity to develop effective resource and environmental strategies.

The site is organized into four groups. The Energy, Solid Waste, and Risk Analysis groups work primarily in North America. Tellus also hosts the Boston Center of the Stockholm Environment Institute (SEI).

U.S. Agency for International Development (US AID) Environmental Pollution Prevention Project (EP3)

XIII. U.S. Agency for International Development (US AID) Environmental Pollution Prevention Project (EP3)

www.epa.gov/envirosense

U.S. Agency for International Development (US AID) Environmental Pollution Prevention Project (EP3)

EP3 is sponsored by the United States Agency for International Development
Can be freely viewed and saved in to local machine.

The Environmental Pollution Prevention Project (EP3) is a five-year program sponsored by the United States Agency for International Development (USAID) to address urban and industrial pollution and environmental quality in developing countries. The objectives of the program are:

- to establish sustainable pollution prevention programs in developing countries
- to transfer urban and industrial pollution prevention expertise and information, and
- to support efforts to improve environmental quality.

The site contains miscellaneous documents (reports, newsletters, etc.), EP3 News, Case Studies, and International Resources.

XIV. Waste Prevention Association "3R"

www.rec.hu/e_index.html

Waste Prevention Association was founded in March 1993. This independent (not umbrella) association was created as a result of the demand of members of many NGOs, such as the Club "Gaja", Green Federation, Polish Ecological Club, Greenpeace International and local activists to establish a professional organization to service the information needs of these groups.

WPA is non-governmental and non-profit environmental organization. WPA's mission is to promote clean production methodology, waste reduction at source, and environmentally friendly waste management: segregation and recycling, as well as rational utilization of "historical" waste. Internet Resources included are divided in to following section:

- Pollution Prevention and Clean Production

- Municipal Solid Waste
- Hazardous Waste and Toxic Substances
- Waste Incineration

XV. World Cleaner Production Society (WCPS)

www.nif.no/index3.asp

World Cleaner Production Society (WCPS)

TI, P.O. box 2608 St. Hanshaugen, 0131 Oslo, Norway

The goal of the organization is to build capacity for self-sustaining Cleaner Production activities in countries with no or low capacity for transition to cleaner production.

The site contains information about ongoing cleaner production dissemination programs in 8 countries in Central and Eastern Europe, Asia and Africa. Programs are under final preparation in additional four countries in Asia and Europe.

XVI. World Resources Institute

www.wri.org

WRI is classified by the Internal Revenue Service as a tax-exempt, publicly supported, educational organization.

World Resources Institute

10 G Street, NE

Suite 800

Washington, DC 20002

Phone: 202/729-7600

Fax: 202/729-7610

general email: lauralee@wri.org

World Resources Institute started in 1982. It believes a healthy environment and healthy economy can coexist. The organization conducts policy research, publicize policy options, encourage adoption of innovative approaches and provide strong technical support to governments, corporations, international institutions, and environmental NGOs.

The site also provides links to various other sites categorized in following areas:

Links Related to Thematic Areas

Biodiversity and Ecosystems Links;

Business and Environment Links;

Climate Protection;

Environmental Education Links;

Forest Resources Links;

*Forest Frontiers Initiative: Internet Resources;
Sustainable Agriculture
Business and the Environment*

XVII. Environmentally and Socially Sustainable Development

www-esd.worldbank.org

The Environment Department at the World Bank

1818 H Street, N.W.

Washington, D.C. 20433

Voice: 1 (202) 522-ESSD

E-mail: EADVISOR@WORLDBANK.ORG

The site includes following environmental and social themes,

- natural habitat and terrestrial ecosystem
- freshwater, marine and coastal resources
- pollution management
- environmental economics and indicators
- social policy and resettlement
- portfolio monitoring and environmental assessment
- global overlays

Other Resources: Bulletins / Periodicals / Journals / Newsletters

Business and the Environment

Cutter Publishing

37 Broadway, Suite 1

Arlington, MA 02174-5552, USA

Tel: +617 641 5125 (client services) +617 641 5123 (editorial)

Fax: +617 648 8707

Email: lovering@cutter.com (customer service),

bate@igc.apc.org (editorial)

Web: <http://www.cutter.com>

Subscription rate: \$397 per year;

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(subscription includes 12 monthly issues, quarterly Meeting Planner that lists conferences, trade shows, etc.)

California Management Review

Address: California Management Review,

S549 Haas School of Business #1900, Berkeley,

CA 94720-1900, USA;

Phone: (510) 642-7159;

Fax: (510) 642-1318

Cleaner Production

The Newsletter of the UNEP IE network dedicated to promoting cleaner production.

Appears twice a year. Subscription free. For subscription write to UNEP IE, Paris, France.

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Marietta GA 30067

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Rockville, MD 20850, USA

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Publisher: Thomas F.P. Sullivan

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US Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington DC 20460, USA.

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Pollution Prevention Northwest

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Fax: 206-223-1165

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Tel: 212 850 6479
Email: SUBINFO@jwiley.com
Publisher: James F. Slabe
Editor: Ann B. Graham

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Waste Reduction Tips

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APPENDIX D

National Productivity Organizations (NPOs): Contact Information

BANGLADESH

NATIONAL PRODUCTIVITY ORGANISATION (NPO)

Established: 1983

Ministry of Industries,
Shilpa Bhaban (1st Floor),
91, Motijheel Commercial Area,
Dhaka-1000, Bangladesh

Phone: (880-2) 9562883

Fax: (880-2) 9563553 (Attn. NPO)

E-mail: npobd@gononet.com

CAMBODIA

NATIONAL PRODUCTIVITY UNIT (NPU)

Established: 2004

No. 45 Norodom Blvd.,
Phnom Penh, Cambodia

Phone: (855-12) 814150

Fax: (855-23) 428263

E-mail: bunnayea@yahoo.com

012814150@everyday.com.kh

REPUBLIC OF CHINA

CHINA PRODUCTIVITY CENTER (CPC)

Established: 1955

2nd Fl., No. 79, Sec. 1,
Hsin-Tai-Wu Road,
Hsichih 221, Taipei Hsien
Taiwan, Republic of China

Phone: (886-2) 2698-2989

Fax: (886-2) 2698-2976

E-mail: 0092@cpc.org.tw

www.cpc.org.tw

FIJI

THE TRAINING AND PRODUCTIVITY AUTHORITY OF FIJI (TPAF)

Established: 1984

Beaumont Road, 8 Miles,
P.O. Box 6890, Nasinu, Fiji

Phone: (679) 3392000

Fax: (679) 3340184

E-mail: info@tpaf.ac.fj

www.fntc.ac.fj

HONG KONG

HONG KONG PRODUCTIVITY COUNCIL (HKPC)

Established: 1967

TST P.O. Box 99027 Hong Kong,
HKPC Building,
78 Tat Chee Avenue,
Yau Yat Chuen
Kowloon, Hong Kong

Phone: (852) 2788-5678

Fax: (852) 2788-5090

E-mail: hkpcenq@hkpc.org

www.hkpc.org

INDIA

NATIONAL PRODUCTIVITY COUNCIL (NPC)

Established: 1958

Institutional Area,
Lodi Road,
New Delhi 110 003,
India

Phone: (91-11) 24690331

Fax: (91-11) 24615002

E-mail: npc@npcindia.org

www.npcindia.org

INDONESIA

INDONESIA DIRECTORATE GENERAL OF TRAINING AND PRODUCTIVITY DEVELOPMENT, DIRECTORATE OF PRODUCTIVITY MINISTRY OF MANPOWER AND TRANSMIGRATION R.I.

Established: 1968

Jl. Jend. Gatot Subroto Kav. 51,
Floor III/B, Jakarta Selatan 12950,
Indonesia

Phone: (62-21) 52963356 / 5255733 ext.237

Fax: (62-21) 52963356 or (62-21) 5227588

E-mail: protek@centrin.net.id; protek@binaprod.org

www.binaprod.org

ISLAMIC REPUBLIC OF IRAN

NATIONAL IRANIAN PRODUCTIVITY CENTER (NIPC)

Established: 1992

P.O.Box 15815-3693,
No.23, Daneshsara St.,
Baharestan Sq., Tehran
Islamic Republic of Iran

Phone: (98-21)77655500

Fax: (98-21)77646271

E-mail: nipo@nipo.ir

www.nipc.mporg.ir

JAPAN

JAPAN PRODUCTIVITY CENTER FOR SOCIO-ECONOMIC DEVELOPMENT (JPC-SED)

Established: 1955 (as Japan Productivity Center)

1994 (as Japan Productivity Center for Socio-Economic Development)

1-1, Shibuya 3-chome, Shibuya-ku, Tokyo 150-8307, Japan

Phone: (81-3) 3409-1135

Fax: (81-3) 3409-5880

E-mail: Y.Osaki@jpc-sed.or.jp

www.jpc-sed.or.jp (in Japanese)

www.jpc-sed.or.jp/eng/index.html (in English)

REPUBLIC OF KOREA

KOREA PRODUCTIVITY CENTER (KPC)

Established: 1957

Saengsansung Building,
122-1, Jeokseon-dong,
Jongro-ku, Seoul 110-751,
Republic of Korea

Phone: (82-2) 724-1180/7

Fax: (82-2) 737-9140

E-mail: shkang@kpc.or.kr

www.kpc.or.kr

LAO PEOPLE'S DEMOCRATIC REPUBLIC

LAO NATIONAL PRODUCTIVITY ORGANIZATION (LNPO)

SMALL AND MEDIUM ENTERPRISE AND DEVELOPMENT OFFICE (SMEPDO)

Ministry of Industry and Commerce,
Naxai Road, Xaysetha District,
P.O. Box 4107,
Vientiane, Lao PDR

Phone: (856-21) 414064 ext. 105

Fax: (856-21) 263590

E-mail: info@smepdo.org; productivity@smepdo.org

www.smepdo.org

MALAYSIA

NATIONAL PRODUCTIVITY CORPORATION (NPC)

Established: 1962 (as Government Body)

1966 (as National Productivity Centre)

1991 (as National Productivity Corporation)

P.O. Box 64, Jalan Sultan,
46904 Petaling Jaya,
Selangor, Malaysia

Phone: (60-3) 79556323

Fax: (60-3) 79578068

E-mail: PRO@npc.org.my

www.npc.org.my

MONGOLIA

NATIONAL PRODUCTIVITY AND DEVELOPMENT CENTER (NPDC)

Established: 1992

Room 102 & 103, Central Cultural Palace,
Sukhbaatar Sq. 3,
Ulaanbaatar 11, Mongolia

Phone: (976-11) 326115

Fax: (976-11) 329799

E-mail: npdc-mon@mongol.net

www.owc.org.mn/npdc

NEPAL

NATIONAL PRODUCTIVITY AND ECONOMIC DEVELOPMENT CENTRE (NPEDC)

Established: 1974 (as Industrial Services Centre)

1988 (as Economic Services Centre)

1994 (as National Productivity and Economic Development Centre)

P.O. Box No. 1318,
Balaju Industrial District,
Balaju, Kathmandu, Nepal

Phone: (977-1) 4350293

Fax: (977-1) 4350530

E-mail: npedc@wlink.com.np

PAKISTAN

NATIONAL PRODUCTIVITY ORGANIZATION (NPO)

NPO Secretariat,

House No. 42-A,

Nazim-ud-Din Road

Sector F-7/4, Islamabad, Pakistan

Phone: (92-51) 9215981, 9251982, 9251983

Fax: (92-51) 9215984

E-mail: npopakistan@yahoo.com

www.npo.gov.pk

PHILIPPINES

DEVELOPMENT ACADEMY OF THE PHILIPPINES (DAP)

Established: 1967 (as part of the National Economic Council – later reorganized as the National Economic and Development Authority)

1973 (became part of the Development Academy of the Philippines)

DAP Building, San Miguel Avenue,
Pasig City, Metro Manila,
Philippines

Phone: (63-2) 631-2143, 631-2137, 631-2138

Fax: (63-2) 631-2123

E-mail: apolu@dap.edu.ph

www.dap.edu.ph

SINGAPORE

STANDARDS, PRODUCTIVITY AND INNOVATION BOARD (SPRING)

Established: 1967 (as National Productivity Centre)

1972 (as National Productivity Board)

1996 (as Singapore Productivity and Standards Board)

2002 (as Standards, Productivity and Innovation Board)

2 Bukit Merah Central,
Singapore 159835, Republic of Singapore

Phone: (65) 62786666

Fax: (65) 62786665

E-mail: ird@spring.gov.sg

www.spring.gov.sg

SRI LANKA

SRI LANKA NATIONAL PRODUCTIVITY SECRETARIAT (NPS)

134, 4th Floor, CIL Tower, High Level Road,
Colombo 06, Sri Lanka

Phone: (94-11) 2513156

Fax: (94-11) 2513296

E-mail: npost@sltnet.lk

THAILAND

THAILAND PRODUCTIVITY INSTITUTE (FTPI)

Established: 1994 (replacing Thailand Management Development and Productivity Centre as the national productivity organization for Thailand in 1995)

12th - 15th Floor, Yakult Building,
1025 Phahonyothin Road, Samsennai, Phayathai,
Bangkok 10400, Thailand

Phone: (66-2) 619-5500, 619-8087

Fax: (66-2) 619-8099

E-mail: apo_liaison@ftpi.or.th

www.ftpi.or.th

SOCIALIST REPUBLIC OF VIETNAM

DIRECTORATE FOR STANDARDS AND QUALITY (NATIONAL PRODUCTIVITY ORGANIZATION)

Established: 1962

8, Hoang Quoc Viet Street,
Cau Giay District,
Hanoi,
Socialist Republic of Vietnam

Phone: (84-4) 7911633

Fax: (84-4) 7911595

E-mail: thien@netnam.org.vn
vpc@fpt.vn

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1-2-10, Hirakawa-cho, Chiyoda-ku,
Tokyo, 102-0093 Japan

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Fax: (81-3) 5226-3950

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www.apo-tokyo.org

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