Environmental Management Practices Implementation: A Study with respect to Chemical Industries of India

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Abstract

The objectives of this paper were to identify various types of environmental management practices of firms like end-of-pipe treatment, pollution prevention by process modifications and reuse and recycling in some of the chemical industrial units of GIDC (Gujarat Industrial Development Corporation) industrial estate, Ankleshwar, Gujarat, India and also to determine the key factors influencing the implementation of these practices. In addition the study also identifies the various impediments encountered during the adoption process. Among the 73 units studied, in the chemical industrial sector of GIDC industrial estate, a majority of firms preferred end-of-pipe treatment to comply with regulations, followed by reuse and recycling and pollution prevention by process modification. The Ankleshwar industrial estate has a heavy concentration of small and medium sector firms, most of which have traditional and outdated technologies, which result in large quantities of waste per unit of production. Such a state of affairs if left unattended, would have serious adverse implications on public health, water quality and overall quality of life. Thus the study focuses on the chemical industrial sector, particularly the small and medium sector firms, which form the backbone of the industrial growth in Gujarat and it will help them to identify improved methods of environmental management. Hence various recommendations are suggested for improvement by shifting the focus of firms to areas of process improvements, improved housekeeping practices, and other newer concepts of environmentally conscious manufacturing.

Keywords: Environmental management practices; End-of-pipe treatment; Pollution prevention; Process modification; Reuse and recycling; environmentally conscious manufacturing.

Introduction

The changing business conditions around the globe emphasize the importance of environmental performance in an organization, which necessitates more focus on its environmental management practices. Sustainable industrial development can be achieved only by the adoption of proper *environmental management practices.* In recent years, firms are increasingly oriented towards the adoption of environmental management initiatives like ISO 14000, Life Cycle Analysis, Life Cycle Costing etc. and different labels like environmentally conscious manufacturing, environmentally responsible manufacturing, green manufacturing and environmental operations management are being used to define these practices. In the Indian industrial sector, these concepts are yet to gain popularity and its percolation is among very few of the large scale units [67].

In the Indian scenario, studies dealing with a comprehensive evaluation of environmental management practices of firms appear to be scarce. In the case of Gujarat, such studies are almost non-existent with very few in the area of Cleaner Production by various organizations [50,67]. In Ankleshwar, there is a heavy concentration of small and medium sector firms, most of which have traditional and outdated technologies, which result in large quantities of waste per unit of production. Such a state of affairs if left unattended, would have serious adverse implications on public health, water quality and overall quality of life. Hence an attempt was made to study the influence of various factors on different types of environmental management practices followed by the firms. The present paper presents the results of the study carried out in the chemical industrial sector of Gujarat {GIDC (Gujarat Industrial Development Corporation), Ankleshwar} which revealed that three main types of environmental management practices namely end-of-pipe treatment, recycling & reuse and pollution prevention by process modification were being adopted by the firms and the importance given to these were obtained on a Likert scale. Further, certain key factors (compliance with legal requirements, water and energy saving, reduction of waste disposal costs, improvement of employee well-being, green image, identification of pollution prevention opportunities, improvement of stakeholder relations and public image, top management commitment and monitoring of environmental targets attainment) were identified that influence the implementation of these environmental management practices. The paper also explores the relationships of these factors on the implementation of different environmental management practices followed by the firms.

Gujarat being one of the most industrialized states in India has become a major producer of petrochemicals and chemicals including a wide range of fertilizers, dyes and dye intermediates, drugs and pharmaceuticals, pesticides, paints, inks and numerous specialty organic and inorganic chemicals. More than 20% of the chemicals manufactured in India are from Gujarat. The products mainly include dyes and dye intermediates, bulk drugs and pharmaceuticals, paints, resins, pesticides and other specialty organic & inorganic chemicals. Gujarat Industrial Development Corporation (GIDC) was established in 1962

under the auspices of the state government and its objective was to encourage and facilitate rapid and systematic development of industries, zones, industrial belts, business trade zones etc. in all areas of the state. Over the years, GIDC has played a vital role in acting as a catalyst in the transition of the state with a marked dependence on agriculture and textiles to an acknowledged industry leader in the field of chemicals, fertilizers, pharmaceuticals, engineering, petrochemicals, etc.

Ankleshwar, situated 10kms away from Bharuch town on the southern bank of river Narmada in the state of Gujarat, India is a town having population of 1, 50, 000 and has developed in the last 25 years into a largest industrial area in Asia. Ankleshwar industrial estate was established by GIDC in 1978 with an aim to represent the problems of member industries and also claim its participation in all development activities and is spread around a total area of 1600 ha. The industrial estate is made up of approximately 3,000 individual companies. Over half of these are chemical units, manufacturing dyes, paints, fertilizers, pharmaceuticals, industrial chemicals and pesticides. The Ankleshwar Industrial Association has estimated that its

members generate between 250-270 ML/d of liquid waste, and approximately 137 t/d of solid waste. Of this, 58% originates from the manufacture of dyes and dyes intermediates, 19% from drugs and pharmaceuticals, and 5% from inorganic chemicals. The firms here are mainly concentrated in the small and medium sector and this sector forms the backbone of the industrial growth in Gujarat. Most of these units have traditional and outdated technologies, which result in large quantities of waste per unit of production [50]. During the study, it was found that the concepts of environmental management were relatively new to them and majority was hesitant towards the adoption of such practices. A majority of them were satisfied with common treatment facilities (Common Effluent Treatment Plants, CETP) for waste management to comply with the regulatory requirements. Only very few firms were conscious about the various environmental management practices and the benefits that could be incurred as a result of its adoption. The different factors were chosen based on the literature review and discussions with experts from the industry.

2. Literature Review: Concepts of Environmental Management Practices

The environmental management practices of firms include a combination of macro-scale concepts (of sustainable industrial development, industrial ecology and life cycle analysis) and operational concepts (pollution prevention, reuse and recycle and end-of pipe treatment) that together address specific functions of the business. According to Hamner and Lofgren [20], the concept of environmental management practice should be understood to be a kind of staircase where the various concepts like waste disposal, pollution control, recycling, waste minimization, pollution prevention and cleaner production, industrial ecology (that include life cycle analysis) and sustainable development make up the steps. Concepts higher up the staircase include the concepts below, and add additional elements of scope and complexity. An Environmental Management System can address only one step of the staircase or the whole staircase depending on the choices made by the top management. Sroufe et.al. [62] Points out in his study that these descriptive labels have overlooked a more detailed list of environmental activities that corporations practice at the operational, tactical and strategic levels of the firm. While there are a number of specific practices that can be found within industrial ecology these same practices may not be found within environmental operations management. While there is overlap between the different labels, there are also differences. To clarify this potentially confusing situation, researchers and practitioners need a more comprehensive approach to defining environmental management practices. Their study proposed a new environmental management framework to include tactical, operational and strategic activities of a firm to identify their commitment to these environmental management practices.

Literature reveals that firms are adopting environmental management practices in reaction to the rise in environmental legislation, concern over liability, the direct and indirect costs of regulatory compliance, concern about overall firm competitiveness, and public concern about environmental degradation [24, 45]. These management practices include environmental audits, total quality management, waste treatment options, pollution prevention plans, reuse and recycling, environmental training for employees, total cost accounting, life-cycle analysis, R&D, environmental standards for suppliers, and employee incentive programs for

environmental suggestions [15, 22, 59]. Nawrocka and Parker [42] emphasize the need for research in the area of environmental management to see how it affects the performance of organistaions. Their study analyses a pool of 23 studies connecting environmental performance to environmental management systems. They find that existing studies fail to measure environmental performance and also the mechanisms that lead to environmental improvement are expected to be the same for all companies or dependent on each implementation. They recommend a case by case approach since environmental performance varies in each organization.

The literature suggests *three* possible performance outcomes as a result of environmental management practices adoption, i.e. Its introduction makes no observable difference to a firm's environmental performance, *or* it will produce an improvement in environmental performance *or* performance could deteriorate after its adoption. Process focused environmental management practices can be seen as the basic precondition for the implementation of all other practices and as the most basic building block of a responsible environmental strategy. However Berry and Rondinelli [3] found that in some of the world's largest pharma companies, adoption of environmental management practices were beginning to produce positive results and that considerable progress had been made in waste reduction and resource conservation. Schaltegger and Synnestvedt [57] argue that not merely the level of environmental performance but mainly the kind of environmental management with which a certain level of performance is achieved, influences the economic outcome. Hence research and business practices should focus less on general correlations and more on causal relationships of eco-efficiency and environmental performance.

Several researchers like Florida and Davison [15], and Heffelman [23] have surveyed firms' adoption of environmental management practices and identified significant adoption of these practices among the firms studied. These studies revealed broad trends of adoption of environmental practices across industrial sectors and firm sizes. However, none of these studies focused on entire industrial sectors; all included fewer than ten firms from any one of a number of industrial sectors. Hence these researchers were unable to draw statistically significant conclusions about the adoption of environmental management practices in particular industries. Chan [6] pointed out that the adoption of environmental management practices by an organization indicates that it is practicing environmental policies, making regulatory compliance an integral part of the business operation, giving emphasis to prevention rather than cure and providing passport to a green market.

The ***end-of-pipe treatment*** concept in environmental management is included under the command and control approach and is mainly oriented towards regulatory compliance. The direct relation between regulation and end-of-pipe technology is shown by King and Lenox [30], Laurent and Kephaliacos [35], Yarime [72] and Dupuy [12] in their studies on environmental policy and technological change. Wagner [68] argues that end-of-pipe technology has no effect on production process and hence cannot change production cost or product quality whereas integrated technologies can influence product quality.

In a study in the industries of OECD countries, Frondel et.al. [16] and Rehfeld et.al. [51] Indicate that regulatory measures and the stringency of environmental policies are more

important for end-of-pipe technologies while cost savings, general management systems and specific environmental management tools favour cleaner production or pollution prevention. Fatta and others [13] argue that pollution prevention and cleaner production emphasizes the human and organizational dimensions of environmental management, including good plant operation to avoid deliberate or accidental discharges. Adoption of end-of-pipe technologies often leads to higher labor, operating and maintenance costs for companies which in turn decreases the productivity of the company whereas pollution prevention measures can lead to an increase in productivity due to cost savings and rationalization effects in the production process.

In a study by Christmann [7], in 512 units of chemical companies operating in U.S, the importance of capabilities of ***process innovation and pollution prevention*** as complementary assets in the relationship between process-focused environmental "best practices" and cost advantage were established. The study showed that the *chemical companies*, which employed innovative pollution prevention technologies, realized significant cost savings and these savings were greatly enhanced for firms with pre-existing capacity to innovate. Those units, which employed 'best practices' pollution prevention technology, revealed no statistically significant cost savings while those which employed 'innovative' pollution prevention technology revealed a significant and positive correlation with cost savings data. Pollution prevention can reduce the costs associated with waste management and future environmental costs such as remediation activities. Since these techniques are part of the production process they cannot be easily imitated by the firms' competitors unlike the end-of-pipe solutions that are easily available in the market [60]. Product and process innovation aimed at reducing pollution at source are generally regarded as being one way to improve not only aspects of product and process performance but also economic efficiency and competitiveness [17, 22, 27]. Public Image and social legitimacy in relation to environmental behaviors are factors that have been mentioned as motivating firms to embrace cleaner production or pollution prevention [18, 41]. Also the role of consumers is considered an important driver of innovation.

Lober [39] identifies that one of the greatest potential gains from pollution prevention is to recognize the potential of pollution prevention as not only individual ventures but as a form of corporate self-renewal. In this capacity, pollution prevention has the potential to be a significant corporate change agent. Implementing pollution prevention requires the reconceptualization of the whole corporate approach to materials, energy, and water use as well as to the central manufacturing processes. By focusing on what enters and moves through the corporate enterprise, managers improve the efficiency and outcomes of these processes. By drawing on the lessons of entrepreneurship, the corporation can move towards realizing these potentially significant gains.

Lee & Rhee [36] who studied the evolution of corporate environmentalism in Korea, found that Korean companies have progressed through different eras of corporate environmentalism: the ignorance era, the compliance era and the strategic compliance era. Enforced regulation was the main force behind end-of-pipe approach whereas local community pressure and new knowledge and information for environmental management were the main forces for pollution

prevention approach. Even though these companies were far behind the sustainable development approach they were turning their attention from end of pipe to prevention for better environmental management. Proactive environmental management strategies in the form of investments in pollution prevention technologies (rather than reactive investments in pollution control) only led to environmental and competitive improvements when they were associated with the development of certain strategic managerial and manufacturing processes [34].

Reuse and Recycling is synonymous with waste minimization. There are almost always some wastes created by production processes, so they need to be recycled as much as possible. Reclaiming wastes usually involves some kind of separation technologies such as distillation, filtration, etc., whereas straight recycling usually is understood to mean that the waste is simply reused somewhere else or back in the original process. However there is an important distinction to be made between on-site and off-site recycling. Off-site recycling is really a form of waste disposal for the company which creates the waste and so is a low priority action compared to preventing the waste in the first place. Thus closed loop and on-site recycling can be considered a subset of waste minimization since it is primarily focused on the production process [24].

Peattie & Peattie [44] states that the consequent flow of capital for new projects has favoured the shift to renewable resources and closed-loop systems, cleaner production, improved eco-efficiency and industrial ecology. However the larger problem of responding to unsustainable consumption is a future challenge.

According to a study by Pun et.al [49], inorder to compete in the present dynamic and competitive markets, a paradigm shift in management from environmental performance appraisal to improvement and transformation of business from compliance to competitiveness is needed. In an empirical study done in Hong Kong, an EMS planning framework was prepared by them which integrates various perspectives of environmental management and strategy formulation and also provides the organizations with a procedural guide for implementing environmental management practices.

A study by Hui et. al. [27], to analyze the environmental management practices and green manufacturing practices in Hong Kong shows that most of the companies have a positive attitude towards the implementation of green manufacturing or environmental management systems, which can effectively strengthen their competitiveness in business.

Hemel and Cramer [24] focuses on the barriers and stimuli for ecodesign in SME's by conducting an empirical study on the ecodesign behaviour of 77 Dutch SME's. The four most successful solutions implying their realization within 3 years were recycling of materials, high reliability/durability, recycled materials and low energy consumption. They concluded that internal stimuli are a stronger driving force for ecodesign than external stimuli. The most influential internal stimuli were the opportunities for innovation, the expected increase of product quality and the potential market opportunities. Their results indicate that enhancing ecodesign in SME's does not only depend on finding alternative solutions for technical

problems but also on economic and social factors like the acceptance of environmentally improved products in the market.

3. Methodology and Data Sources

In this study, the unit of analysis is a firm, engaged in chemical manufacturing business. Simple random sampling method was used for collecting the samples from Ankleshwar GIDC. Since Ankleshwar industrial estate is one of the largest in Gujarat, its characteristics can be considered similar to the other estates of the state. Individual firms constituted the unit of analysis and included 73 organisations from the small, medium and large scale units, belonging to the chemical industrial sector. Firms involved in the manufacturing of fine chemicals and agrochemicals were selected due to their polluting nature and sample availability. Small and medium scale units dominated the region when compared with the large scale units. This explains the difference in sample proportions. The questionnaire was formulated using inputs collected from literature review, experienced persons in the academia, industry and industry associations. It included questions on three different types of environmental management practices that were followed in these firms and various factors influencing their adoption. A 5 point Likert scaling technique was used to grade the responses where 1=very low, 2=low, 3=moderate, 4=high, 5=very high. Usage of a five point Likert scale has been supported by a number of researchers such as Babakri et.al. [2], Christmann [7], Likert [38], Hua et. al. [26]. Since views from experts and practitioners were involved in its development, separate validity testing of the questionnaire was not carried out.

Face to face administration of the questionnaire was used for carrying out the interviews for getting the responses from the respondents which included the persons in charge of the environment division (manager rank) in each of these firms. Each respondent was introduced to the concept of environmental management practices so that they can respond more accurately for the different questions.

Thus data collected in this study are primary data gathered from an extensive survey relating to the various environmental management practices of chemical industries in the GIDC, Ankleshwar region during 2005-2007 period. Secondary sources of data used included information regarding the firms collected from the reports of Ankleshwar Industries Association.

3.1. Description of the Sample

Firms involved in the manufacturing of fine chemicals and agrochemicals were selected due to their polluting nature and sample availability. Based on the number of employees, [Lee [37]], the firms were classified into small, medium and large. In this region, a number of small and medium scale industries were involved in the manufacture of various chemicals whereas large scale industries were few. Previous research has shown that small and medium sized enterprises (SMEs) are important not only from a financial point of view but that the sector also has a considerable environmental impact [19, 28]. The extent of this impact is not known, but according to Hillary [25], SMEs could be contributing up to 70% of all industrial pollution. Several authors state that SMEs are collectively responsible for a significant portion of the total environmental burden. This is because of the little external pressure on these firms to manage

activities in a more environmentally proactive manner. Low internal motivation coupled with lack of incentives also plays a major role in the SMEs not going beyond the existing environmental legislations. The basic perception of SMEs with respect to environmental issues is extra costs and not extra benefits since these benefits are usually long term. [13, 17, 62].

A sizable proportion of the sampled units, 53% (39 out of which 20-dyes and dye intermediates, 19-organic and inorganic chemicals) belonged to the small scale sector; 41% to the medium-scale sector (30, out of which 18-dyes and dye intermediates and 12-organic and inorganic chemicals) and 6% (1-paints, 3-organic and inorganic chemicals) to the large-scale sector.

Table I here

4. Data Analysis and Findings

In order to develop the theory in the growing field of environmental business management and research as discussed in the literature review, the various aspects of environmental management practices and its adoption were considered. The environmental management practices were classified under three categories, which included the conventional end-of-pipe treatment (EOPT), pollution prevention by process modification (P2PM) and reuse and recycle (RR). This classification followed from Sroufe et.al's [62] classification of operational, tactical and strategic practices. Depending on the importance given to each of these methods, the firms were asked to mark the responses using Likert scale values. The mean score obtained for each type is shown in the table. It shows that for majority of the firms, end-of-pipe treatment (mean=72.35) was the preferred alternative followed by reuse or recycling (mean=66.34) and pollution prevention (mean=60.23). Since many of these were single ownership firms, their only aim was profit making and environmental practices were followed merely for satisfying legal requirements. This is in congruence with earlier studies by King and Lenox [30], Laurent and Kephaliacos [35], Yarime [72] and Dupuy [12].

4.1 Factors Responsible for the Implementation of Environmental Management Practices

The questionnaire asked the respondents to indicate on a five point Likert scale where 1=very low, 2=low, 3=moderate, 4=high, 5=very high, both the quantifiable and non-quantifiable factors that lead to the adoption of various environmental management practices namely end-of-pipe treatments, pollution prevention by process modification, and reuse & recycle. The values were analyzed using SPSS software to find out the correlation. Tables 3, 4 and 5 represents values for the correlation coefficients (Pearson correlation) of different environmental management practices against the various factors influencing their adoption.

Table 2 here

The results show strong positive correlation between end of pipe treatment and compliance with regulations (0.615). All the other factors show weak correlation. If the value of the coefficient is greater than 0.50 either in the positive or negative direction, there is a significant

correlation between the variables. Here, such a value is seen only in the case of compliance with regulations. This shows that firms in this region believe strongly in the end-of-pipe methods for environmental management practices merely for the purpose of regulatory compliance. Results indicate that end-of-pipe treatment methods are the most preferred alternative for most of the firms belonging to the small scale and some of the medium scale units. This reinforces the earlier findings by Laurent and Kephaliacos [35], Yarime[72] and Dupuy [12] which showed a direct relation between regulation and end-of-pipe treatment. These results also corroborate the studies of Frondel et.al. (16) and Rehfeld et.al. (51) which indicate that regulatory measures and the stringency of environmental policies are more important for end-of-pipe technologies while cost savings and specific environmental management tools favour cleaner production or pollution prevention. There is no significant correlation in the case of public image which may be due to the fact that the firms that are conscious about achieving the targets merely for compliance requirements are least bothered about public image and the social implications of their actions. This trend is seen mainly in the small scale industries where profit making is the only driving force. Again the top management commitment towards environmental performance is significantly lower for these firms which indicate their lower awareness levels. This seems to reflect the behavior of firms in this region since their attitudes are based on that of the owners of the firms.

Table 3 here

In the case of pollution prevention as shown in the table, the positive correlation is strongest (0.949) for the variable namely identification and implementation of pollution prevention opportunities. Next comes the top management commitment towards environmental performance (0.910). ie. As the top management commitment towards environmental improvement increases more and more process modification measures will be adopted for pollution prevention. This is supported by a study by Sroufe [61] which indicates a positive relationship between the environmental practices like pollution prevention and the top management commitment towards firm performance. This study is also in congruence with the findings of previous researchers like Wee & Quazi [70] and Berry & Rondinelli [3] who identified top management commitment as one of the critical factors for proactive environmental management practices adoption. The companies that are conscious about pollution prevention as environmental management practice are bothered about attaining a green image (0.891) and also in the improvement of employee wellbeing (0.885). Improvement of public image (0.851) is also given due importance. Saving water and energy (0.830) and reduction in the waste disposal costs (0.729) also show strong positive correlations with the adoption of P2PM. Factors like monitoring of set environmental objectives and targets (0.583) and relation with stakeholders (0.493) also show significant correlation. The only factor showing weak correlation with P2PM is legal requirements (0.230) which indicates the fact that pro-active firms are more oriented towards environmental improvement. This results support the argument put forth by early researchers like Walley and Whitehead [68] and at the same time negates the one put forth by Porter and Linde [47], ie.more stringent regulatory requirements drive the firms away from innovative methods of environmental management

like P2PM. In such cases the firms' orientation will be more towards achievement of targets rather than innovation.

Table 4 here

In this case of reuse and recycling as shown in the table, the positive correlation is strongest for the factors namely top management commitment towards environmental performance (0.882) and identification and implementation of pollution prevention opportunities (0.882). This means that reuse and recycle are preferred options of environmental improvement for the top management since they are proven methods for economic gains. Then come the attainment of green image (0.875) and saving of water and energy (0.845). Improvement of employee wellbeing (0.841) and improvement of public image (0.808) are also given due importance. Other factors showing strong positive correlation are reduction in the high waste disposal costs (0.724), monitoring of set environmental objectives and targets (0.567) and also relation with stakeholders (0.432). The only factor showing weak correlation is legal requirements (0.210). This result indicates that in the case of firms where the top management commitment towards environmental improvement is greater, measures like reuse and recycle are given more importance than the end-of-pipe compliance measures. This is seen in the case of large scale units and some of the medium scale units where environmental improvement measures are linked to the competitive advantage of firms.

3.2. Impediments in the Adoption of Environmental Management Practices

During discussions with the experts in the industry some obstacles were identified with respect to the adoption of various environmental management practices. Hence the survey asked the respondents to rate the various impediments on a five point Likert scale. From the responses obtained the mean values were calculated and presented in the table below.

Table 5 here

The respondents rated "lack of awareness and knowledge" (4.45) as the highest hassle in the adoption of environmental management practices. A general feeling across the various units was that high costs were involved in the documentation, training and charges towards the consultancy (4.41) but due to lack of awareness they do not realize the long-term benefits of these additional expenses. The regulatory bodies like the pollution control boards give more focus on compliance (4.39) than improvement measures. Hence the firms were also more oriented towards compliance rather than preventive or improvement measures. There was "lack of expertise" (4.40) regarding structured methodology and innovative techniques.

Often the larger units possessing the technology are unwilling to share them with other units for competitive reasons. Hence the data banks and requisite information is lacking. There was "lack of top management commitment" (4.38) which was felt as a hindrance to the adoption of newer concepts of environmental management. Another impediment identified was the "non-availability of resources" (4.32) in the form of funds, technical-know how, training and so on. Finally there is "lack of co-operation from regulatory bodies" (4.30) coupled with "resistance

from stakeholders" (3.78). Hence in-order to make the principles of sustainable development percolate through environmental management and pollution prevention much work has to be done right from the grass root level to all levels of decision-making and policy including industry associations, institutions and government.

5. Conclusions and Recommendations

The findings of this study expand our understanding about the influence of various factors on the environmental management practices adopted by chemical industries. The survey results show reluctance on the part of industries in the adoption of various environmental management practices especially the newer concepts like pollution prevention and process modification. Further, the study also helps to evaluate the environmental management practices in industries, especially the small and medium scale units in an industrial estate.

For a majority of firms, EOPT was the preferred alternative since their main objective was to comply with the regulations put forth by the authorities. The second preferred option was RR. Here the correlation is highest for the top management attitude from which we can infer that among the proactive firms adopting RR, there is a management commitment towards continual improvement and compliance comes as its by-product.

A small fraction of firms felt strongly for the P2PM option. Here, also, the factors like top management commitment towards environmental performance and attainment of green image are given high significance. Other factors like improvement of employee wellbeing and public image, saving energy and water and reduction of waste disposal costs are also given high significance. Weak correlation exists only for legal requirements, which supports the argument by early researchers like Porter [46], ie. The firms would rather concentrate towards achievement of regulatory requirements than investing in effective R&D for the development of innovative process modifications measures.

The main reason for adoption of environmental management practice namely end-of-pipe treatment is identified as regulatory compliance. At the same time, saving energy and water along with employee wellbeing are given due importance. This shows that the newer concepts of environmental management can pick up, if sufficient exposure and dedicated efforts are given at all levels of the organization. The top management has to accord more importance to such environmental performance issues, which alone can increase participation from all levels. Moreover the smaller enterprises can adopt incremental improvements which require lesser investments. Concepts like life cycle analysis and reverse logistics are given the least importance since these are entirely new to most of the firms. These concepts were followed only by very few of the firms belonging to the large scale sector. Hence they were not included for the analysis.

Further, the analysis of various impediments showed that proactive policies are necessary for percolating the technological know-how required for the adoption of these management practices. Face to face communication and strategic alliances with top management as well as industry associations and other decision-making bodies will help to give them a better

understanding about the various environmental management practices and pollution prevention techniques, which are being adopted globally. Moreover funding from development and governmental bodies and other financial agencies are required to a larger extent. The information and suggestions are useful to the industries especially in the small and medium scale sector planning to incorporate environmental management practices and pollution prevention techniques in their units to join the journey towards sustainable industrial development.

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Table1. Firm size based on the number of employees

Size of the Organization	No. of Employees	Number of Organizations Responded	Proportion in the Sample
Small	0 to 50	39	53.42%
Medium	50-100	30	41.1%
Large	>100	4	5.48%
Total		73	100%

Table 2.Correlation coefficient between EOPT & Various Factors Responsible for its Implementation

Factors	EOPT
To comply with legal requirements	0.615**
Towards saving of water and energy	0.166
To reduce high waste disposal costs	0.030
To improve employee well being	0.066
Towards identification and implementation of pollution prevention opportunities	0.045
Towards attainment of a green image	0.010
To improve relation with stakeholders	0.148
To improve public image	0.158
To monitor set environmental objectives and targets	0.067
Top management commitment towards environmental performance	0.176

**Correlation is significant at the 0.01 level

Table 3. Correlation coefficient between P2PM & Various Factors Responsible for its Implementation

Factors	P2PM
To comply with legal requirements	0.230
Towards saving of water and energy	0.830**
To reduce high waste disposal costs	0.729**
To improve employee well being	0.885**
Towards identification and implementation of pollution prevention opportunities	0.949**
Towards attainment of a green image	0.891**
To improve relation with stakeholders	0.493**
To improve public image	0.851**
To monitor set environmental objectives and targets	0.583**
Top management commitment towards environmental performance	0.910**

**Correlation is significant at the 0.01 level

Table 4. Correlation coefficient between RR & Various Factors Responsible for its Implementation

Factors	RR
To comply with legal requirements	0.210
Towards saving of water and energy	0.845**
To reduce high waste disposal costs	0.724**
To improve employee well being	0.841**
Towards identification and implementation of pollution prevention opportunities	0.882**

Towards attainment of a green image	0.875**
To improve relation with stakeholders	0.432**
To improve public image	0.808**
To monitor set environmental objectives and targets	0.567**
Top management commitment towards environmental performance	0.882**

**Correlation is significant at the 0.01 level

Table 5. Impediments Experienced in the adoption of EMPs' (*Mean of Likert scale values)

Impediments	**Mean***
Lack of co-operation from regulatory bodies	4.30
High Costs Involved in Documentation, Training and Consultancy	4.41
Main focus on compliance rather than improvement	4.39
Lack of expertise	4.40
Lack of awareness and knowledge	4.45
Non-availability of Resources	4.32
Lack of Top Management Commitment	4.38
Resistance from Stakeholders	3.78