Porter’s value chain model for assessing the impact of the internet for environmental gains

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Abstract: The revolutionary potential of the internet promises to transform economic and environmental gains. By reducing the amount of energy and materials consumed by business, the internet stands to revolutionise the relation between economic growth and the environment. The internet is improving the capability to understand the science of environmental degradation and communicate that knowledge to public and private decision makers. It also helps decrease resource waste and associated pollution by improving the efficiency of economic activity and provides improved sensors and instantaneous telecommunications links to control pollution spillovers, better manage shared resources and reduce waste. This paper examines the impact and potential of internet-based technologies in the performance of important information and communication functions for resolving the environmental issues using Porter’s value chain model. Managerial implications of using the internet for environmental gains for SMEs are also discussed.

Keywords: internet; digital technologies; environment; Porter’s value chain model.


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1 Introduction

Studying natural environment is always a complex exercise because natural environment is produced by combined interactions among geological, hydrological, biological and human social systems and is therefore one of the most complex systems. The complexity of issues involved in understanding the impact of the industrialised world on the environment requires an interdisciplinary approach. For example; ecosystem and natural resource management involves integrating scientific knowledge of ecological relationships within a broader policy and economic framework. Transportation issues often carry important implications for the environment (Anderson and Bateman, 2000). In this study, we are examining the impact and potential of internet-based technologies in the performance of important information and communication functions for resolving the environmental issues using Porter’s value chain model. Internet-based technologies offer the potential to improve pollution prevention and environmental monitoring; for instance, the capabilities and limitations of satellite and other remote sensing systems to scan ecosystems and enhance the effectiveness of monitoring large tracts of land (Benedick, 1991). Internet and related information technologies help to capture process and transmit information with far more ease and efficiency than in the past; they can play a role at each point of this process, improving both the quantity and quality of scientific understanding about pressing environmental problems (Dodson, 1995; Starik and Marcus, 2000). The internet, has also proved valuable in allowing multiple researchers to access and process data simultaneously thus multiplying the analysis capability. The Human Genome Project demonstrated this capacity through immediate online publication, making the code results available to all scientists over the internet (Bentley, 1996). Thus, the internet provides numerous avenues for collecting, distributing and analysing environmental information, making it available to greater numbers of researchers, reducing redundancy and increasing our capacity to understand the complex global ecosystem. The graphical capabilities of the internet help policymakers and others to ‘see’ and understand the sources of environmental degradation. Images, such as the ‘ozone hole’ or the impacts on agriculture of a doubling of global temperature, are becoming increasingly available on the web. Furthermore, an OECD study indicates that generalised use of internet retailing could eliminate the need for 12.5% of retail-building space, saving the energy and materials needed to build, operate and maintain buildings (OECD, 1999) and product delivery from e-tailers, contrary to common opinion, may use 40% to 90% less fuel than if customers drive their cars to the mall (Romm, 1999). UPS expects to improve on these numbers by using the internet to fill what would otherwise be empty trucks as they make the return trip from a delivery. Added benefits from these efforts are reduced traffic congestion, air pollution and fuel use. Even larger gains can be had with products that can be digitised and delivered entirely online, like software, music,
entertainment, and some consulting services (Wired, 1999). Along this line Egghead Software has closed all physical stores and moved to a completely online business model (Libert and Ribaudo, 1996).

The internet helps in product life cycle through improved supply chain management. By using the internet to integrate customers, manufacturers and suppliers, wasteful over production and spoilage can be largely eliminated (Siekman, 1999). An Ernst and Young study estimates that internet applications could reduce inventories by 25% to 35%, while IBM estimates the savings could be as high as 50% (Romm, 1999). All of these study indicate that the internet could prove an important innovation for reducing environmental degradation. The internet has also helped reduce environmental impacts in agriculture, water pollution etc. The internet has served as an important innovation in facilitating what is called ‘precision farming methods’ that dramatically lower the amount of inputs needed for any given crop (Chong et al., 2005).

There are not many articles in current literature dealing specifically with the internet and natural environment. However, there are a lot of articles dealing with different aspects of environment from awareness to benefits, to strategy implementation and so on, which can be impacted by the internet. One of the questions of the past decade is how individual environmental concerns shape corporate environmental actions (Avila, 1993; Starik, 1995; Bansal and Roth, 2000). Bansal and Roth (2000) mentioned that personal concern and values could affect a firm’s environmental efforts in important ways. First, values and concern can help decision makers discriminate, identify, and prioritise (Dutton, 1997). Second, environmental concerns will induce some individuals to champion eco-initiatives (Anderson and Bateman, 2000; Lawrence and Morell, 1995). Third, a firm’s top management will be more proactive in their environmental effort if their value systems reflect environmental concerns (Dutton and Ashford, 1993). Environmental decision-making is also dependent on concerns of external stakeholders such as customers and suppliers (Johnson, 1998). It is logical that the internet can be used effectively to convey relevant information to different stakeholder group which in turn will make them more understanding of the need for sustainability.

Positive economic impacts of environmental strategies are discussed by Porter and Van der Linde (1995) and Cordano (1993). Porter and Van der Linde suggested that by reengineering the production process, firms could reduce environmental impacts and simultaneously reduce the cost of inputs and waste disposal. Cordano (1993) proposed that revenues could be increased through green marketing, sale of waste products and outsourcing a firm’s environmental expertise. Additionally, there are suggestions in the literature that eco-initiatives will improve corporate image (Hart, 1995; Russo and Fouts, 1997). Here we can also use the internet to make business processes reengineering, marketing and other functions more environmentally friendly. Despite the potentially important role that the internet is playing in improving environmental activities at a macro level, little research has been performed to date that examines the factors that affect environmental supply chain management at a micro level. This paper examines the impact and potential of internet-based technologies in the performance of important information and communication functions for resolving the environmental issues using Porter’s value chain model. The intent of this paper is to examine the internet as a communication and information dissemination tool for resolving environmental issues at a macro and a micro level, and identify the eco issues and eco criteria using Porter’s value chain model.
2 Impact and uses of internet-based technologies at macro level

Internet-based technologies are providing fast, easy and cost-effective means through which to access, use, create and disseminate information. E-mail, which knows no geographic boundaries, provides a cost-effective method of communication with other similar organisations and individuals. E-mail also provides a means of direct access to government representatives. Listservs, which are focus group discussions disseminated via e-mail, provide opportunities for individuals to join in conversations about timely, focused topics. Organisational webpages provide mechanisms through which environmental organisations can affordably disseminate information about themselves to a large, geographically dispersed audience. Additionally, there is much useful information and data on the web to further grassroots environmental activists’ causes, which have never before been freely and easily accessible. The ability to transport computer files over the internet allows for rapid distribution of timely information. The internet also provides access to free downloadable software.

The internet is a unique medium because of its speed, low cost, easy capacity for forwarding messages and unlimited capacity (Frantzich, 1999). The various interest groups can easily converse with each other and present their collective voice to national and international organisations to further their environmental causes. Neighbourhood organisations can use internet-based technologies to communicate effectively within their own communities and across neighbourhoods to build and expand their intracommunity and intercommunity power base (Craig, 1998). Internet technologies facilitate a shift from representative democracy to a more direct democracy, as the technology provides the ability for wide range participation by people outside existing power structures (Grossman, 1995). To understand the significance of the impact of internet-based technologies on the information functions of grassroots environmental justice initiatives, two guiding concepts are suggested, borrowed respectively from the fields of sociology and political science. First, the internet breaks the insider/outsider dichotomy as related to the flow of information. Traditionally, insiders such as government officials have had privileged access to certain kinds of information and do not seek information and advice from citizen for various decision-making related to environmental concerns (Chatman, 1996). The internet appears to be breaking down this traditional insider/outsider dichotomy and political empowerment, and makes it possible for citizens to participate in environment-related policy making. The internet is changing the flow of political information and thereby changing the pattern of political participation (Hill and Hughes, 1998). Secondly, the internet allows direct communication, bypassing many information intermediaries and also substantially reduces the cost of communicating through space and time, allowing for greater organisation around shared interests, and allowing for a more heterogeneous base of participants in political processes (Pierce et al., 1992). Using the internet, the media, opposition politicians, environmental entities, individual citizens, community groups and other nongovernmental organisations, can easily obtain vast quantities of data on environmental results. Substandard performance by governments or companies is easier to spot. Transparency may also smoke out cases where special interests distort the policy process. Power, in the form of the ability to create and disseminate information, has been given to relatively powerless segments of society through the use of internet-based technologies (Zelweitro, 1998).
Using the internet to connect satellite imaging and global positioning systems to digital controllers on farm tractors and harvesters allows the precise applications of fertilisers and pesticides to local conditions in the fields. The result is higher yields, quality and profits and at the same time much lower environmental impacts. Similarly, the forestry giant Weyerhaeuser is using digital maps and satellite imagery to classify forest type, age and health (Horrigan et al., 1998). This information is delivered to field crews over the internet through handheld devices and laptop computers. The technologies allow forest managers to extract maximum value from precious natural resources while reducing the environmental damage. The various impacts of the internet to resolve environmental issues at the macro level are shown in Figure 1.

Figure 1 indicates how internet-based technologies have been helping to improve environmentalism through various means at a macro level.

### 3 The Porter’s value chain model

Internet-driven, web-based technologies have a tremendous impact on procurement, manufacturing, and distribution to significantly compress time and reduce costs throughout the supply chain (Benjamin and Wigand, 1995). To better understand the impact, we have mapped the environmental issues on Porter’s value chain model. In the later section, we have mapped the impact of the internet on these environmental issues (Porter and Miller, 1985). Our identification of environmental issues using Porter’s value chain model are detailed in Table 1.
Table 1  Identification of environmental issues using Porter’s value chain model

<table>
<thead>
<tr>
<th>Primary activities</th>
<th>Environmental issues</th>
<th>Eco-performance criteria</th>
<th>A-criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-bound logistics</td>
<td>Returnable containers</td>
<td>Percentage of returnable containers</td>
<td>Percentage of returnable containers</td>
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<td></td>
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<td>Cost of returning the containers</td>
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<td>Amount of pollution due to non-returnable containers</td>
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<td></td>
<td>Efficient transport route</td>
<td>Load-distance</td>
<td>Amount of fuel consumption</td>
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<td></td>
<td>Less pollutable transport mode</td>
<td>Amount of pollution generated in transport mode</td>
<td>Amount of fuel consumption</td>
</tr>
<tr>
<td></td>
<td>Warehousing and storage space requirements</td>
<td>Amount of fuel consumption</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplier relation</td>
<td>Number of suppliers who has environmental programme</td>
<td>Number of suppliers who has environmental programmes</td>
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<tr>
<td></td>
<td></td>
<td>Number of supplier ISO 14000 certified</td>
<td>Number of suppliers on JIT</td>
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<td>Number of suppliers on JIT</td>
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<tr>
<td>Operations</td>
<td>Product</td>
<td>Service life</td>
<td>Service life</td>
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<td></td>
<td></td>
<td>Percentage of output recycled</td>
<td>Percentage of output recycled</td>
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<td></td>
<td>Percentage of output reused</td>
<td>Time to degrade</td>
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<td></td>
<td></td>
<td>Amount of waste generated per hour of use</td>
<td>Amount of raw material needed</td>
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<td></td>
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<td>Decibel of noise</td>
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<td>Amount of toxicity</td>
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<td>Time to degrade</td>
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<td></td>
<td></td>
<td>Amount of raw material needed</td>
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<tr>
<td>Process</td>
<td></td>
<td>Amount of energy needed per unit of output</td>
<td>Amount of pollution generated per unit of output</td>
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<td></td>
<td></td>
<td>Amount of pollution generated per unit of output</td>
<td>Amount of energy needed per unit of output</td>
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<td></td>
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<td>Percentage of production related waste recycled</td>
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<td></td>
<td></td>
<td>Percentage reduction in production related waste</td>
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<tr>
<td>Material</td>
<td></td>
<td>Amount of hazardous material</td>
<td>Percentage substitution of hazardous material</td>
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<td>Percentage of substitution for hazardous material</td>
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<tr>
<td>Outbound logistics</td>
<td>Storage and warehousing</td>
<td>Warehousing cost per unit of output shipped</td>
<td>Warehousing cost per unit of output shipped</td>
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<tr>
<td></td>
<td>Packaging</td>
<td>Pound of material used in packaging</td>
<td>Pound of material used in packaging</td>
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<td>Percentage of degradable material in packaging</td>
<td>Percentage of packaging recyclable</td>
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<td>Percentage of packaging recyclable</td>
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<td></td>
<td>Shipping</td>
<td>Load-distance</td>
<td>Fuel consumption per mile per item</td>
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<td>Fuel consumption per mile per item</td>
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</tbody>
</table>
Table 1  Identification of environmental issues using Porter’s value chain model (continued)

<table>
<thead>
<tr>
<th>Primary activities</th>
<th>Environmental issues</th>
<th>Eco-performance criteria</th>
<th>A-criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing and sales</td>
<td>Communication of environmentally friendly product offerings</td>
<td>Percentage of total advertising expenditure for environmentally friendly products</td>
<td>Percentage of total advertising expenditure for environmentally friendly products</td>
</tr>
<tr>
<td></td>
<td>Value added service in the environmental area</td>
<td>Total dollar amount of environmental value added service provided</td>
<td>Total dollar amount of environmental value added service provided</td>
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<tr>
<td></td>
<td></td>
<td>Number of customers provided with environmental value added services</td>
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<tr>
<td></td>
<td></td>
<td>Number of environmental value added offerings</td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>Environmental awareness and audit</td>
<td>Number of customers on environmental audit programmes</td>
<td>Percentage of customers on recycling programme</td>
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<td></td>
<td></td>
<td>Percentage of customers on recycling programme</td>
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<tr>
<td></td>
<td>Product take back</td>
<td>Percentage of product take-back</td>
<td>Percentage of product take-back</td>
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<td></td>
<td></td>
<td>Percentage of customers on take-back programme</td>
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<td></td>
<td></td>
<td>Cost per unit of product take-back</td>
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</table>

<table>
<thead>
<tr>
<th>Support activities</th>
<th>Environmental purchasing</th>
<th>Number of suppliers who has environmental programme</th>
<th>Number of suppliers who has environmental programme</th>
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<tr>
<td></td>
<td>Number of supplier ISO 14000 certified</td>
<td>Number of suppliers on JIT</td>
<td>Number of suppliers on JIT</td>
</tr>
<tr>
<td>Human resource development</td>
<td>Environmental training and awareness</td>
<td>Percentage of employees trained in environmental programme</td>
<td>Percentage of employees participating in environmental programmes</td>
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<tr>
<td></td>
<td></td>
<td>Percentage of employees participating in environmental programmes</td>
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<tr>
<td>Environmental audit</td>
<td></td>
<td>Number of employees trained in environmental audit</td>
<td>Number of employees participating in environmental audit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of employees participating in environmental audit</td>
<td></td>
</tr>
<tr>
<td>Technological development</td>
<td>Waste reduction technology</td>
<td>Number of units or plants using waste reduction technology</td>
<td>Percentage change in waste reduction in last five years</td>
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<tr>
<td></td>
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<td>Percentage change in waste reduction in last five years</td>
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<td></td>
<td>Recycling technology</td>
<td>Number of plants or units using recycling</td>
<td>Percentage of output recycled</td>
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<tr>
<td></td>
<td></td>
<td>Percentage of output recycled</td>
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<tr>
<td></td>
<td>Energy reduction technology</td>
<td>Percentage of units or plants using energy reduction technology</td>
<td>Percentage of total energy reduction in last five years</td>
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<tr>
<td></td>
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<td>Percentage of total energy reduction technology</td>
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</table>
Eco-criteria are environmental performance criteria that can be used to track the impact of environmental strategies or decisions in the value chain. For example, for inbound-logistics, one of the ways to achieve environmental efficiency is to use returnable containers. Several criteria such as the percentage of returnable containers, cost of returnable containers, amount of pollution reduction by returnable containers etc., can be used as eco-criteria.

Among several eco-criteria, which can be used to track impact of a strategy or decisions, some could be more important than others. For efficiency and simplicity one can use one or some but not all of the eco-criteria. These are called A-criteria. For the environmental strategy of using returnable containers, the A-criteria can be a percentage of returnable containers.

4 Impact of internet technologies at micro level

4.1 Inbound logistic: efficient transport and logistic management

Internet-based technologies will enormously help the environment industry improve its value chain by conveying real-time information to ensure a product’s timely arrival. Information include raw materials to manufacturers, goods to distributors, products to retailers and purchases to customers. Retailers, customers, suppliers and manufacturers can now have immediate access to their supply chain information to track valuable shipping information (Rayport and Sviokla, 1996).

Real-time information available to manufacturers and retailers will help them to manage their transportation and logistics resources more effectively. This would not only help for efficient transport routes and less pollutable transport mode but help to manage warehousing and storage space requirement with better efficiencies. Efficient package delivery by truck may replace at least in part inefficient personal driving to malls, supermarkets, bookstores and the like. The transportation sector is responsible for about one-third of US energy consumption today. The internet holds the prospect of reducing transportation energy intensity by replacing some commuting with telecommuting; replacing some shopping with teleshopping; replacing some air travel with teleconferencing; enabling digital transmission or e-materialisation of a variety of
goods that are today shipped by truck, train and plane, including formerly printed material, software, construction materials, and the like; improving the efficiency of the supply chain and increasing the capacity utilisation of the entire transportation system.

As traditional manufacturing and commercial companies put their supply chain on the internet, and reduce inventories, overproduction, unnecessary capital purchases, paper transactions, mistaken orders, and the like, they achieve greater output with less energy consumption. These things will have a larger environmental benefit than pollution prevention, especially in the energy-intensive manufacturing sector.

The internet allows vastly superior supply chain management, which can dramatically reduce inventories, improve forecasting, and eliminate mistakes and wasted production. This would improve capacity utilisation, and holds the potential for increased material reuse. Avoiding overproduction, waste, and mistakes, and fostering material reuse, can have disproportionately large energy and environmental impacts.

Web-based technologies enable buyer and supplier to operate more efficiently, as a result of visibility of orders throughout the entire distribution network. Transactional outsourcing for transportation, warehousing, packaging, and related activities is being replaced by network outsourcing, where these individual functions are managed integrally by a third-party provider. Also, the Logistics Management module helps companies transport goods more efficiently because suppliers and customers configure optimal truckload and delivery schedules. This reduces wasted truck (or other carrier) space, wasted time, and fuel mileage due to inefficient routing.

4.1.1 Warehousing and storage space requirements

The internet-based technologies will enormously help the companies improve its value chain by conveying real-time information to customers, suppliers and manufacturers. This would help companies to accurately predict consumer demands and that will result into a reduction of excess inventories at the retail level by replenishing them on a just-in-time basis. This could decrease the space needed to store excess inventories, thereby minimising the environmental impacts of warehousing: the consumption of open spaces by warehouses; the materials used to build them; and the energy needed for heating, cooling and lighting (Stein and Sweat, 1998; Basile, 1998).

The internet makes mass customisation possible because it facilitates information exchange between companies and individual customers. The internet and innovative production technologies are helping companies to manufacture products specifically designed for individual consumers. Customisation enables producers to manufacture the products that are needed by customers thus reducing product waste or slashing inventories by reducing stockpiles of soon-to-be obsolescent equipment and machines (Mathieson, 1998). For example; e-book or publishing on demand may eliminate the waste thus saving on paper and reducing printing and storage costs (Basile, 1998). Mass customisation could have profound environmental benefits for reducing the energy and construction waste associated with the warehousing of products.
4.1.2 Relationships

Internet technology has enabled a firm to begin to extend the concept of its value chain to include all of the firm’s suppliers and business partners into a single web. This enables companies to work directly with companies around the world. One-to-one buyer-supplier relationships are quickly being replaced by interenterprise collaboration enabled by horizontal and vertical marketplaces. Defined products and services are giving way to dynamic, customer-configurable offerings, where products and services related to those products are bundled to meet the unique requirements of individual customers. In addition to efficiently balancing demand (orders) with supply (availability and capacity), effective demand and supply planning significantly impacts the bottom line. Optimisation of the planning process can drive revenue growth, reduce inventory investment, and lower operating costs.

4.2 Operations

Through mass customisation, manufacturers can formulate products specifically for individual customers: detergents that fit the cleaning needs of particular workplaces; pesticides that fit the insect population of specific localities; lawn-care products that fit the nutritional needs of unique landscapes; and cosmetics and personal hygiene products formulated to avoid a particular allergen or exposure to a particular chemical or chemicals (Schafer, 1997).

Efficient product, processes and technology: e-materialisation

Many of the materials such as newspapers, books, dictionaries and encyclopedias, periodicals, stereos, video recorders, cameras, telephones, and answering machines, are products designed to manipulate, store and transmit information. Similarly, many of our institutions, from the post office to the local bank, consume energy and materials by occupying structures that exist mainly to process information. As a technology for manipulating, storing and transmitting information, the internet can perform many of the same functions as these material objects, and in some cases much more quickly and conveniently. This substitution of bits and bytes for physical goods has been called ‘dematerialisation’. Dematerialisation through the internet helps not only to assimilate and communicate information, and conduct financial transactions online, but also has the potential to dramatically reduce the raw materials used in the production of goods, the energy consumed in manufacturing, and the solid waste generated by businesses and consumers. For example, the manufacture of film, processing chemicals, and photographic paper is a significant source of emissions of toxic chemicals such as methylene chloride, methanol, acetone, toluene, chromium, selenium, and methyl ethyl ketone (US-EPA, 1994). Digital photography avoids the major environmental impacts of film manufacturing and photo processing. Few companies offer customers to receive and store pictures electronically, thus, enables broad distribution without any material required. Financial transactions performed via the web require far fewer material resources and none of the energy involved in moving information stored on paper to and from the home or office. It is estimated that electronic billing saves approximately 50 to 75 cents per bill in envelopes and postage, and another $1 in handling costs.
The internet is helping companies and organisations to reduce energy costs and Greenhouse Gas (GHG) emissions by providing them with tools and strategies that can improve the environment, while increasing profits and productivity. E-materialisation of paper alone holds the prospect of cutting energy consumption by about 0.25% of total industrial energy use. By 2010, e-materialisation of paper, construction, and other activities could reduce US industrial energy and GHG emissions by more than 1.5% (Romm et al., 2003; Romm, 1999).

4.3 Outbound logistics

Manufacturers invest large amounts of money in the design of packaging. The environmental costs of packaging are enormous. The packaging results into solid waste. Using internet for selling, and marketing products makes attractive pollution-causing packaging a less attractive proposition for manufacturers (Walker, 1999). Moreover, since the backbone of online shopping is shipping efficiency, e-commerce creates incentives to reduce the size and weight of product packaging. As a result, companies may find it advantageous to reduce the quantity of the materials used to package their products. Many gifts can be converted into digital gifts such as Christmas cards etc. This can avoid a considerable amount of transportation energy consumption and air pollution.

Packaging is the single largest category of municipal solid waste. With the advent of internet-driven e-commerce, however, third-party shippers have an incentive to devise cost-effective take-back systems, meanwhile expanding their market and increasing the efficiency of their vehicles. Moreover, to reduce the costs of home delivery and make internet purchases competitive with store-bought products, companies may shift to reusable shipping containers to reduce the cost of corrugated boxes.

4.4 Marketing and sales: communication of environmentally friendly product offerings

Internet resources in the form of websites provide a wealth of information and assistance for environmental activists, customers and manufacturers. The internet helps companies to offer products and services online, therefore, shopping and selling may no longer require a shop or buildings for retail facilities (Rasmusson, 1999). Companies can use websites to communicate with customers, suppliers, partners and with their employees. This would reduce the physical space requirements for office buildings, which consume more than 30% of our total energy and 60% of our electricity (Wilson et al., 1998; Schwartz, 1996; Borsuk, 1999). If companies put their stores on the internet using software, rather than constructing new retail buildings, that would save energy (Cort, 1999). Internet-driven e-commerce has the potential to create a global yard sale, matching people’s requirements worldwide (Turner, 1999). The internet and numerous websites help companies find buyers for materials they no longer need, reducing waste disposal costs and generating revenue at the same time. Internet technologies are integrated with the current generation of CRM applications to gain better understanding of their customers (Quelch and Klein, 1996). Many enterprises have already integrated interactive customers’ support into their CRM strategy (Hoffman and Novak, 1996a–b).
4.5 Service and support

The internet makes it easier for companies to continue providing customers with information after they make a purchase. When customers buy electronically, manufacturers automatically capture information such as home and e-mail addresses and use this data to provide product updates and information on new products. In addition to its marketing function, this capability can be an effective tool in providing support and other information on safe product use, product recalls, proper maintenance for optimal performance and energy efficiency, and options for recycling, refurbishing, and disposal.

4.6 Technology development

The internet appears to be promoting greater use of home offices, allowing telecommuters to spend less time at the office and also spawning many purely home-based businesses. This shift will increase energy consumption in homes, but will likely save far greater energy in avoided office building construction and utility bills, as well as reduced commuting energy.

4.7 Procurement

By automating and standardizing procurement processes across the enterprise and transacting electronically with suppliers, companies have a tremendous opportunity to reduce costs and improve production cycle times. Traditionally procurement processes are highly manual, paper-based, and fragmented; this creates the opportunity for process waste, inaccurate order entry, and increased cost through maverick buying. Internet-based technologies are rapidly being adopted that enable companies to not only reduce the costs for materials and services they purchase, but also reduce the operating costs associated with the procurement function itself. These technologies also reduce the labour associated with the acquisition process, yielding productivity gains. Business-to-Business (B2B) marketplaces are being formed to bring efficiency and collaboration to entire industries.

5 Managerial implications to SMEs

The internet is changing the landscape of competition: as price and location become less important, firms will need to differentiate products and services on other attributes. Perhaps the most significant impact of the increased use of the internet by members of the supply chain is that it can facilitate changes in relationships along the chain, both between the manufacturer and its supplier and the manufacturer and its customer and end-consumer (Kuo et al., 2005). All other impacts stem from this. The internet can facilitate a change in the relationship between manufacturer and end-consumer by more closely linking them through direct internet sales (Kumar and Liu, 2004).

The SME sector is an important target for competitiveness, innovation and environmental policies and practices, as its size means that collectively it can deliver significant economic, social and environmental benefits (Simon and Pierret, 1998). SMEs and corporate websites need to address multiple constituents using smart website design. Companies should consider forming alliances and web links to reflect intentions and
demonstrate action (Chong et al., 2005). Firms should get in touch with green groups, and protestors, and collaborate on tackling issues. Companies should use the internet to establish better communications up and down their supply chains. SMEs now have better channels of communication with their suppliers on ingredients and processes. Internet is a technology that enhances the value proposition offered by companies to their customers. To achieve this goal, SMEs have to integrate the use of this technology within some of their business processes. They need to perform new activities, modify the exercise of actual ones and eliminate some others. Increased competition has also resulted in a greater emphasis on differentiation and a search for potential sources of value-added for consumers. This has led some retailers into internet shopping as discussed above. It has also increased the importance of service so that order-winning criteria are likely to be service-based rather than product-based. Obviously, there are market opportunities for SMEs manufacturers to sell product online themselves and broaden their customer base geographically. SMEs are using the internet as a medium to partner themselves with global as well as local partners to deliver products and services online. SMEs manufacturers need to be alert to changing consumer behaviours as a result of increased shopping online (Gulledge and Sommer, 2004).

Even without selling online, effective use of the internet by SMEs can provide a low cost ‘gateway’ to international markets and help overcome many of the barriers or obstacles to internationalisation commonly experienced by such firms. For example, an internet connection can substantially improve communications with actual and potential customers, suppliers and partners abroad; generate a wealth of information on market trends and developments worldwide; provide a ‘ear-to-the-ground’ on the latest technology and R&D; and can be a very powerful international promotion and sales tool (Li and Tan, 2004). One of the fundamental impacts on SMEs is the need to change their mindset. Increased adoption of ICT means that companies have to accept there will be greater information sharing between supply chain partners as well as within companies. The traditional source of power deriving from control of information is diminished by adoption of various ICTs. Therefore, adoption of ICT is a company-wide activity that will require full commitment from the company’s decision makers, with the support of comprehensive ICT plans and strategies and a change management plan. Environmental issues are not at the top of the agenda for SMEs and therefore environmental messages need to clearly accompany other more mainstream areas of concern (Bradford, 2000; European Commission, 2001).

Managerial implications of using the internet for environmental gains are many folds for SMEs. The capacity of the internet to facilitate alliances irrespective of geographical distance, allow greater organisational possibilities for groups with limited resources, more extensive access to wider audiences, and create new forms of environmentalism (Borden and Harvey, 1998; Brick, 1998). Through websites, newsgroups and mailing lists, people who are concerned about an environmental issue are able to find one another, exchange information and establish some sort of collective action. This can help to remove the sense of isolation often felt by those who seek change, particularly when challenging financial and socio-political ‘heavyweights’ such as corporations or government entities. There are indications that the internet may be helping to change the balance of power between environmental groups and entities that oppose environmental reform, such as some industries and government bodies (Zelweiro, 1998; Anderson, 1997; Escobar, 1996).
Technology such as the internet amplifies the opportunity for companies to collect, filter and analyse huge amounts of information from numerous sources almost instantaneously (Frederick, 1993). Managers in the companies can make them more aware of various global environmental concerns and the remedies that are adopted to tackle those concerns. For example, researchers could compare environmental messages in the online and offline contexts and focus more on what the internet can do for environmental groups in poor communities or provide more information about online anti-environmental activities (Gauntlett, 1997; Karliner, 1997). The international consulting firm Ernst and Young predicts that by 2010 there will be nearly 10,000 telemetric devices (meaning devices that transmit or receive data) for every person on earth. Managing connectivity on a scale like this will be too difficult for humans to do on their own. In the future, network management will be partially delegated to software programmes called agents that learn about their users and act autonomously on their behalf. Managers may have to face concerns related to personal privacy, hacking, increasing network vulnerability, and digital terrorism. Environmental benefits can be realised only when society shifts from a traditional focus on personal computing toward broader concepts based on adaptive, self-organising systems. But changes in computing might also bring humans closer to their environment and enable them to better understand and manage the natural world around them (Rheingold, 1994; Snider, 1995).

There are a number of issues to consider when looking at how SMEs are motivated to engage in environmentally friendly production. These include: training; use of IT; networking; assistance already available to SMEs overcoming the barriers to innovation and organisational issues; and learning from past good and bad experiences. SMEs collectively form an important part of both environmental and economic issues and as such they form a target for improved efficiency in both of these areas. There is a need for a clear strategy with respect to SMEs environmental and business performances, which other organisations, such as Trade Associations, Green Business Clubs and Regulators can then help to deliver. In order to be able to achieve such a strategy, there needs to be clearer thinking on the targets set for SMEs (Liu and He, 2005; CECOA, 2004).

6 Further directions for resolving environmental issues

The internet helps to bring customers and manufacturers closer. Using the internet, consumers can provide manufacturers with feedback on products, packaging, and delivery systems, and demand that they implement environmentally sound practices. Online customers can demand super-concentrated products and refills, reusable or recyclable product containers, and the option to pay their bills electronically. Manufacturers can respond by voluntarily instituting codes of practice for e-commerce that protect the environment. Manufacturers should take advantage of internet-based technologies for providing product descriptors that define the environmental characteristics of products sold online, so that consumers can scan for qualities like energy efficiency and chemical composition. Also, the various organisations should encourage electronic payment of bills and putting manuals and forms online thus reducing waste material that can contribute to environment pollution. More and more companies should move toward more environmentally sound packaging designs (e.g., lighter and thinner packaging; reusable packaging; packaging that contains fewer
materials or more recycled materials; packaging that contains fewer dyes and inks). The government agencies should go online and should offer more and more information electronically through the internet. Government agencies could conduct their own banking, billing, and purchasing online, and require vendor take-back of shipping containers and packaging. Only with the use of internet-based technologies, for analysing data on transportation patterns and shipping logistics, product design, consumer behaviour, and resource consumption will the government be able to help design programmes and policies to produce positive environmental impacts.

7 Conclusion

The growing commercialisation of the World Wide Web has led to the increased availability of corporate information via the internet. While much of the information available from these commercial sites is intended for product promotion and public relations, a side-effect of this trend has been the increased accessibility of corporate Environment, Safety and Health (ES&H) information. The internet is reshaping manufacturing and distribution systems, product design, and the fundamental relationship of producer to consumer. By linking the world together, the internet has the potential to vastly improve the efficiency of commerce that could reduce or eliminate the need for products, for warehouses and retail stores, and for the materials, energy, and space. It could curb automobile use, reduce traffic, and enable businesses and consumers to be savvy green shoppers. The use of internet-based technologies for resolving environmental problems has been increasing as various organisations have already been exploiting the internet for access, use, dissemination and creation of information resources. To date, there has not been any systematic research study done on the impact of internet-based technologies on the information and communication functions using Porter’s value chain model. This study demonstrates how the internet helps to resolve environment-related issues using value-added activities of Porter’s value chain model. This study certainly would help to increase understanding of the role of the internet as a significant feature in information functions of resolving environmental issues.

References


Porter’s value chain model


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