



A Review Essay on Proactive Approaches towards Sustainable Manufacturing Engineering and Service Provision

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ABSTRACT

This review describes the concept of Sustainable Development with emphasis on company's approaches towards improving environmental performance and the effect of environmental legislation on the company's performance. A proactive approach towards improving environmental performance often leads to improvement in company's performance because resources are optimally utilised, and there is diversification in business activities through the creation of vital products from waste. Other benefits include excellent public image, reduction in the cost of landfill or landfill tax, avoidance of environmental fines, and availability of sufficient time to plan for the possible changes in the future. Environmental Management Systems and Life Cycle Analysis/Assessment of products are some of the fundamental measures required to take a proactive approach towards improving environmental performance and company's performance. With various evidence obtained from some multinational corporations, this review confirms that the benefits of a proactive approach towards improving environmental performance of any organisation outweighs its cost.

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Introduction

Environmental protection should be a major concern to everyone. Business managers should see their investment towards improving environmental performance as one of their corporate social responsibilities and stop treating environment as a free good that can be damaged without being questioned. Besides, environmental legislation should be viewed as one of the Standard Operating Procedures (SOP) for companies towards better performance if strictly obeyed.

Environmental performance is an ecological sustainability (Roome, 1998), and according to Holt and Ghobadian (2009), environmental sustainability is not an option but a necessity, and that for every company to flourish and optimize its performance, its activities must also take care of the natural environment and resources on which its economic activity and social fabric depends. The Chisso Corporation in Japan was initially dumping its waste containing mercury into the river rather than developing a technology that would ensure a total separation of mercury from its waste (MMP409 Video 1, 2009); the company failed to be proactive towards improving environmental performance in its activities and this led to the outbreak of the 'Minimata' disease. The management eventually paid dearly for their nonchalant attitude towards improving environmental performance.

Every company needs a suitable environment to operate profitably. It is therefore imperative to protect the environment as every company seeks to improve its business performance. This is because proactive approach towards environmentally conscious manufacturing directly and indirectly secures economic advantages and social benefits, both in the short and longterms. According to Rahimifard (2009), environmental

issues must be consistent with company's goals and objectives, and in fact, appropriate investment in environmental improvement will earn a positive return. Environmental legislation should not be seen as a threat to company's performance and growth; it is aimed to encourage more sustainable patterns of production and consumption by internalising the external cost of environmental degradation to the costs of products and services (Mayer and France, 1999). This review aims to achieve the following objectives:

- To describe the influence and the effects of environmental legislation on the company's performance;
- To compare a proactive approach and a reactive approach towards improving environmental performance;
- To describe the pros and cons of a proactive approach and a reactive approach towards improving environmental performance;
- To describe how to obtain the benefits of a proactive approach towards improving environmental performance;
- To describe the reasons behind the benefits associated with a proactive approach to improving environmental performance.

Environmental Legislation and Company's Performance The Environment

The environment provides the energy, the materials which every business manager transforms into goods and services, and also acts as a vast sink, but with limited carrying capacity, for the wastes and polluting substances generated by the business activities (Thornton and Beckwith, 1997).

Environmental Legislation and its Objectives

Environmental legislation first arose as a response to specific identified problems, and the emphasis was originally to control the pronounced air emissions with established limits for

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specific products. In addition to this, the legislation, at present, is being used to encourage sustainable pattern of production and consumption. Some of the environmental legislation include Alkali & Coal Works Regulations Act (1900's), Public Health Acts (1930's), Clean Air Acts (1950/60's), Health & Safety at Works Act (1970's), Control of Pollution Act (1970's), Water Act (1980's), Control of Substances Harmful to Health (COSHH) Regulations (1988), and Environmental Protection Act (1990's) (Pearson *et al.*, 1992; Rahimifard, 2009).

Some of the legislations cover discharges to air, water, and landfill, together with the use and carriage of hazardous substances and other wastes (Pearson *et al.*, 1992). According to Thornton and Beckwith (1997), the legislations were based on the following principles:

1. The principle of State sovereignty over the use of natural resources;
2. The principle of environmental responsibility for the use of natural resources;
3. The principle of good neighbourliness and co-operation;
4. The principle of preventive action;
5. The polluter pays principle;
6. The principle of common but differentiated responsibility;
7. The principle of sustainable development.

The objective of Environmental legislation is to prevent the introduction of substances, vibrations, noise, heat or energy liable to cause hazards to human health, harm to living resources and ecological systems, damage to structures or amenity, or interference with legitimate use of the environment either directly or indirectly (Holdgate, 1979). This implies that environmental legislation is towards the sustainable growth of every company and common good of every business manager. According to Rahimifard (2009) and Whalley (2009), implementing environmental legislation such as ISO 14001 will help to minimise energy consumption, minimise water consumption, reduce consumption of non-renewable materials, reduce solid and non-solid waste (hazardous waste inclusive), and also help to effectively manage waste associated with the business activities.

Effects of Environmental Legislation on the Company's Performance

According to Rogers *et al.* (2008), governments in most of the developed countries have already created legislative incentives for companies that pay attention to environmental performance. If this is in place, how then will environmental legislations be threats to company's growth and performance?

Impartial and comprehensive view of environmental legislation reveals that additional production cost is not incurred whenever a company operates in strict compliance with the demands of the laws. Costs are only incurred in form of fines if environmental laws are disobeyed. Environmental legislation is only forcing major changes in the industrial operations coupled with the corresponding environmental management activities towards ensuring efficient use of resources and significant reduction of waste and pollution. This consequently creates a balance system that meets the needs of the present without limiting the potential of the future generations to meet their own needs. The overall effect of the legislation on the environment is to arrest the declining quality of human environment in all aspects (Pearson *et al.*, 1992).

Proactive Approach to improving Environmental Performance

There are unlimited benefits associated with the proactive approach towards improving environmental performance. The company's operations and activities will be in compliance with

environmental laws even before the formation and enforcement of such laws. There is no need for a sudden change in methods of production and/or equipment. A sudden change in production methods and equipment will be capital intensive and this can lead to permanent closure of the company. Costs of operations with respect to energy and raw material requirements; waste disposal requirements; and cost of non-compliance are reduced. All the possible sources of waste are identified and systems are put in place to proactively minimise them. This consequently reduces waste and disposal costs. There is an increase in productivity through efficient use of raw materials. This implies that this approach is an effective and efficient means to create wealth. This system creates more wealth with less waste through optimal utilisation of resources.

Proactive approach towards improving the environmental performance helps the business managers to carefully evaluate all the requirements (energy, materials, environmental, disposal) and the corresponding liabilities to its product in terms of waste arising from the business activities, costs of disposal, from the conception stage throughout its entire lifecycle. It encourages the "cradle to grave" approach in the operations of the company. The company is fully aware of the nature of the product at the end of its useful life and measures are in place to avoid any adverse effect on the environment. This can be applied by simple labelling of parts via tooling technique with no additional cost incurred. This leads to better identification of parts for remanufacture, reuse, recycling, energy recovery and disposal.

A proactive approach leads to a better way of implementing business strategies and effective planning. There is an establishment of a strategic environmental management with a clear vision across the company (Rahimifard, 2009). It is possible to create an environmentally friendly product that meets the need of the masses at a balance price which is affordable by the end users and also suitable for continuous success and growth of the company through continuous improvement on the design. Such design is often with significant reduction in material, energy and water requirement. This will consequently lead to more profit which can be used to conveniently offset the cost, if any, attached to environmental legislation. Low insurance cost is often associated with the products and the processes. Risks arising from the environmental problems due to the health and safety of the employees and the end users of the products are minimised through the implementation of environmental standards.

Proactive approach creates an excellent public image and accountability. Positive marketing image as a clean or green organisation is becoming a prerequisite for sales and/or supply of most products. End users and other companies in the supply chain are now giving specific requirement with respect to the environment and power/energy demand for most products. Being proactive makes the company to be ahead of these demands. According to Rahimifard (2009), 'most companies are pushing environmental issues across the supply chain, expecting their suppliers to adopt environmental practices and be certified through standards such as British Standard-BS 7750, European Union Eco-Management and Audit System, and International Standardisation Organisation-ISO 14001'.

Proactive companies also enjoy external support. Financial institutions, insurance companies, investors, and government are now making clear commitments to environmental issues. According to Pearson *et al.* (1992), bankers have united to adopt environmental impact assessments (EIA) as part of credit provision procedures. Now that environmental liability has been established as one of the industrial risks, the insurance

companies are more cautious in providing supports for companies. This is because the insurance companies may eventually pay for the environmental damages done by their clients if they are found guilty of any environmental laws. Hence companies with proactive approach to improving environmental performance secure substantial benefits from financial institutions; insurance companies; and attract investors' support and government incentives.

Challenges of Proactive Approach towards improving Environmental Performance

In the short term, the approach may be costly for capital-intensive industries which require substantial investment in machines. However labour-intensive industries may not be significantly affected. Continuous training of personnel so as to enable them to cope with current technologies may also be capital intensive. Although being proactive allows the company to have sufficient time to plan and execute its actions, the company will still need to make some financial commitment. The approach may significantly change the nature and content of the product and this may adversely affect its subsequent sales. Also, if not well managed, the consumers may significantly react to the changes if the reasons for the change are unknown to them. Proactive approach requires constant monitoring and a feedback system such as environmental audit, and this may add to the cost of production in the short term. However in the long run, the benefits will offset the cost.

Reactive Approach to improving Environmental Performance

Unlike proactive approach that focuses on waste prevention at the outset, reactive approach focuses on waste management. Reactive approach will therefore require more resources to produce a unit product than proactive approach. Waste is a lost resource which has an intrinsic material value (Pearson *et al.*, 1992), and to throw such away, or have it destroyed without a beneficial transformation into other useful product(s) or other input resources is an irreversible loss of resources. This will adversely affect profit accruable from resources. In the short run, this effect may be latent; but it becomes more pronounced and evident in the future.

Reactive approach is basically an application of end-of-pipe solutions, and according to Mulder (2006), the advantages of end-of-pipe solutions include: no change to the productive process and thus prevent risks associated with change in production process with respect to product quality and continuity of production; and capital and operating costs are foreseeable and controllable.

Disadvantages of a Reactive Approach to improving Environmental Performance

Reactive approach is all about generating and managing waste and characterised by inefficient methods of production and waste of resources. Thus, introduction of new environmental laws may force a sudden change of processing methods. This may lead to a total change of industrial equipment and set-up. When the company is unable to financially effect the required change, permanent closure is imminent. Industrial accidents are often common and fatal to this approach because there is no contingency plan for such occurrences let alone putting measures in place to reduce the fatality. Depending on the degree of fatality, accidents in the industry can lead to a permanent closure of that industry.

Reactive approach is typically characterised by "end-of-pipe" solutions which are inevitably capital intensive. Treatment of a high level of waste streams can be challenging and difficult to manage (Mulder, 2006). The approach often views

environment and its resources as free gifts of nature and are treated as such where possible. Hence the overall production costs are often underestimated. The company that adopts such approach in actual sense incurs 'latent costs' which accumulate over time. This 'latent costs' of production may be environmental fines the company will pay in the future or damages to the affected people such as in Minimata disease outbreak in Japan (MMP409 Video 1, 2009). The company may be held responsible for the disposal of the products at the end of their useful life. When eco-design features are not considered at the outset, the company pays dearly for the disposal or perhaps finds it difficult and/or capital intensive in an attempt to choose any of the recovery options.

Real Life Examples / Case Studies

The following companies reveal the benefits of a proactive approach towards improving environmental performance.

British Sugar Plc (www.britishsugar.co.uk)

To a layman, British Sugar Plc produces only sugar; but the name 'notjustsugar' in one of the company websites (www.notjustsugar.com) reveals the sustainable manufacturing strategy of the company. The company diversifies its activities to protect the environment by converting its waste into other useful products and the much needed energy. The company aims to transform all the raw materials into sustainable products and use a highly integrated approach to manufacturing which is designed to maximise efficiency and avoid unnecessary waste. The proactive approach of British Sugar Plc is revealed in the following activities:

- Production of 450,000 tonnes of animal feed from waste.
- Production of stones and sand that come as by-product during harvesting and preprocessing of massive tonnes of sugar beets for building and landscaping respectively.
- The company uses Combined Heat and Power to export enough electricity for 350,000 people and use the combustion gases to grow 80 million tomatoes.
- The company invested in the UK's first bio-ethanol plant, producing 70 million litres of renewable fuel.
- In addition the company has reduced the energy required per tonne of sugar in the UK by 40% as at 1980.

The Procter & Gamble Company (<http://www.pg.com/sustainability>)

In the recently released P&G 2009 Sustainability Report, P&G operations have reduced (per unit of production) water consumption by 52 percent, energy usage by 48 percent, CO₂ emissions by 52 percent and waste disposal by 53 percent since 2002. One example cited in the report was P&G's Household Care plant in Brockville, Canada, where teams reduced total site energy use by 20 percent. Since 2007, P&G has achieved \$13.1 billion in cumulative sales of products with low environmental impact. This includes Ariel Excel Gel, a highly concentrated detergent requiring 20 to 50 percent less energy during use. During manufacturing, the process cut down water and energy requirement by 40 to 50% and 30 to 40% respectively.

Ford Motor Company (Ford and the Environment, 2009)

Ford has begun to introduce a range of eco-friendly vehicles globally. The technologies provide customers with more fuel-efficient vehicles emitting fewer greenhouse gases, yet critical factors such as compromising safety and performance are not compromised. Advancements from Ford include EcoBoost turbocharging and direct injection technology, multi-speed transmissions, advanced electric power steering, weight reductions, aerodynamic improvements, hybrid vehicles, diesel engines, biofuel-capable vehicles, plug-in hybrids and hydrogen fuel cell-powered vehicles. Some of the proactive measures

already put in place towards improving environmental performance include the following:

- The smaller-displacement turbocharged gas engines aimed to provide fuel savings of between 10 and 20 percent.
- Fifty percent of Ford vehicles will be capable of running on alternative fuels by 2012.
- Ford expects to achieve a 30 percent reduction in CO₂ emissions from Ford vehicles in the U.S. and Europe by 2020.
- Over the next decade, Ford is planning vehicle weight reductions ranging from 250 to 750 pounds without comprising safety by exploiting material properties.
- The company has developed seat cushion and headrest foam for the Ford Enviro Seat from soybeans.
- The company is also researching on how to incorporate natural fibres to reinforce plastic parts.

The proactive approach of Ford Motor Company towards better environment has brought the company into limelight with several awards in recognition of the company's commitment, and substantial increase in sales of its products.

Pfizer Group UK Ltd (BCE, 2009)

Pfizer won the Management Premier Award 2009 of the Environmental Leadership award on 1 July 2009 (BCE, 2009). The company is a leading global, research-based, pharmaceutical company. The company introduced 'green chemistry' to eliminate the use of hazardous materials and improve resource efficiency in the development and manufacturing processes. The Pfizer Green Chemistry Programme established a management system for the integration of the principles of green chemistry into key stages of the processes of discovery, development and manufacture of new pharmaceuticals (BCE, 2009). This prestigious award will, in no small measure, boost the company's morale and increase in performance and demand for its products.

Sainsbury's Supermarkets (BCE, 2009)

The company won the Product Premier Award 2009 of the Environmental Leadership awards on 1 July 2009 (BCE, 2009) for its respect for the environment. In June 2007, Sainsbury's took a giant step to become the first European retailer to install the NCR 2ST receipt printer (Figure 2.1). The machine prints on both sides of the receipt. This consequently reduces the millions of rolls of receipt paper used in its stores each year. Cutting receipt paper usage was cut down by about 40% in 2008. The devices use 35 to 50% less energy than the previous printers. The transportation cost for rolls of receipt has drastically reduced. Print times are faster and customers are quickly attended to at the checkouts as the receipts are printed on both sides of the paper simultaneously. This will invariably reduce the numbers of staff needed to attend to a given number of customers and therefore lead to an improvement in the company's performance.



Figure 2.1: The NCR 2ST Receipt showing the Front and Back Views

(Source: BCE, 2009)

Toyota Motor Manufacturing (UK) Ltd (BCE, 2009)

Toyota Motor Manufacturing (UK) Ltd also won the Process Premier Award 2009 of the Environmental Leadership awards on 1 July 2009 (BCE, 2009). Toyota Motor Manufacturing, UK continues to set challenging targets with key indicators to measure its environmental performance. The company focuses on reducing energy and water use, solvent emissions and waste requiring disposal.

Initially, the painting process used to consume 54% of the energy used in the whole manufacturing process and the majority of this (52%) is used to maintain the temperature and humidity in the spraying booths. Towards improving environmental performance, the engineers investigated how a superior quality paint finish could be maintained with lower energy input in the paint booths. At present, the company has been able to reduce the amount of steam used during painting by 40%, with a resulting decrease in CO₂ emissions. These proactive approaches towards reducing the environmental impact of the company's operations will consequently reduce costs coupled with other diverse benefits for the company.

Lloyds TSB

Lloyds TSB's has been using multifunctional devices to boost its efficiency and help the environment (Williams, 2007). The Financial Markets building at 10 Gresham Street in London is without a single fax machine. The bank is using multifunctional devices (MFDs) to serve as printers, copiers and fax machines. This strategy has helped the bank to reduce energy, paper and toner costs. At present, customers are being encouraged to check their statement of account online rather than coming to the bank for hard copies. All these strategies are not only good for the environment, but also to increase the company's performance and profits.

Conclusions

Improving environmental performance requires an efficient and effective use of Environmental Management Systems (EMS) and Life Cycle Analysis/Assessment of products. Every company should have a measure of control on each of the product stages (Madu, 1996). This section summarises the benefits obtained by the aforementioned companies that embrace a proactive approach towards improving their environmental performance. Each subsection identifies a benefit, reason(s) for the benefit, and how it was achieved.

Rapid Growth and Diversification of Operations

The companies tend to grow rapidly while developing technology that will carefully handle their waste. The activities and operations of the companies become broader by formulating valuable products from their waste. Business managers that are proactive towards an acceptable level of environmental performance are seeing opportunity for diversification of business activities in waste management.

Substantial Increase in Sales

The adverse effects of the industrial activities on the environment are becoming more pronounced than before. Hence, most end users are now demanding for products that offer financial savings and are also environmentally friendly. Hence eco-products are now attracting more customers than non-eco-friendly counterpart. In the past, a proactive approach to quality management and quality standards (ISO 9000) was known to increase patronage for the companies. Improving environmental performance is doing same, even more, at present.

Optimal Utilisation of Resources

These companies tend to develop ability to produce more with few resources by incorporating up-to-date technologies in

their operations. While improving environmental performance, there is a continuous improvement on products, and energy is efficiently utilised. For instance, light weight design increases the product delivery rate to the end users, thus reducing the energy needed for transporting the finished goods to the end users.

Economies of Scale

Economies of scale are evident due to rapid growth and expansion. As the companies improve their environmental performance average cost per unit product tends to fall because resources are optimally utilised thereby producing more with less. Design for environment is typically towards reducing raw materials and energy needed per unit output. Companies that are proactive towards improving environmental performance are known for producing more output with less input. Some of the companies are achieving about 50% reduction, especially in the areas of energy and water usage.

Unsolicited Free Marketing and Advertisement for the Company and its Products

For being environmental friendly in their operations, companies are winning several local, national and international awards. In the process, members of the public get to know more about the companies, their products and/or services. Besides, these awards are presenting the companies, their products and/or services in an acceptable and desirable manner to the members of the public, thus creating an excellent public image for the companies. This consequently boosts their sales.

Reduction in the Cost of Landfill or Landfill Tax

Products are easily reused, remanufactured and/or recyclable. While proactively responding to environmental legislations, companies are now designing products that are easy to assemble and disassemble, even with reduced number of components. In most cases, components are biodegradable. Business managers are now encouraging new applications for used equipment and components through investment in the research and development section of the company to effectively achieve this benefit. Hence being proactive reduces the cost of landfill.

High Returns on Investment

Some companies are taking a proactive approach towards improving environmental performance by extending product life while some are selling services rather than products and they have high return for this action. Extending product life can eventually attract more customers and thus brings more income for the company. Maintenance operations are done with ease and consequently product life is extended. Companies such as General Electric and Pratt & Whitney, Rolls-Royce (Power by the Hour) are rapidly implementing the concept of servitization. Most end users particularly in the developed nations are now interested in the services obtainable from the product and they are willing to pay more to obtain better service rather than paying to dispose a product after using it for a short period of time.

Legal means to avoid Environmental Fines

Another important benefit of a proactive approach towards improving environmental performance is that company is immunised against payment of environmental fines. The company is always ahead of the environmental laws; its

operations are in strict compliance with the environmental laws even before such laws are enforced.

Sufficient Time to plan for the Future

Being proactive towards improving environmental performance makes the company to have sufficient time to plan for possible changes in the future. The company has sufficient time required to train personnel to handle any new system or approach to be introduced. The activities of such company are not disrupted by sudden changes in legal requirements.

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