

Impact of sustainable manufacturing practices on consumer perception and revenue growth: an emerging economy perspective

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The view that adopting an environmental perspective on operations can lead to improved operations has become commonplace over the past decade. The implication is that any operational system that has minimised inefficiencies is also more environmentally sustainable. In the first phase of our research, we conducted a field research of the green manufacturing techniques in place in two world-class, ISO 14001-certified paint manufacturing firms in India. This phase of the study was undertaken to ascertain the cost benefits that these firms enjoy due to green manufacturing and recycling. Based on the field work in these two companies, a conceptual framework was proposed to investigate any relationship between the consumer's attitude towards the environment and the perceived image of a company that was environmentally conscious. Subsequently, a survey was administered to understand the impact of green marketing on the decision of consumers to buy paint manufactured by a firm that stringently regulates its hazardous waste. Results indicate that there is a strong correlation between the environmental concern of the survey respondent and the perception that the respondent forms of the firm that has implemented green manufacturing techniques. There is also a strong correlation between the decision to buy a green product and the respondent's concern for the environment as well as the perception formed of the firm. Further research is required to substantiate the cost benefits of green manufacturing.

Keywords: green manufacturing; environmental management; empirical research

1. Introduction

A firm's ability to measure, monitor and improve environmental performance is becoming increasingly important to the management and personnel involved in the implementation and execution of environmental programs and processes. The consequences of not managing a firm's environmental practices may result in waste, pollution and other related problems. Over the past couple of decades, there has been a heightened awareness of environmental issues by governments, policy makers, advocacy groups, business and the public. All these stakeholders need credible information on environmental activities of firms to make decisions. This growing trend appears to reflect changes in market systems in which increased regulatory forces and public environmental concern have the potential to influence the operational processes of the firm. The argument that if firms adopt an environmental perspective, it can help them improve their performance has been made by several researchers. Porter and van der Linde (1995) provide several examples of how environmental conditions had encouraged firms to allocate resources more effectively and efficiently and as a result become productive. Hart (1995) discussed how a focus on environmental performance can be a competitive resource for firms. Larson *et al.* (2000) invoked the Schumpeterian notion of creative destruction to explain how firms have become more entrepreneurial and discovered new goods and services when forced to adopt new perspectives such as sustainability.

It is apparent that, in today's competitive world, low-cost leadership or product differentiation is not sufficient to provide organisations with long-term, sustainable competitive advantage (Reed 2003). Hart (1995) identified continuous improvement and stakeholder management as two specific organisational resources related to sustainable environmental management. These are both knowledge-based resources that can build lasting competitive advantages because of their ambiguity and social complexity. In the last decade or so, both regional and

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global attention has been given to the integration of economic, social and environmental issues that focus on reduction of waste and pollution (Tan and Zailani 2009). Environmentally friendly manufacturing practices are not only perceived to be instrumental in increasing market share (Chan 2001), but there is also increasing evidence that such practices lead to increased customer loyalty. This realisation has led to an increasing number of firms all over the world to remodel their supply chains to reduce waste and also voluntarily publish this information.

This trend towards self-regulation has led to what are now being called firm-structured environmental management systems (EMS) that closely monitor compliance with international standards set by organisations such as the International Standards Organization (ISO). The roll-out of certifications such as ISO 14001 is driving this trend towards a time when environmentally friendly practices will be a competitive necessity for survival (Tan and Zailani 2009, Curkovic and Sroufe 2010). These EMSs represent an organisational change in terms of culture and drive the link between production decisions and the environment. While ample empirical research has been done regarding the relationship between environmental activity and firm performance (Klassen and McLaughlin 1996, Russo and Fouts 1997), the same is not true concerning how firms need to organise and manage activities to promote and improve environmental performance. More specifically, how do characteristics within a firm, such as organisational design and management practices such as communication, monitoring and incentives, influence a firm's ability to improve in areas such as operations performance, the design of new products, or improvements in waste reduction, through environmental programs?

The motivation for our current research comes from the field study that we conducted with two world-class ISO-certified paint manufacturing firms to explore green manufacturing techniques in India. This first stage in our two-pronged approach played an important role in understanding the operational and environmental phenomena that exists in these two companies. This phase also helped to illuminate the actual behaviour of the operations and environmental managers and the employees in these two firms. Recycling initiatives undertaken to achieve minimal waste (especially waste classified as hazardous) in these two leading manufacturing firms in India were studied to analyse cost benefits. The analysis from the first phase of research helped us put together a conceptual framework to investigate: (a) whether the perceived image of a company following green manufacturing techniques might play any role in consumers' attitudes towards the environment; and (b) whether the positive image of the firm might influence the consumers' decision to purchase any product manufactured by the firm. In this second phase of our research, we conducted a survey of urban, middle-class people in India to test the hypotheses. Our analysis generally supports the notion that green manufacturing and its marketing has a direct effect on the bottom line and top line growth of firms that implement and market them effectively.

Specifically, this study intends to address the following question: *Is there a positive relationship between consumers' attitude towards environmental issues and the perceived image of a firm in following green manufacturing techniques?* We organise the rest of the paper as follows. In Section 2 we present a literature review and background for our paper. In Section 3 we describe the first phase of research (field research) where we studied the green manufacturing techniques in place in two world-class, ISO 14001-certified paint manufacturing firms in India to ascertain whether the benefits that these firms enjoy were due to the proactive stance the two firms have taken with respect to environmental green supply chain management. In Section 4 we provide the conceptual model and develop the hypotheses for our research. In Section 5 we discuss the research setting, data collection, measurement validation, analysis and results. In Section 6 we provide the limitations of and future research for this study.

2. Literature review and background

Over the past decade or so, the topic of green supply chain management has gained interest among both researchers and practitioners. There has been an increasing focus on identifying best practices that simultaneously reduce the negative impact of any of the firm's environmental activities while contributing to any competitive advantage in the marketplace. The research relating environmental management to firm performance is fragmented across multiple business disciplines. The traditional economic view suggests that any environmental improvement made by a firm transfers costs previously incurred by society back to the firm (McGuire *et al.* 1988). Hence, environmental performance was expected to negatively influence operational and financial performance. Further, poor environmental performance can also have a negative effect on a firm's market value (Klassen and McLaughlin 1996, Konar and Cohen 2001). However, researchers, including Porter and van der Linde (1995) and Reinhardt (1998), have identified strategies in which environmental management can improve firm-level financial performance and overall competitiveness. Additionally, researchers such as Derwall *et al.* (2005) have reported that superior

financial performance has been found in firms with better environmental performance across multiple industries. As pointed out by Klassen and McLaughlin (1996) and Guide *et al.* (2000), environmental issues can affect performance either by increasing revenues through new market opportunities or by cutting cost through process improvement, waste reduction and stronger system-oriented capabilities.

It is important to note that cost advantages can result from adopting best practices that focus on firms' production processes (Hart 1995, Stead and Stead 1995). These practices include redesigning production processes to reduce pollution, substituting less-polluting inputs, recycling by-products and incorporating less-polluting processes (Hart 1995, Porter and van der Linde 1995). Such practices are intended to reduce the production cost by increasing the process efficiency while reducing input and waste disposal costs (Newman and Breeden 1992, Shrivastava 1995a, Stead and Stead 1995). More comprehensive approaches to environmental management, including 'cradle-to-grave design' (Shrivastava 1995b) and 'design for environment' (Hart 1997), can also contribute to cost advantages. Innovative product development dictates the presence of sustainability as one of the key requirements during the design of a product (Rachuri *et al.* 2009).

Corbett and Klassen (2006) report that superior environmental performance is often a reflection of good management rather than the sole root cause of good financial performance. The greening of industry is fast becoming a vibrant and desirable trend among companies in emerging economies such as India. India has a third of its population still under the poverty line (Ravallion 2010). It is also among the fastest growing economies in the world. This makes the country a breeding ground for breakthrough sustainable innovations (Prahallad 2007). Green supply chain management is an important initiative that many companies in Asia are keen to adopt. The driving forces for implementing the sustainability concept in company operations comprise of reactive regulatory reasons to proactive strategies to remain competitive (Sarkis 2001). They also include working collaboratively with suppliers on green product design and helping suppliers establish their own environmental programs. Linton *et al.* (2007) indicate that there has been a conscious need to integrate environmental concerns across the entire supply chain in order to help contribute to the sustainability of the company's future.

The literature involving case studies of firms in the US ranging from small to very large operations identifies process-focused practices and quantifies the associated cost savings. Companies that have cut costs after implementation of such practices include 3M's pollution prevention pays (PPP) program, which emphasises pollution prevention, natural resource conservation and continuous improvement (Shrivastava 1995a, Stead and Stead 1996). The PPP program has saved 3M well over \$810 million since its inception in 1975. Dow's pollution prevention initiatives such as waste reduction always pays (WRAP) or Chevron's save money and reduce toxins (SMART) have also produced substantial cost savings (Stead and Stead 1996). However, such studies have been performed on companies that have successfully and profitably implemented EMS.

Nehrt (1996) found that one best practice of environmental management – early timing of environmental investments – significantly contributed to growth in profits and that the intensity of investment in pollution prevention, a process-focused best practice, had an unexpectedly negative, significant effect on profit growth. Stead and Stead (1995) revealed that out of their sample of companies, 44% indicated a positive relationship between environmental best practices and financial performance and the rest showed negligible or no direct correlation. Hence, the literature on the impact of EMS on a company's bottom line performance is inconclusive. Although the connection between environmental management and firm financial performance has been discussed for several decades, the results reported by empirical studies are often conflicting or ambiguous, and have given way to an ongoing debate in the literature (Derwall *et al.* 2005). These mixed results are due to the complex set of relationships that underlie the apparent linkage between environmental management and firm financial performance.

While the past literature reveals that the environmental management system (EMS) has strongly taken root in developed countries such as the US and Europe, sincere efforts are now being made in emerging economies such as India, Brazil and China to implement EMS. Even though the per capita contributions from the BRIC nations are very low, advanced countries still think of the BRIC nations as the major cause of worry in the long term. Hence, a more rigorous approach towards reducing supply chain waste and combating pollution is required in these countries to sustain their growth rates without having to buck down to western pressure. Anecdotal evidence also suggests that the growing stringency of environmental regulations imposed by consumers in the US and Europe on manufacturing units in India, the rising costs of non-compliance, the environmental concern amongst consumers and reputation with share holders motivate 'corporate environmentalism' (Florida and Davison 2001). The literature on environmental self-regulation demonstrates that firms may have several tactical and strategic reasons to voluntarily improve their environmental performance because it impacts the top line and bottom line performance of the firm (Khanna 2001). Clearly, there is sufficient activity and ongoing development in the area

of sustainability. While some of the relevant questions have been considered by work on topics such as greener product design (Dambach and Allenby 1995, Lennox *et al.* 2000), lifecycle assessment (Kim *et al.* 2010), cleaner process technology (Hasek 1997, Clelland *et al.* 2000), product life extension (Linton and Jayaraman 2005), product lifecycle management (Barreto *et al.* 2010), closed-loop supply chain management (Guide *et al.* 2000, 2003, Jayaraman *et al.* 2003, Jayaraman and Luo 2007) and environmental management systems (Florida 1996, Sroufe 2004, Jacobs *et al.* 2010), we still need to start looking at how organisations are beginning to think beyond environmental compliance towards environmental performance, especially from an emerging economy standpoint.

As indicated in the introduction of this paper, we first conducted field research on two world-class, ISO 14001-certified paint manufacturers in India to ascertain whether the cost benefits that these firms enjoy are due to the green manufacturing techniques that these firms had undertaken. The Indian paint industry is truly global with regards to the supplier/buyer chain. Several paint manufacturers such as Asian Paints have global buyers and such buyers are conscious about the manufacturing practices and environmental standards in place from their Asian suppliers. Hence, apart from government regulations, the presence of consumer-driven regulations has driven the Indian paint industry to become early adopters. Further, focusing on sustainability issues would make the paint industry in India technologically and economically competitive. An additional objective for this field research was also to investigate the extent of EMS elements used in these two Indian organisations and to determine the influencing factors for adopting EMS and its associated benefits. The next section of our paper describes the field research conducted in two paint companies located in India.

3. Field research

The World Commission on Environment and Development (1987) (the Brundtland Commission) defines sustainable development as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’ The sustainability movement has gained traction because of the inefficiency of our current products and manufacturing processes in their use of the planet’s resources. This is true for both industrialised countries as well as emerging economies as it provides huge opportunities for creating new value (Hart 1995, Prahalad 2007). Business and political leaders at the World Economic Forum’s India Economic Summit 2007 called on India to focus on addressing environmental degradation and water scarcity to sustain the high growth the country required to remain sustainable and competitive. Prahalad (2006) in his book *The fortune at the bottom of the pyramid*, discussed not just the hidden fortune with the four billion people who live on less than \$2 per day globally, but also how businesses could identify, tap into and expand this fortune by developing new sustainable models of doing business. India poses sustainability challenges of gigantic scales for businesses to tackle through innovative approaches.

In a research study of Indian companies that had adopted innovative, sustainable practices by Joshi *et al.* (2007), the report identified five case studies and attempted to provide a number of sustainable ideas that ranged from incremental changes to more radical business model innovations and from those that offer quick implementation and a short pay-back period to long-term strategies. The first case study on BASIX looked at a new business model of sustainable livelihood promotion to improve the quality of life for the ‘have-nots’. The second case study on Cosmos Ignite focused on social entrepreneurship where the company introduced LED-based solar power lighting systems to the poor and the needy. ITC created a sustainability image by introducing benefits across small business units by integrating material and competence flows across its supply chain. L&T, on the other hand, identified sustainability-driven opportunities through technology products and service delivery, while TCS introduced innovative solutions for sustainability challenges by leveraging IT innovations. All these companies have shown that it is possible to link sustainability with innovation. Those who are responsible for the bottom line of a company are also beginning to recognise that a well-designed EMS can have a profound impact on a company that not only extends the bottom line and public image, but also the long-term financial health of a company. It is within this context that we investigate the paint industry in India.

3.1 Indian paint industry

The Indian paint industry has grown steadily at a rate of 13% over the past 5–10-year period with a domestic per capita consumption of about 1.2 liters (Devraj 2007). Despite the steady growth of the Indian economy, the Indian paint industry is less than half the size of their Chinese counterpart and about one-fifth of the US market by volume.

Devaraj (2007) indicates that the key drivers for the expected growth in paint retail sales are reduction in poverty levels, construction of new homes, a greater inclination to spend and an increasing number of middle-class people who are not only décor-conscious but also very environmentally conscious.

In India, the demand for paints is relatively price-elastic but is linked to the industrial and economical growth. The organised sector in India controls 70% of the total market and the remaining 30% is in the hands of nearly 2000 small-scale units. Further, the industrial paint segment accounts for 30% of the paint market while the decorative paint segment accounts for 70% of paints sold in India. Stricter regulation to reduce volatile organic compounds in paints and the increasing consumer demand for eco-friendly products has encouraged the industry to develop paints with minimal harmful compounds. Many paint manufacturing companies, including Asian Paints Limited, Goodlass Nerolac Paints Ltd., Berger Paints and Jenson & Nicholson, are well prepared with a comprehensive portfolio of environmentally friendly solutions that fit well into many areas of the value chain for a paint manufacturer. A range of environmentally friendly oxygenated solvents that are non-volatile organic compounds without any hydrocarbons provide better dissolution of the coating constituent for these paint manufacturers. The standards set by the regulatory boards are provided in Figure 1.

3.2 Data source

The data for this first phase of our study came primarily from three data sources: in-depth semi-structured interviews, documents and personal observations. To gain a deeper understanding of environmental practices at the manufacturing plants of both companies, an in-depth semi-structured interview technique was used to probe the actors. In-depth, semi-structured interview techniques encourage individuals to explain themselves (Kaplowitz 2000), leading to greater information sharing and elaboration (Agar and MacDonald 1995). Interviews were structured around loose themes following an inductive methodology (Choi and Hong 2002). Each interview was allowed to proceed at its own pace. The interviewer simply had the responsibility to facilitate the questions. Instances of new interviews were added until new information was no longer forthcoming, at which point data saturation was said to have been reached (Glaser and Strauss 1967, Eisenhardt 1989). The names of the two companies have been disguised at their request.

Environmental Standards

Wastewater Discharge Standards of Paint Industry	
Parameter	Concentration not to exceed units in mg/l except pH
pH	6.0 to 8.5
Suspended solids	100
BOD at 27°C for 3 Days	50
Phenolics as C ₆ H ₅ OH	1.0
Oil & grease	10.0
Bioassay test	90% survival of fish in 96 hours in 100% effluent
Lead as Pb	0.1
Chromium as Cr	
Hexvalent	0.1
Toal	2.0
Copper as Cu	2.0
Nickel as Ni	2.0
Zinc as Ni	5.0
Total Heavy Metals	7.0

Source : Environmental Standards for Ambient Air, Automobiles, Fuels, Industries and Noise, Central Pollution Control Board, Ministry of Environment & Forest.

Figure 1. Environmental standards (2006).

3.2.1 Company A

Our first site visit was undertaken in October 2008 to Company A, a world-class paint manufacturing unit in India, and data on the outcome of their sustainability initiatives was collated during this time. Company A, a leading manufacturer of industrial paints, took a proactive stance to understand the need for improving and protecting the environment. The firm has put together a system to not only comply with the legal requirements set in place in India, but also go beyond compliance to ensure that the manufacturing plants are located in a safe environment. The company's four paint and two chemical plants have all been awarded the ISO 14001 certification for environmental management standards. For the quarter that ended on 31 March 2008, on consolidation of the accounts of various subsidiaries and joint ventures, the net profit of the company was around Rs. 90 crores (1 crore rupee = \$200,000).

In the process of improving environmental performance, the company has a very innovative methodology of converting paint sludge (a hazardous waste) into primer by a unique remanufacturing process. Industrial painting by spraying generated waste due to off-spray. This paint when washed with running/circulated water led to the generation of paint sludge, which is highly hazardous in nature and severely pollutes water bodies if not disposed of cleanly. It has been ascertained that, on average, paint guns generate 4050% sludge due to excesses and that the total amount of paint sludge that was generated in India in 2007 was close to 46,000 kilolitres, which is approximately 35% of the industrial paint manufactured in the country. The only available way to dispose of this sludge was through incineration after due treatment. This is a costly procedure and consumes a lot of natural resources, including fuels, and thus pollutes the atmosphere further. As a solution to this problem, Firm A developed an innovative remanufacturing and recycling technology to convert this sludge into usable paint primer. The process is explained in Figure 2. The process is an eco-friendly safe process wherein there is minimal generation of waste water and the process would result in only 2–5% remnant waste from the total primer that is produced.

The primer thus manufactured met all the industry standards in terms of viscosity, adhesion, impact resistance and water resistance. The company identified a total of 78 types of waste from the paint manufacturing facilities, of which 18 were designated as being hazardous. The company followed a common format for all the plants that details the disposal options for each of these wastes. All the hazardous wastes are stored in a scrapyard where the detoxification equipment is also installed. The hazardous containers are located in three zones for storing dirty waste (red zone), cleaned but waiting for approval and detoxification (orange zone) and containers that have already been approved for disposal (green zone). All containers are detoxified with caustic solution and solvents. In addition, the hazardous waste containers from packing operations are crushed in hydraulic presses and detoxified by incineration and then disposed to authorised scrap contractors.

3.2.2 Company B

Our second site visit was undertaken in December 2008 to Firm B, a world leader in the commercial paints section. The firm is also a leader in the Indian paint industry for its strict adherence to environmental standards and

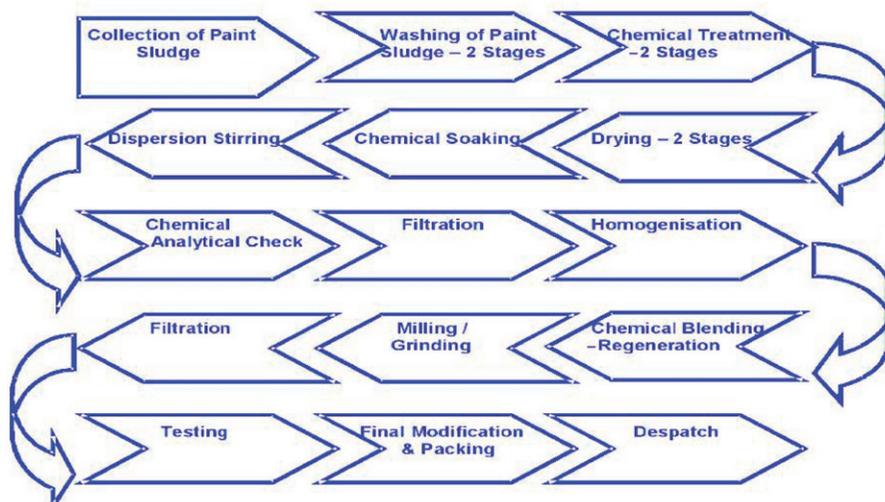


Figure 2. Converting sludge into usable paint primer.

stringently monitors its hazardous waste levels. Firm B's supply chain is truly integrated. Its suppliers have adopted various approaches to improve the sustainability of the paint and have developed new additive formulations and technologies that help minimise the environmental impact of final paint formulations. Other innovations include developing resin systems with unique properties and many others are focused on reducing waste production and energy consumption. The firm has also invested in a new water-based acrylic emulsion polymer plant. This facility has a zero discharge policy and operates under the firm's twenty-first century sustainable manufacturing program. In this plant, all waste water is recycled so that only residual solids from the waste water go to landfill. Reduction of waste is a key aspect in addition to reduction of emissions to the air. This ISO 14001-certified company uses an ultra-filtration system to recapture waste latex for use in other lower-end products that do not require the highest purity levels. For the quarter that ended on 31 March 2008, the net profit of the company was around Rs. 55 crores (1 crore rupees = \$200,000).

For Firm B, one of its suppliers is promoting the use of recyclable plastic containers for their products. The supplier has developed a closed-loop container that does not rust, offers better sealability and is made of 100% recycled materials. By implementing a closed-loop container system, the goal of Firm B is to keep man-made materials out of landfills and at the same time reduce the consumption of other resources. Company B is at the point of forming partnerships with its key customers in order to establish collection sites where they can use small footprint shredders that can grind up the buckets at the end of their useful life. The company is also dedicated to sustainability and environmental issues and will eventually ensure that closed-loop recycling is a long-term opportunity with the potential to achieve significant cost savings while benefitting the environment. Additionally, an additional goal of Firm B is to educate their end consumers to relate to the idea of recycling and view such programs in a positive manner.

Both firms are committed to and have taken a proactive stance on environmental management and resource conservation as key drivers of efficiency and productivity. They follow a strategy of waste minimisation through waste reduction at source and recycle waste in an optimal fashion. Additionally, both firms have implemented both product- and process-based environmentally conscious practices. By implementing pneumatic conveying systems for raw materials and superior cleaning systems, they have been able to minimise waste generation. Both firms have implemented rain water harvesting schemes, drip irrigation systems and ground water recharging strategies across their plants and this has led to reduced water consumption. Closed-loop recycling schemes are now in place to minimise waste generation. A periodic waste disposal audit in terms of reduction of the cost of waste and energy audits to save on energy at both firms indicate a profitable trend. By conducting net present value analyses and bottom line benefits at these two paint manufacturing firms over the last five years, there is a strong indication of a significant impact of EMS and waste management techniques on the bottom line performance and revenue growth at these two firms. We now document the next phase of our research in Section 4 of this manuscript.

4. Conceptual model and hypothesis development

In the field of green marketing and the impact of green manufacturing techniques on a company's top line growth, Arbuthnott and Lingg's (1975) study of environmental behaviours, knowledge and attitudes suggested that environmental knowledge acts as a mediating variable for environmental attitude and behaviour. Similarly, Synodinos (1990) stated that environmental knowledge influences attitudes towards green products. Cohen (1973) verified that students who were taught courses focused on the management of the environment exhibited different attitudes towards the environment than the control group that was not exposed to the course. Davies (1993) found that advertisements that aim to develop consumer's knowledge on the environmental performance of the product have also been shown to build positive consumer attitudes towards the product being advertised. Porter and van der Linde (1995) argue that tough environmental standards can trigger innovation and upgrading of sustainable technologies while noting that properly constructed regulatory standards, which aim at outcomes and not methods, will encourage companies to re-engineer their technology. The result in many cases is a process that not only pollutes less, but also lowers costs or improves quality. Processes will be modified to decrease the use of scarce or toxic resources and to recycle waste by-products. Porter and van der Linde (1995) documented examples from several companies to show that environmental improvements can lead to improved processes, products and hence profits.

Globally, the public and its governmental representatives have been demanding improved performance on environmental, health and safety issues. There are several ways in which adopting an environmental perspective

affects the entire supply chain. First, the supply chain itself is extended beyond the final consumer to end-of-life strategies such as recycling and disposal (Jayaraman *et al.* 2003, Jayaraman 2009). Second, similar to total quality management, the notion of the 'customer' is now replaced by an acceptance of multiple stakeholders including the NGOs that represent the local communities' interests, governments and future generations whose quality of life will be affected by supply chain design and operations (Corbett and Klassen 2006). Hart (1995) and Lamming and Hampson (1996) argue that strategic resources for green supply include continuous improvement and product stewardship that encompass product responsibility from cradle to grave.

Green SCM techniques can be a great source of competitive advantage, although they must be linked to other dimensions of operations strategy (Newman and Hanna 1996). Min and Galle (1997) report that competitive advantage plays a relatively minor role for managers considering green purchasing compared with liabilities and product disposal costs. Hence we hypothesise that consumers who have a high level of environmental knowledge can be influenced to buy green products through advertisements laced with the environmental benefits of the product. In addition to regulatory pressures, market pressures may influence an organisation's decision to adopt EMS and rely on green supply chain practices (Rao 2002, Gupta and Piero 2003, Darnell and Carmin 2005). Hoffman (2000) indicated in his study that, over the last decade, market actors had placed greater pressure on organisations to consider their operational impacts on the natural environment. Ginsberg and Bloom (2004) claim that, overall, 15% of consumers in the United States routinely pay more for green products, and another 15% seek green products if they're not very expensive. A study by Ellen *et al.* (2000) suggested that respondents evaluated organic T-shirts as more appealing than normal ones. There has also been a wave of organic vegetable consumption in the West over the past few years, suggesting that organic products may be perceived in a more positive manner. Consumers mostly participate in environmentally conscious behaviour when they are reminded of the intrinsic rewards that environmentally conscious activities may bring (Carlson *et al.* 1993). Such appeals are generally targeted at environmentally aware market segments.

Hence, adopting green supply chain practices may provide a vehicle for organisations to signal to market participants that their environmental strategies not only adhere to but also exceed generally acceptable environmental standards (Darnall *et al.* 2008). Taking this strategy may lead to a greater acceptance of the firm's strategic approach (DiMaggio and Powell 1983) and even perhaps insulate organisations from competitors' criticisms (King and Lennox 2001). By developing an environmentally conscious reputation, a firm may invite patronage from consumers and generate additional opportunities for interaction with other organisations who share the same values (Darnall and Carmin 2005). Goldsmith *et al.* (2000) suggest that the perceived expertise and trustworthiness of the brand owner (the firm) will influence consumers' attitudes. Unless advertising campaigns offer justifiable information and credible benefits, overt brand claims are analysed closely and critically by consumers (Branthwaite 2002). Thus, green brands are an important and rich source of decision-making information to consumers. In this era where environmental claims are strictly regulated (Cason and Gangadharan 2002), it is important for all firms that publish their green initiatives to publish credible and well-supplemented information, so as to influence the customer's decision to buy. Situations where two products are perceived as equal in all respects except that one is superior in its environmental performance and benefits may influence consumer preference and choice (Ottoman 1998).

A green brand may enhance the emotional connect with the audience and increase customer loyalty (Ginsberg and Bloom 2004). It may further generate a positive public image that might lead to enhanced sales and increase stock prices (Marshall and Mayer 1992), thus driving top line growth. Positive differentiation from competing brands can be achieved by constructive positioning and can be exploited as a competitive advantage (Grace and O'Cass 2002). For consumers who are conscious of environmental products and purchase them through choice, there might be a segment that might be willing to pay more for the environmental benefit. While past research suggests that consumers are willing to pay more for environmentally friendly products and procedures (Kapelianis and Strachan 1996, Laroche *et al.* 2001), others suggest the opposite (Simon 1992, Sims 1993). In fact, while many consumers might not be influenced by a company's proactive environmental practices, the same consumers might change their purchasing decisions if a company violates environmental laws or emits high levels of toxins (Prakash 2000).

A small group of consumers are also ready to pay significantly higher premiums for environmental benefits. This premium could be as high as 20% or more (Roper Organization 1990). This may occur when the environmental benefits are perceived to create personal benefits for the consumer rather than public goods that benefit society as a whole (Gallagher and Kennedy 1997, Ottoman 1998). Research studies have also found a relationship between

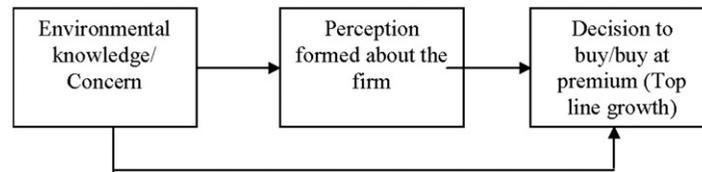


Figure 3. Conceptual model.

environmental concern and other related attitudes and patterns of behaviour. However, most studies are vastly inconclusive. Hence we propose the following set of hypotheses for our research.

- H₁. *There is a significant, positive relationship between consumers' attitudes towards the environment and the perceived image of a company following green manufacturing techniques.*
- H₂. *A positive image of a company created due to green initiatives might influence a consumer's decision to buy.*
- H₃. *Green manufacturing, if marketed to target consumer segments, will drive a company's top line.*

Our conceptual model for this research is shown in Figure 3. We propose that there is a positive link between the environmental knowledge/awareness that is possessed by consumers and their evaluation of a firm's image. This could also drive their decision to purchase a product at premium price from the company.

In the next section of the paper we focus on the research design and administration of the survey.

5. Research design

5.1 Q-Sort method

Given the nature of the study, a questionnaire was used to collect data to measure the environmental consciousness, the perception formed of the company who had taken a proactive stance towards the environment and the decision of the consumer to buy green manufactured products. The study also tries to explore whether focused messages sent to segments of customers who are environmentally conscious in the form of advertisements and messages on packages might affect their decision to buy, even if the product is priced at a 5% premium over average market rates. The first step in the questionnaire design process was to use the Q-sort method to assess initial levels of construct reliability and content validity (Moore and Benbasat 1991). The survey questionnaire focused on four important constructs: Environmental concerns (adapted from Van Liere and Dunlap 1981), environmental commitment (Roper Organization 1990), organisational image and consumer's willingness to buy from a company that is environmentally proactive. Figure 4 provides a flow chart on the steps we undertook for data collection and analysis.

The various measures were scrambled and given to a panel of academic and industry participants. Each participant was provided with a list of construct definitions and instructed to associate each item with one construct. Responses were used to compute item placement ratios and inter-judge agreement statistics for each construct. Item placement ratios, which assess construct validity of the generated items and construct reliability, exceeded the recommended level of 0.70 considered acceptable for exhibiting content validity (Moore and Benbasat 1991). The inter-judge agreement statistic measures (these quantify the observed proportion of agreement between participants) had values greater than 0.65 as recommended by Perreault and Leigh (1989). Based on the feedback from the Q-sort procedure, changes were made to the survey questionnaire before it was sent to potential respondents.

5.2 Data collection

Buda and Zhang (2000), drawing on attribution theory, argue that consumers presented with a promotional message will make an effort to evaluate the accuracy of its claims and the degree of credibility of the source. Phau and Ong (2007) further proved in their research that environmental claims in promotional messages and advertisements positively influenced buying behaviour in the clothesline industry in Australia. Hence, a questionnaire that measures the environmental consciousness of the respondents and measures the subsequent impression formed due to this was designed. Further, a section that specially targeted buying behaviour at prices on par and at a 5% premium was put in place for correlation.

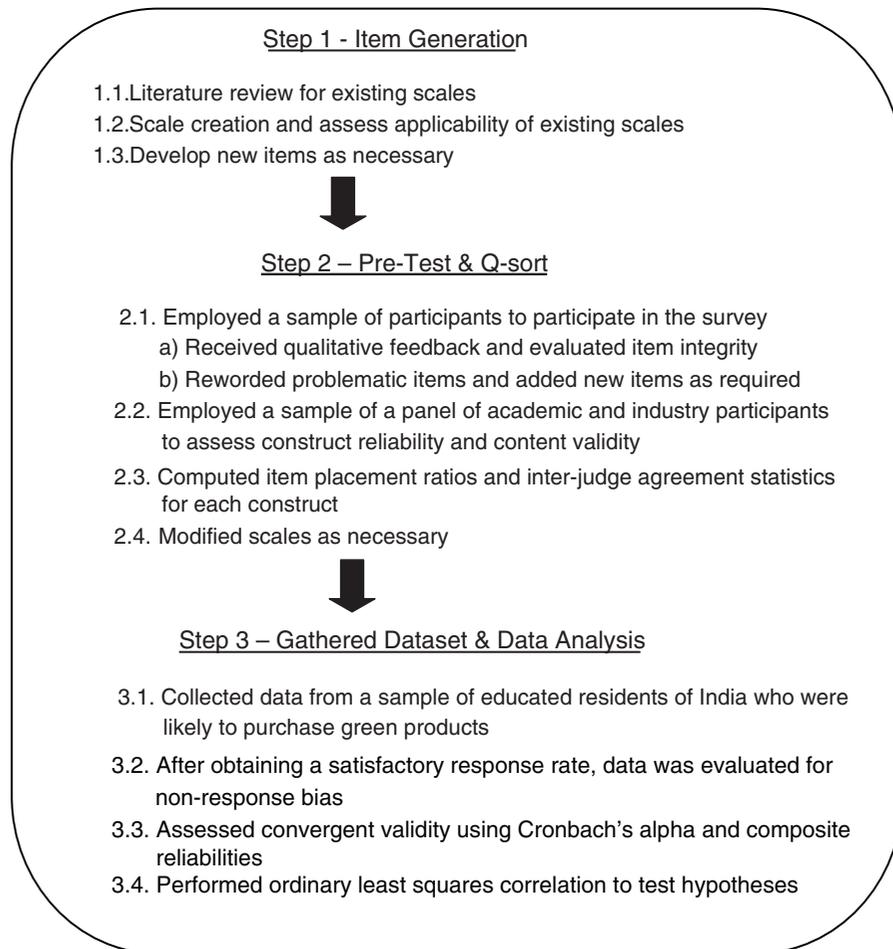


Figure 4. Methodological steps in data collection and analysis of the survey.

The data for this study were gathered from a sample of educated residents of India in the 18–40 age group who were likely to purchase green products. The respondents were urban, upper-middle class citizens and belonged to tier 1 and tier 2 (Iyengar 2005) Indian cities. Hence an assumption was made that the respondents were aware of issues such as global warming, green products and hazardous waste disposal techniques. Of the 260 surveys that were sent out, a total of 90 responses were received with a response rate of 35%. This is well over the recommended rule-of-thumb baseline minimum of 20% for empirical studies (Malhotra and Grover 1998), although several other studies subscribe to the philosophy that there is no generally accepted minimum response rate (Fowler 1993). The final sample had respondents in the age group 22–35 and had an equal distribution between men and women. Non-response bias was evaluated by investigating any differences between early respondents and late respondents, with late respondents being considered a surrogate for non-respondents (Armstrong and Overton 1977). Using this method, responses of the first 30 surveys received were compared with the responses of the last 30 surveys received. The results indicated no significant difference between the responses.

5.3 Data analysis – Validity and reliability

Convergent validity represents how well item measures relate to each other with respect to a common concept and is exhibited by having significant loadings of measures on hypothesised constructs (Anderson and Gerbing 1988). By removing item measures with insignificant factor loadings from the scale while not sacrificing content validity, convergent validity of the scales was established. Reliability represents the systemic variance of the constructs and is

Table 1. Environmental concerns.

		Mean	SD
1	We are approaching the limit of the number of people the earth can support	4.7	1.8
2	The balance of nature is very delicate and easily upset	5.3	1.6
3	Humans have no right to modify the natural environment to suit their needs	5.4	1.7
4	When humans interfere with nature it often produces disastrous consequences	5.8	1.3
5	Humans must live in harmony with nature in order to survive	6.2	1.2
6	Human beings are severely abusing the environment	6.3	1.1

Notes: Scoring: 1 – strongly disagree; 7 – strongly agree. Source: Items taken from the new environmental paradigm (NEP) of Van Liere and Dunlap (1981).

Table 2. Perception formed of the firm.

		Mean	SD
1	African Paints seems to care about the community and society	5.8	1.1
2	African Paints has highly ethical practices in place	5.6	1.0
3	African Paints is a leader in the paint industry for its best practices	4.9	1.1
4	African Paints is an innovative company	5.1	1.0
5	African Paints is a company I can trust	5.1	1.2
6	African Paints has credible leaders	5.0	1.1

Notes: Scoring: 1 – strongly disagree; 7 – strongly agree.

assessed using Cronbach's alpha and composite reliabilities. Researchers including Flynn *et al.* (1994), Narasimhan and Jayaram (1998) and Malhotra and Grover (1998) consider a Cronbach's alpha value of 0.60 as the practical lower bound. We now provide the reliability criteria for all the measures that form part of the survey questionnaire.

5.3.1 Environmental concern

This dimension was measured by adapting part of the 'new environmental paradigm' devised by Van Liere and Dunlap (1981), which applies a seven-point scale of agreement to six strongly worded statements concerning the balance of nature, the economy and natural resources. The possible range of summated scores thus ranges from 6 to 42. The mean scores shown in Table 1 demonstrate that respondents had a relatively strong sense of environmental concern. Scores of summated items produced an approximate mean of 33.7 ($\sigma = 8.7$, Cronbach's alpha = 0.663).

5.3.2 Perception formed about a firm that is environmentally conscious

The sample administered the survey was briefed about the environmental standards followed in an imaginary firm called 'African Paints'. African Paints follow stringent manufacturing practices and has an environmentally safe and sustainable disposal/recycling system in place for hazardous waste. The firm also: (a) does not pollute water bodies with life-threatening chemical effluents; (b) does not produce excessive amounts of wastes/effluents that harm the soil/environment; (c) distributes unused, residual paints free of cost to eligible sectors of society such as local charities, community organisations and social service departments; and (d) converts paint sludge (by-product) into paint primers through advanced remanufacturing techniques, thus reducing overall supply chain wastes.

Following this, a set of six questions was formulated as part of the questionnaire that tried to capture the impression the survey taker had formed about the firm. The mean scores shown in Table 2 demonstrate that respondents developed a relatively good impression of the firm and the competitiveness of its technology and products. Scores of summated items produced an approximate mean of 31.4 ($\sigma = 6.6$, Cronbach's alpha = 0.872).

5.3.3 Buying decision

Finally, the decision or willingness of a consumer to buy the product and to suggest that product to fellow consumers was measured by three highly correlated questions (Table 3). The possible range of summated scores thus

Table 3. Buying decision.

		Mean	SD
1	I will prefer African Paints as I now know that they follow environmentally safe practices	5.8	1.0
2	I will recommend African Paints to others	5.6	1.1
3	I will buy African Paints even if it is priced at 5% above the market standard	5.6	1.1

Notes: Scoring: 1 – strongly disagree; 7 – strongly agree.

varied from 3 to 21. The mean scores shown in the table demonstrate that respondents develop a strong urge to purchase from African Paints. Scores of summated items produced an approximate mean of 17 ($\sigma = 3.2$, Cronbach's $\alpha = 0.886$).

A factor analysis was performed and confirmed consistent factor loadings on environmental concern, the firm's perception and buying decision with eigenvalues greater than 1 and with an explained variance of 69.84.

5.4 Discussion of results

Ordinary least squares correlation was then performed on the factors. Results indicated statistically significant correlations at the 95% confidence interval. Hypothesis 1 suggests that there is a significant relationship between the environmental concern of the person taking the survey and the impression that the person formed of the firm following green manufacturing techniques. The Pearson correlation at the 95% confidence level is 0.218, and the p -value is 0.042, which is sufficiently significant to reject the null hypothesis that the environmental concern of the survey taker has no positive effect on their perception of the manufacturing firm that has EMS in place.

Hypothesis 2 suggests that there is a highly significant relationship between the survey taker's perception of the firm and the inclination to buy the firm's products. The Pearson correlation at the 95% confidence level is 0.564 and the p -value is 0.000, which is sufficiently significant to reject the null hypothesis that the perception of the survey taker of the firm's competitiveness has no positive effect on the decision to buy its products.

Hypotheses 1 and 2 along with hypothesis 3 suggest that there is a highly significant relationship between the survey taker's concern for the environment and the inclination to buy the products of the firm that has green manufacturing techniques in place. This further indicates that firms can indulge in green marketing through focused advertisement strategies to drive their revenues. The Pearson correlation at the 95% confidence level is 0.262 and the p -value is 0.014, which is sufficiently significant to reject the null hypothesis that the survey taker's concern for the environment has no positive effect on the decision to buy its products.

These findings along with the outcome of the NPV analysis of the implementation of EMS and waste reduction techniques in paint manufacturing units in India seem to suggest that green manufacturing and its marketing do affect the bottom line and top line growth of firms that implement and market them.

6. Conclusion and limitations of the study

This study, through the established new environmental paradigm and organisation perception framework, has analysed the three-way environmental concern–perception–decision framework in addition to the cost benefits of green manufacturing. Results show that the best practices of environmental management generally have a positive effect on the profitability of the company. These results further add mileage to the fact that proactive environmental management practices simultaneously protect the environment while increasing competitiveness. The results further suggest that, if green manufacturing techniques are marketed to the correct target group in India, it can lead to a revenue increase as consumers concerned about the environment are willing to buy commodities manufactured through green techniques at a premium price that is 5% above the market standard.

The study was performed on a sample that was urban, educated and had a steady inflow of disposable income. Hence, irrespective of the environmental concern quotient, the variation across geographies and income groups was not factored in. Therefore, the scope of the study was narrowed to determine the buying behaviour of a reduced cross-section of Indian society. This can be perceived as both a strength as well as a weakness of the study.

Although the behaviour of this group can be ascertained to a significant level across all product groups, the results cannot be extrapolated to understand whether green marketing drives revenues across all sections of Indian society.

Another important limitation in the findings of the paper is the number of organisations that were studied to understand the cost benefits of green manufacturing. Further research and analysis of manufacturing firms from all major sectors such as automotive, tannery, auto ancillary, chemicals and plastics, which also generate hazardous by-products as waste, must be carried out to strengthen the link between green manufacturing and cost benefits. Further research can also be pursued to understand other factors that motivate firms to set up EMS given the fact that this calls for significant initial investment. Another issue that is worth investigating for future research is to include additional environmental and sustainability measures in the survey instrument.

India and China are well on the way to becoming the factories of the world. Manufacturing has its own implications for the environment and there is increasing world-wide concern about degradation of the environment. Hence, more in-depth research in the field of the benefits of renew–reuse–recycle–remanufacture is required not only from an Asian context but also from the perspective of other emerging economies.

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