

Management Commitment and Employee Empowerment in Environmentally Conscious Manufacturing Implementation

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ABSTRACT - Management commitment and employee empowerment are most important and vital principles for the successful implementation of any newer manufacturing system or modern practice in any organization because the newer systems/practices require changed roles for people at all levels. The general human tendency to resist change understood properly may lead to dysfunctional implementation of newer systems/practices. Environmentally conscious manufacturing (ECM) being a new paradigm in manufacturing requires the changed roles for top management, middle management and employees. Therefore the managers must have measures to convince the shareholders that the plan to implement ECM has taken care of changed roles of people. This paper identifies the top management commitment, middle management commitment and employee empowerment measures for the successful implementation of ECM. The identified measures have been validated by a case study of Indian large scale enterprises. The measures identified from the literature have been validated by using SPSS for Windows statistical tool. The reliability and validity of the data has been assessed by the Cronbach alpha and factor analysis respectively. The results provide sure evidence that the identified measures are highly reliable and valid.

KEYWORDS - Green Manufacturing; Sustainable manufacturing; Environmentally Conscious Manufacturing.

I. INTRODUCTION

With growing awareness of environmental issues – from global warming to local waste disposal – business and government have come under increasing pressure to reduce the environmental impacts involved in the production and consumption of goods and services. Until quite recently the usual response to environmental problems involved measures to reduce pollution and waste after they had been produced; for example, by installing flue gas desulphurization equipment in a power station or waste water treatment plant in a factory or adding catalytic converters for cars. Lately, some organizations began to shift their attention from these ‘end of pipe’ approaches towards developing ‘clean or green’ manufacturing, which generates less pollution and waste in the first place and make efficient use of energy and materials.

Approach to environmental issues can be broadly classified into three categories – concept approach wherein the organizations employ environmental protection measures and think of biodegradable products, compliance approach wherein organizations comply with the environmental regulations and also think ahead of continual

improvement, and finally a system approach to environmental issues by implementing green manufacturing as a system. Melnyk and Smith[1] defined green manufacturing as “a system that integrates product and process design issues with issues of manufacturing planning and control in such a manner as to identify, quantify, assess, and manage the flow of environmental waste with the goal of reducing and ultimately minimizing environmental impact while also trying to maximize resource efficiency”. Green Manufacturing (GM) is the intersection of product development and manufacturing practices with environmental issues and concerns. The greater the overlap between these areas, the greater the extent to which manufacturing practices recognize and embody environmental issues, concerns, and practices as shown in Figure 1.

India, with its economic growth of around 8% and also being world’s second most populated country, will contribute a lot to climate change. Any improvements in Indian organizations will contribute significantly to the overall reduction in the energy and material consumption. With enhanced competition from China and a few low cost centers of production from abroad many units have of late been facing a tough time. However, those large scale enterprises who had a strong technological base, international outlook, competitive environment and willingness to restructure themselves can withstand the current challenges faced by these organizations and environmental concerns is one of the biggest challenges. There is scope for Indian large scale enterprises for increasing their export potential, domestic market share and developing themselves as serious players in the global value chain if their products and processes meet the international environmental standards.

In recent years the ECM has been widely considered for implementation to maintain competitive advantage. However, the implementation of such systems is expensive and relative investments tend to be irreversible, thus necessarily requiring careful consideration before a decision can be made. Managers, who are considering the introduction of ECM in their organizations, have to identify the application and plan its implementation to ensure the effective and successful implementation of ECM. The people from top management to front line workers in the organization have to understand the changed roles. The managers must have measures to convince the shareholders that the plan to implement ECM has taken care of changed role of people. This paper identifies the top management commitment, middle management commitment and employee empowerment measures for the successful implementation of ECM. The identified measures have been validated by a case study of Indian large scale enterprises. The paper is structured as: next two sections provide the

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theoretical background of management commitment and employee empowerment measures. It is followed by a case study of Indian large scale enterprises. Importance index analysis, reliability assessment and validity assessment of the collected data has been provided next. Last section provides the important conclusion of the study.



Figure 1: Green manufacturing - the critical intersection [1]

II. MANAGEMENT COMMITMENT

There are two schools of thought on benefits of ECM. One school, based on the sound theoretical foundation, is of the opinion that being green ultimately makes an organization more efficient and competitive. The argument is simple that being green means reduction of material and energy consumption in addition to reduction of pollution. This leads to the reduction of all types of waste in the organization thereby making organization competitive and efficient which delivers more benefits to the shareholders. The second school, based on the practical outputs, is of the view that green manufacturing objectives are not consistent with the organization goal of maximization of shareholders value. There is evidence to this particularly in the developing countries like India. For the organization wide successful implementation of ECM, management commitment is critical. Management commitment can further be classified at two levels – top management and middle management levels.

Top Management Commitment

Top management has significant ability to influence, support and champion the actual formulation and deployment of environmental initiatives across the organization. Top management must realize that supporting ECM must be visible and seen as a commitment. Someone within top management must be willing to act as the environmental champion. For any strategic program, much of the support necessary for its success needs to be derived from top management [2][3]. In general, management support is a critical element of adoption and implementation of innovations in an organization, especially environmental systems[4][5][6] show that organizational innovations may remain stuck at the initial idea stage in the absence of dedicated champions. Carter *et al.*[7] demonstrate that management support is especially useful for environmental practices such as ECM when they lie outside the specific domain of the environmental staff within the organization.

Cairncross[8] emphasizes the importance of having a corporate environmental policy. These environmental policies and strategies must reflect sound environmental goals. Furthermore, environmental goals and targets should be both clear and measurable. The formation of an environmental policy is usually one of the first, if not the first, steps in developing an EMS [9]. It establishes an overall sense of direction and sets the guidelines for environmental actions by the organization in place. Senior management must be clearly behind an EMS for the initiative to succeed [10]. While senior management can demonstrate commitment by lending their names to widely

distributed environmental policy statements, actions carry more weight than words like forming an environmental committee at the board of directors' level. Organizations must commit sufficient management time, staff and financial resources to deal with environmental issues that will improve the organization's chances of sustained growth and success [11]. Ultimately the test of commitment is how well environmental policies are integrated into the decision making processes of the organization [12].

Welford [13] also suggests that for any organization committed to improving its environmental performance, the starting point must be to make a clear statement of that commitment through an environmental policy. Appropriate organizational structures must also be set up with clear lines of authority and communication channels. All activities of the organization should be identified and documented. Environmental audits and reviews need to be carried out. The environmental impact of products must be evaluated via life cycle assessments. The integration of product launch goals into the product design process is an important one. If environmental goals are not emphasized at the corporate level and communicated to product launch teams, then the path of least resistance is to simply discount them. Experience has shown that designers are not motivated to reduce waste unless organizational leaders provide the structure, goals and incentives to do so. When environmental goals are not explicitly translated into product launch goals, the result is a remedial "end-of-pipe" solution.

The importance of top management commitment and support has been emphasized by various authors [14][15][16][17][18][19] in terms of provision of resources for carrying out the activities needed to reduce a product's environmental impact and also to establish clear environmental goals. This refers to aspects such as the provision of resources for carrying out the activities needed to reduce a product's environmental impact. Another important management responsibility is to establish clear environmental goals. This implies that environmental considerations should be addressed as business issues, i.e. the environmental considerations need to be balanced against commercial aspects [20] [21] [19]. It also implies that not only the operational dimensions of eco design should be considered, but also the strategic dimensions [22] [23].

However, top management commitment is difficult to get for ECM implementation in India as top managers are interested in getting the one time clearance of the projects from the regulatory authorities. It has been observed that top managers are more interested in the opinion of the people external to the organization. Thus various measures for top management commitment in ECM implementation can be summarized as:

- i) Top management commitment for ECM is visible to all employees
- ii) Organization has an explicit environment policy/vision
- iii) Environmental issues are addressed as business issues
- iv) Written strategy to guide organization to achieve environmental vision of the organization
- v) Top management monitors the progress in ECM
- vi) Regular financial resources are allocated for ECM development
- vii) Periodic environmental audits are done

Middle Management Commitment

An interesting paradox for ECM is that it may be easier to get top management support than support from middle management. Top management, by virtue of its position, can see the big picture and the broad issues. In contrast, middle management often lacks this perspective and their focus is often narrow, confined to issues of quality and productivity. If it adversely affects this, they will be against it. If it has no impact, they will be indifferent to it. If ECM improves quality and/or productivity, they will embrace it readily. Middle management must be involved in fixing goals/targets of ECM and an implementation document must be prepared. Proper training programmes must be conducted for them to broaden their perspective on one hand and to develop competency to implement ECM on other hand. This will help management to create some ECM champions at middle level to percolate the ECM vision/mission to bottom. Thus the various variables or items which can be used for the measurement of middle management commitment to ECM can be summarized as:

- i) Middle management is involved in environmental policy development
- ii) Environmental goals/targets to be achieved clearly conveyed to the middle management
- iii) There is a documented ECM implementation methodology
- iv) ECM implementation improves productivity
- v) ECM implementation improves quality
- vi) Environmental awareness / training / competence programs conducted for middle management

III. EMPLOYEE EMPOWERMENT

To implement the corporate policy, management must ensure the total involvement of employees. Organizations may have environmental experts at plant level but they are not familiar with production and design processes. They lack detailed knowledge of what takes place in the various processes. So, instead of imposing the task of ECM implementation to these experts, environmental experts should be used as part of broader environmental team/teams encompassing representatives from every function of the processes or products. Central to these teams should be the users or those who work directly with the processes that create the environmental problems. The central player on the team looking at production problems on the shop floor should be the operator at the station that generated the problem. It is these people who will ultimately determine the success or failure of ECM initiatives.

Dechant and Altman [24] examined the best practices of firms that were successful at managing environmental issues and identified five common practices. The authors also emphasize that in order to manage change better, it is necessary to conduct assessments of environmental projects, manage human resources, employees share the common vision and are empowered to act on it. They suggest that adequate training will also be needed for employees to avoid costly environmental mistakes and to increase environmental awareness. They also suggest that there is a need to hold managers accountable for environmental performance by linking merit systems to the achievement of environmental goals. "Empowerment" recognizes the importance of leadership and the corporate vision in achieving environmental excellence. "Empowerment"

comprises involvement of employees in setting specific environmental goals to achieve the corporate environmental vision and the creation of "green" teams to implement environmental projects. "Education" consists of open communications and disclosures by the companies to their customers, suppliers, employees, regulators and other stakeholders with regard to environmental performance and practices. To ensure commitment to environmental policies, there is a need to decentralize environmental management. Everyone associated with the business must be involved in environmental management, including suppliers, customers and employees. Training and education programs are thus essential for employees. An environmentally proactive company should also engage in monitoring, auditing and reporting its environmental performance. People participation, team work and empowerment are important drivers for environmental system building and implementation. The various variables or items which can be used to measure the employee empowerment in an organization for ECM implementation are:

- i) There are teams to tackle environmental issues
- ii) Employees are empowered to handle environmental problems
- iii) Employees are actively involved in process of determining environmental goals/targets
- iv) Employees are encouraged to give suggestions on environmental performance improvement
- v) Employees are recognized for their contribution to environmental performance improvement
- vi) Organization has a framework for evaluating quality of employee participation in ECM

IV. CASE STUDY

A study of Indian large enterprises has been done to study the effect of management commitment and employee empowerment in ECM implementation. The various variables/measures identified in the last sections to measure the top management commitment, middle management commitment and employee empowerment were discussed with the ECM practitioners working in Indian large enterprises. This led to the development of a questionnaire.

To ensure understandability of the questionnaire, the questions were critically reviewed for their clarity and content many times and some modifications were incorporated in the questionnaire before finalizing it for printing. A five point Likert scale was used to allow respondents to respond to the survey items as given in appendix. Once the questionnaire was ready, the next step was to select the sample of respondents as samples should be those for whom the instrument is intended. So, the persons working at the level of managers and above were selected having at least 5 years of experience and responsible for various manufacturing activities of the industry. Pre-testing of the questionnaire was done to ensure the accuracy by providing it to 2 academicians and 2 industrial professionals having knowledge of the subject.

This questionnaire was sent to more than 2000 Indian companies through mail (*speed post*) and out of which 285 responses were received. Questionnaire was designed as a research instrument with the intention to make a sincere effort to tap the collective wisdom of the professionals within the various industries. The chosen companies were having number of employees ranging from less than 50 to

more than 500. The 285 respondents by type of industry, business segment and size of organization are given in tables 1-3 respectively. Approximately 19% responses were from the large enterprises. Rest of the paper analyses these responses only.

Table 1: Respondents by type of industry

Type of Industry	Percentage of response
Tiny/Micro	10
SSI	47
Medium Scale	24
Large Scale	19

Table 2: Respondents by type of business segment

Business Segment	Percentage of response
Textile	05
Chemical	06
Rubber/Plastic	05
Cement	01
Fabrication	03
Machinery	10
Electrical & Electronics	08
Automotive	13
Pharmaceutical	06
Steel/Iron	14
Food	12
Others	17

Table 3: Respondents by size of organization

No. of Employees	Percentage of response
No. of employees < 50	50
No. of employees 50 - 200	24
No. of employees 200 – 500	13

V. DATA ANALYSIS AND DISCUSSION

To arrive at a set of highly correlated items for further analysis, purification is carried out by corrected item minus total correlation (CIMTC). In order to initially assess the internal consistency of the items, an inter item correlation matrix was constructed for each factor. In purification process, items are eliminated if their CIMTC is very less. CIMTC is the Pearson correlation coefficient between the score on the individual item and the sum of the scores on the remaining items. Items having a relatively low correlation (≤ 0.30) with the other items have to be deleted prior to further analysis. Table 4 provides the detailed statistics of the sample and the CIMTC for the items. It shows that the CIMTC values of all variables range from 0.5430 – 0.8522. None of the characteristics is deleted because of CIMTC as the values are above the minimum of 0.3.

The data obtained by survey shows a high value of mean (minimum being 3.9020) for all measures with a maximum standard deviation of 1.1031 which implies that the data obtained reflect high importance to all variables identified for management commitment and employee empowerment. Next sections analysis the data for assessing importance, reliability and validity of the proposed management commitment and employee empowerment measures:

Table 4: Importance index analysis, Item Statistics & CIMTC

S. No.	Item Code		Mean	Standard Deviation	Importance Index	CIMTC
Top Management Commitment						
1	TMC1	Top management commitment for ECM is visible to all employees	4.2745	0.9398	0.807	0.7466
2	TMC2	Organization has an explicit environment policy/vision	4.3137	0.9272	0.815	0.7970
3	TMC3	Environmental issues are addressed as business issues	3.9020	0.0051	0.735	0.5430

4	TMC4	Written strategy to guide organization to achieve its environmental vision	4.0392	0.9790	0.767	0.8142
5	TMC5	Top management monitors the progress in ECM	4.1373	0.9802	0.778	0.8321
6	TMC6	Regular financial resources are allocated for ECM development	4.0980	1.0051	0.760	0.8340
7	TMC7	Periodic environmental audits are done	4.2353	1.0505	0.796	0.7919
Middle Management Commitment						
1	MMC1	Middle management is involved in environmental policy development	3.9184	1.0376	0.713	0.6226
2	MMC2	Environmental goals/targets to be achieved are clearly conveyed to the middle management	4.0408	0.8650	0.735	0.7882
3	MMC3	There is a documented ECM implementation methodology	4.0204	0.9680	0.727	0.7038
4	MMC4	ECM implementation improves productivity	4.1429	0.9574	0.753	0.6861
5	MMC5	ECM implementation improves quality	4.1429	0.9574	0.753	0.7318
6	MMC6	Environmental awareness /training /competence programs conducted for middle management	4.0408	1.0400	0.735	0.6568
Employee Empowerment						
1	EMI1	There are teams to tackle environmental issues	4.1346	1.1031	0.782	0.8246
2	EMI 2	Employees are empowered to handle environmental problems	4.0000	0.9701	0.756	0.8522
3	EMI 3	Employees are actively involved in the process of determining environmental goals/targets	3.7308	0.9725	0.705	0.7422
4	EMI 4	Employees are encouraged to give suggestions on environmental performance improvement	4.0962	0.9754	0.775	0.8352
5	EMI 5	Employees are recognized for their contribution to environmental performance improvement	4.0385	0.9694	0.764	0.8393
6	EMI 6	Organization has a framework to evaluate quality of employee participation in ECM	3.7500	1.0073	0.709	0.6550

VI. IMPORTANCE INDEX ANALYSIS

The numerical scores from the questionnaire provided a measure of strength of opinion of the effect of each item on the success of project. These are subsequently transformed into relative importance index using the following formula:

$$\text{Importance Index of item/variable } x \text{ (Ix)} = \left(\frac{\sum_{i=1}^5 a_i x_i}{5 \sum_{i=1}^5 x_i} \right)$$

Where: a_i = Constant expressing weight given to i

x_i = Variable expressing frequency of response for i

$i = 1, 2, 3, 4, 5.$

The importance indices range from zero to 1. The value of 'i' varies from 1 to 5 and the corresponding values of 'a_i' will be a₁, a₂, a₃, a₄, and a₅ respectively where a₁=1, a₂=2, a₃=3, a₄=4, and a₅=5. These indices reflect the relative importance of the variables listed in the questionnaire. The importance indices have been classified into five categories to reflect the respondents' ratings as follows:

- Very important: $0.8 < I_x \leq 1.0$
- Important: $0.6 < I_x \leq 0.8$
- Preferred: $0.4 < I_x \leq 0.6$
- Less important: $0.2 < I_x \leq 0.4$
- Not important: $0 < I_x \leq 0.2$

The importance index analysis for top management commitment, middle management commitment and employee empowerment characteristics given in table 4 shows that three items are very important (importance index above 0.8 but less than 1.0) and all the other identified items are important (importance index above 0.6 but less than 0.8). Table 4 also shows the importance index analysis results for various middle management commitment and employee empowerment characteristics for ECM.

Reliability Assessment

Reliability refers to the degree of dependability and stability of data. Reliable measures will produce the same results each time it is administered to the same person in the same setting. The internal consistency method works quite well in field studies because it requires only one administration. Also, it is the most general form of reliability estimation.

The internal consistency of a set of measurement items refers to the degree to which items in the set are homogeneous. Internal consistency can be estimated using reliability coefficient, such as Cronbach’s alpha. Prior to further analysis, using the SPSS, reliability coefficient (Cronbach’s alpha) was calculated for each benefit. An alpha value of 0.70 is often considered as the criteria for internally consistent established performance measures/ constructs/scale.

Flynn et al.[25] suggested three methods to improve the reliability coefficient. First, the constructs should be accepted without any changes if it has a strong alpha value (at least 0.70), with consistent item inter correlation values. Second, constructs with acceptable (at least 0.60), but not high, alpha values should be further analyzed to determine whether alpha could be improved by removal of some items.

Table 5 provides the summary of the internal consistency analysis. The Cronbach’s alpha (α) value for the top management commitment and employee empowerment is above 0.9 and for middle management factors the value is 0.8860. This reflects excellent reliability of the data collected. The high value of correlation coefficients (minimum value of mean correlation coefficient is 0.5643) for the data also shows that the identified benefits have high correlation among them.

Table 5 : Summary of internal consistency analysis

Factor (No. of factors)	Final Cronbach’s Alpha	Item Mean (Range)	Mean of Correlation Coefficient	Range of Correlation Coefficient
TMC (7)	0.9253	4.1429 (3.9020-4.3137)	0.6388	0.4314-0.8387
MMC (5)	0.8860	4.0510 (3.9184-4.1429)	0.5643	0.4105-0.8636
EMI (6)	0.9282	3.9583 (3.7308-4.1346)	0.6828	0.5104-0.8078

The three measures for large scale enterprises have excellent internal consistency ($\alpha > 0.8$) as shown in table 5. The correlation coefficient values are high (minimum of 0.5643 and maximum of 0.6828). Cronbach’s alpha values of 0.8860, 0.9253 and 0.9282 demonstrate that the developed performance measures characteristics are highly reliable.

VII. VALIDITY ASSESSMENT

Validity refers to the degree to which items truly measure the factors which they intend to measure. Factor analysis has been used on the data collected through survey to validate the data. Factor analysis addresses the problem of analyzing the interrelationships among a large number of variables and then explaining these variables in terms of their common underlying dimensions (factors).

There are two forms of factor analysis, namely, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).The EFA is designed for a situation where links between the observed and latent variables are unknown or uncertain. The analysis thus proceeds in an

exploratory mode to determine how and to what extent the observed variables are linked to their underlying factors. Factor loading is used to present these relations. The EFA helps to identify whether selected items cluster on one or more than one factor. The uni-dimensionality of factors is thus assessed. Usually, three or more items are selected for a latent variable or construct. However, the aim of CFA is to test or confirm a pre-specified relationship between factors and latent variables. EFA was carried out for validation of the underlying factors. In general, there are two steps in a factor analysis: (1) the extraction of factors; and (2) the rotation of factors. The former finds the number of factors and the latter obtains a clear picture of what these factors represent.

Factor analysis

Factor analysis was conducted on characteristics under each measure based upon principal components analysis with Varimax rotation using the statistical computing package SPSS 11.5 for Windows. Factors were extracted if Eigen value was over one. The Eigen values for top Management commitment, middle management commitment and employee empowerment measures were 4.876, 3.831 and 4.431 respectively. The results of the factor analysis are shown in Table 6. All characteristics were found to be uni-factorial. All variables share high variance with each other and therefore will be useful in defining its measure. The factor loadings for all measures, which represent the correlation between the variables and their respective factors, are given in table 6. Factor loading of ± 0.45 are considered to be significant. In this study all factor loadings exceeded 0.6 thereby all characteristics contribute highly to the respective factors. Thus, the findings indicate that the factors have construct validity.

Table 6: Factor Analysis

S. No.	Item Code	Factor Loading
Top Management Commitment		
1	Top management commitment for ECM is visible to all employees	0.775
2	Organization has an explicit environment policy/ vision	0.781
3	Environmental issues addressed as business issues	0.806
4	Written strategy to guide organization to achieve its environmental vision	0.771
5	Top management monitors the progress in ECM	0.766
6	Regular financial resources are allocated for ECM development	0.677
7	Periodic environmental audits are done	0.724
Middle Management Commitment		
1	Middle management is involved in environmental policy development	0.730
2	Environmental goals/targets to be achieved are clearly conveyed to the middle management	0.744
3	There is a documented ECM implementation methodology	0.800
4	ECM implementation improves productivity	0.822
5	ECM implementation improves quality	0.846
Employee Empowerment		
1	There are teams to tackle environmental issues	0.904
2	Employees are empowered to handle environmental problems	0.867
3	Employees are actively involved in the process of determining environmental goals/targets	0.892
4	Employees are encouraged to give suggestions on environmental performance improvement	0.855
5	Employees are recognized for their contribution to environmental performance improvement	0.822
6	Organization has a framework to evaluate quality of employee participation in ECM	0.747

VIII. CONCLUSIONS

This paper identifies the top management commitment, middle management commitment and employee empowerment measures for environmentally conscious manufacturing using an empirical study of Indian large scale enterprises. Further the identified characteristics have been statistically validated using SPSS statistical tool. The importance index analysis, reliability assessment and validity assessment of the data obtained from Indian large scale enterprises demonstrate that the measures can be used by different researchers and practitioners for the assessment of management commitment and employee empowerment during ECM implementation. Organizations can measure the top management commitment for ECM in term of availability of an explicit environment policy/vision imbuing the core business issues, availability of written strategy to achieve this vision, interest shown by top management in term of monitoring ECM progress, allocating financial resources and getting environmental audits done regularly. The five middle management commitment measures for ECM are: involvement of middle management in environmental policy development, understanding environmental goals/targets to be achieved, documentation of ECM implementation methodology, improvement of quality and productivity. The six employee empowerment measures are in term of formation of teams to tackle environmental issues, empowerment of employees to handle environmental problems, active involvement in the process of determining environmental goals/targets, encouragement to give suggestions on environmental performance improvement, recognition for the contribution to environmental performance improvement and existence of a framework for evaluating quality of employee participation in ECM.

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