

Study of the Critical factor Finding's regarding evaluation of Green supply chain Performance of Indian Scenario for Manufacturing Sector

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Abstract

The research outcome based on the the Critical factor Finding's regarding evaluation of Green supply management Performance of Indian Manufacturing Sector. For that objective research mainly carried out for the two major supply chain activities such as Green Sourcing & Procurement, Green Manufacturing & production. The finding will help to identify the critical factor that helps to measure the performance of any organization which is responsible for the impact on the environment due to their activities. To justify these critical factors we conduct a survey covering various clusters of Indian manufacturing and collect some important results in terms of their performance. In the end tried to discuss these facts in terms of cost-profit analysis which helps and motivates manufacturer to shift their steps towards eco-friendly supply chain.

Keywords: *Critical Factors, Indian Manufacturing Sector, cost-profit analysis, eco-friendly supply chain.*

1. Introduction

To make products and services green the businesses need to focus on bringing the green in various aspects such as:

1. Raw Material
2. Manufacturing
3. Product Innovations /development
4. Alternative Ingredients
5. Supply Chain
6. Packaging

It is not enough just to develop a brand or a logo, or invest in an advertising campaign, and then position a product as

Green before consumers. Like any other new concept, marketers must first educate the public about going green, ensure product credibility, and establish trust. Moreover, since "Green" aspect of the product is not a tangible attribute that the consumers receive the consumer has to be convinced about the benefits of the green benefits of the product. It is also important to understand how companies across the globe are innovating and creating "Green" products [4].

Green in Manufacturing: - This focuses on using renewable energy for production and minimizing air and water pollution during the manufacturing process. Energy Star is helping businesses and consumers save money and check pollution. Energy star has its own pre defined parameters and gadgets which conform to the energy efficiency standards. The businesses that join hands with energy star sign an MOU and upgrade their facility as per the requirement outlined by Energy Star. There are about 2,400 corporations, hospitals, schools and other organizations, which are energy star compliant in the US today. The real estate developers, architects and environmentalists across the globe are working together to create the next wave of modern eco-friendly projects: green buildings and manufacturing facilities. They are using energy conservation appliances and recycling building products and water harvesting techniques in their projects.

McDonald's is often blamed for polluting the environment because much of their packaging finishes up as roadside waste. It must be remembered that it is the uncaring

consumer who chooses to dispose of their waste in an inappropriate fashion. With the intent to cut costs and work on eco-friendly image and practices McDonald's tried to reduce the amount of material disposed by its stores. McDonalds asked the supplier to do away with the cartons for napkins. The supplier suggested a better way and came up with dimpling pattern on napkins, which enabled the supplier to pack 25% more napkins in one box and reduction in shipping cost accordingly.

McDonalds also allied with Environment Defence Fund (EDF) and created a waste reduction plan. It also made a Paper Task Force to focus on paper waste reduction and better solid waste management. Some food chain retailers are working on Green Procurement program to help purchasing officers to buy products and services that have a lower environmental impact than comparable products and services.

Green in Packaging: - Packaging is a key element of marketing mix for promoting "Green washing". It can also be an effective tool to display the "Green" component of the product. Such as Natural Package for a Natural Product. When creating product materials, markets need to remember that a "Green" product is appealing to consumers for its benefits to the environment and for its roots in natural resources. There should be a consistent look for the product package, or materials that appear natural, not glossy or extravagant. "Green" consumers tend to appreciate consistence in package and product. They will appreciate the usage of recycled paper and other environment friendly materials. That will help manufacturers/suppliers gain customer loyalty and product credibility.

2. Key Objectives

Objective [A] - Green Sourcing & Procurement

Green procurement is defined as an environmental purchasing consisting of involvement in activities that include the reduction, reuse and recycling of materials in the process of purchasing. Besides green procurement is a solution for environmentally concerned and economically conservative business, and a concept of acquiring a selection of products and services that minimizes environmental impact .The purpose of green procurement is to reduce the load on environment caused by our business activity by actively purchasing environmentally-friendly materials and parts, and devote to the global environmental conservation by delivering the environmentally-friendly products to customers. This standard must be followed for all materials and parts necessary for production. Environmental considerations

forms part of the evaluation and selection criteria, which could cover, depending on goods and services to be purchased, their manufacture, transport, packaging and disposal. [5]

Objective [B]- Green Manufacturing & production

Green manufacturing is defined as production processes which use inputs with relatively low environmental impacts, which are highly efficient, and which generate little or no waste or pollution. Green manufacturing can lead to lower raw material costs, production efficiency gains, reduced environmental and occupational safety expenses, and improved corporate image. Green Production is therefore an organization strategy that focuses on profitability through using environmentally friendly operating processes. None of the above will be a surprise to most readers as most people believe they are already doing the maximum possible both to reduce waste and to maximize recycling. However, a closer examination of an organizations production processes, technologies, and material flows reveals constraints that most people actually accept as fixed. Therefore these constraints are holding them back from moving towards real Green Production. [6]

Adoption of Green Production has also become necessary to stay ahead in a competitive market. Where competitors are moving towards Green Production, it becomes imperative for the organizations to keep up and to try and stay ahead of the competition there is also a growing consumer awareness of the environmental impacts of purchased products.

Consumers are not only increasingly aware of the products production processes, but are demanding that these be updated in order to reduce any environmental pollution and material wastage. Old processes are therefore seen as uneconomical and at times unusable in producing eco - friendly products. For this reason, the adoption of Green Production helps organizations to enhance their image in the eyes of all stakeholders such as the public, consumers, employees, governments, and policy makers.

3. Key Findings

Critical Factor finding regarding performance measure of Green supply chain management of the Indian manufacturing sector [i.e. NGO, Government organizations]. These finding comes from the literature survey

3.1 Literature Survey analysis- Qualitative Approach

Objective [A]:- Green Sourcing & Procurement

Green Purchasing, also known as Environmentally Preferable Purchasing (EPP). Before an organization can go green, it has to want to go green. Why should an organization want to be green?

Brand Image: - An organization that has gone green is seen as a good corporate citizen. This increases its image in the eyes of the public.

Customer Satisfaction: - An organization that goes green in response to customer concerns increases its levels of customer satisfaction, a key point in customer retention.

Reduced Risk :- Not only is any company that does not go green risking a run in with the law by failing to comply with green regulations, which are multiplying at the rate of Fibonacci's rabbits around the world, but it is also maintaining more liability than it needs to. Hazardous chemicals are just accidents, and lawsuits, waiting to happen. With green purchasing, you can offset financial and environmental risk, rather than just inheriting it from your suppliers.

Cost Reduction: - Going green can reduce the following costs, among others like hazardous material management costs, operational costs, repair and replacement costs, disposal costs and health & safety costs (which often come in the form of liability insurance and expensive settlements). [3]

List of critical factor with respect to objective function

(A1) Substitute for hazardous material

- (A11) Employ green friendly design and product lifecycle management in sourcing strategy

(A2) Improved quality & Minimal usage of raw material

- (A21) Use of electronic processes to create efficiencies

(A3) Supplier development

- (A31) Embed "sustainability" into supplier relationships
- (A32) Work with suppliers on green SCM guidelines
- (A33) Audit suppliers for green SCM compliance

(A4) Reduced resource

- (A41) Reduce use of paper in contracts
- (A42) Localised sourcing for JIT
- (A43) Others

Objective [B]:- Green Manufacturing & production

Green manufacturing is that production process which use inputs with relatively low environmental impacts, which are highly effective, and which generate little or no waste or pollution. In manufacturing,

1. Don't use toxic chemicals or hazardous materials
2. Install water conservation technology
3. Design for re-use
4. Design for recycle
5. Design for minimal packaging requirements
6. Design for scrap and waste minimization
7. Don't over produce

Manufacturing can be very wasteful. For example, it takes, on average, the excavation of three (3) tons of waste rock and ore to produce the 1/10th of an ounce of pure gold required for one 14-carat wedding ring. (So, unless absolutely necessary, avoid products that unnecessarily contain gold!)

List of critical factor with respect to objective function

(B1) Process design

- (B11) Recycling programs for raw materials
- (B12) Recycling programs for reusable components parts
- (B13) Implementing ongoing assessment to measure and ensure Green SCM compliance
- (B14) Reducing CO_2 in manufacturing processes

Using or reusing wastes as ingredients in a process or as an effective substitute for a commercial product, or returning the waste to the original process which generated it as a substitute for raw material feedstock. [2]

(B2) Product design

- (B21) Including recycling in new product design
- (B22) Increasing product robustness in product design

(B3) Higher efficiency

- (B31) Measuring your company's carbon footprint
- (B32) Applying carbon off-setting
- (B33) utilization of fuel efficient tools & machines
- (B34) Other

(B4) Employee satisfaction

- (B41) Improved Labour management

3.2 Cost –profit analysis of the factors - Quantitative Approach

According to the analysis of the two main activities such as green procurement and green production few of the activities are found to be cost added activity means might needs some initial investment to start up these activities to become green organization and rest few activities are found to be profit added activity which will be added the profit of the organization just needs to implement these and but in summary all the above activities either belongs to cost added and profit added activity but for the environment is concerned all are the just valuable initiatives towards green supply chain. As shown in Table 1.

Table 1: Cost –Profit analysis of the green supply chain activities

Objectives	Indicator	Kind of Activity
[A] Green Procurement	(A1) Substitute for hazardous material	Cost Added Activity
	(A2) Improved quality raw material	Cost Added Activity
	(A3) Supplier development	Cost Added Activity
	(A4) Reduced resource consumption	Profit Added Activity
	(A5)Minimal usage of raw material	Profit Added Activity
[B]Green Production	(B1) Process design	Cost Added Activity
	(B2) Product design	Cost Added Activity
	(B3) Higher efficiency	Profit Added Activity
	(B4)Employee satisfaction	Profit Added Activity

3.3 Cluster Analysis – An Quantitative Approach

Clustering method developed by Hartigan and Wong (Hartigan and Wong 1979) to determine cluster membership. Generating five manufacturing sectors/Industries clusters that can be useful as a way to help manufacturing sectors/Industries look beyond their income-level or geographic peer groups for models of environmental success in manufacturing sectors/Industries facing similar challenges.

Within each peer group, manufacturing sectors have a better basis for benchmarking their environmental performance because the group members are similar with respect to the indicators used for the classification. This provides a good starting point in the search for best practices.

With the help of this technique we represents the outcome or evaluate the performance of various survey industries in terms of clusters out of which 45% lies in the medium sustainable category but only 4% out of 100 survey industries are lies in the category of the most sustainable. 40 % lies in the less and least sustainable category.

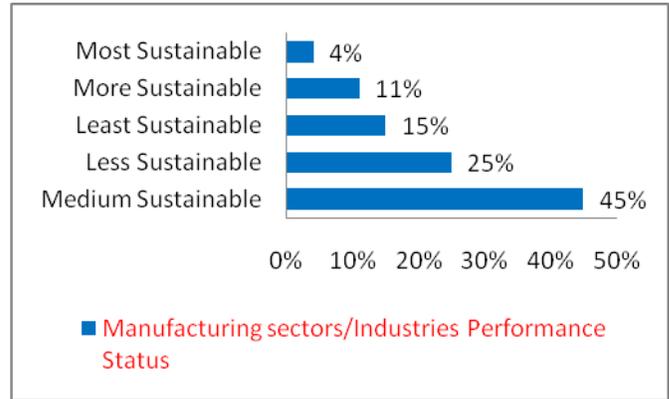


Fig. 1 Manufacturing sectors/Industries Performance Status based on the cluster analysis technique

Cluster group 1:- Least Sustainable [0.00 – 2.00] Score Range

Attributes	Manufacturing sector
Lower GPI for Manufacturing sectors is an indication of challenges in sustainable development due to higher pollution and degradation, more stress on the ecosystems and/or less responsive policies and institutions	15 % out of 100 survey industries lies in the lagging category towards the sustainability capability out of which 1. Hand Tools & Cutting Tools Manuf. [2%] 2. Auto parts & Spare Parts Manuf. [3%] 3. Industrial Equipments (Agro, Electrical & Safety) , Machinery , Components/ Parts Manuf. [6%] 4. Various Others Manuf. [4%]

Cluster group 2:- Less Sustainable [2.01 - 4.00] Score Range

Attributes	Manufacturing sector
Slightly above the Lower GPI for Manufacturing sectors/Industries is an indications to sectors likely to experience increasing environmental problems unless appropriate	25 % out of 100 survey industries i.e. ¼ ratio lies Slightly above the lagging sectors category towards the sustainability capability out of which 1. Hand Tools & Cutting

	Tools Manuf. [7%] 2. Auto parts & Spare Parts Manuf. [6%] 3. Industrial Equipments (Agro, Electrical &Safety) , Machinery , Components/ Parts Manuf. [7%] 4.Various Others Manuf. [5%]
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Cluster group 3:- Medium Sustainable [4.01 – 6.00] Score Range

Attributes	Manufacturing sector
Middle range of the GPI score for Manufacturing sectors/Industries is an indications of sectors Moderately sustainable manufacturing sectors	45 % out of 100 survey industries lies i.e. nearly half the ratio lies in the middle range category towards the sustainability capability out of which 1. Hand Tools & Cutting Tools Manuf. [12%] 2. Auto parts & Spare Parts Manuf. [10%] 3. Industrial Equipments (Agro, Electrical &Safety) , Machinery , Components/ Parts Manuf. [14%] 4.Various Others Manuf. [9%]

Cluster group 4:- More Sustainable [6.01 – 8.00] Score Range

Attributes	Manufacturing sector
Slightly above the Middle range of the GPI score for Manufacturing sectors/Industries is an indications of sectors Manufacturing sectors/Industries with potential to maintain their environment	Results of 11 % out of 100 survey industries very much better than the middle range lies in the slightly above performer category towards the sustainability capability out of which 1.Hand Tools & Cutting Tools Manuf. [4%] 2.Auto parts & Spare Parts Manuf. [4%] 3.Industrial Equipments (Agro, Electrical &Safety) , Machinery , Components/ Parts Manuf. [2%] 4.Various Others Manuf. [1%]

Cluster group 5:- Most Sustainable [8.01 – 10] Score Range

Attributes	Manufacturing sector
Higher GPI for Manufacturing	Only 4 % out of 100 survey industries lies in the leading

sectors/Industries indicates the sectors/Industries has the benefit of better environmental quality and/or policy thus creating the potential to maintain its environment in the future	category towards the sustainability capability out of which 1.Hand Tools & Cutting Tools Manuf. [1%] 2.Auto parts & Spare Parts Manuf. [1%] 3.Industrial Equipments (Agro, Electrical &Safety) , Machinery , Components/ Parts Manuf. [1%] 4.Various Others Manuf. [1%]
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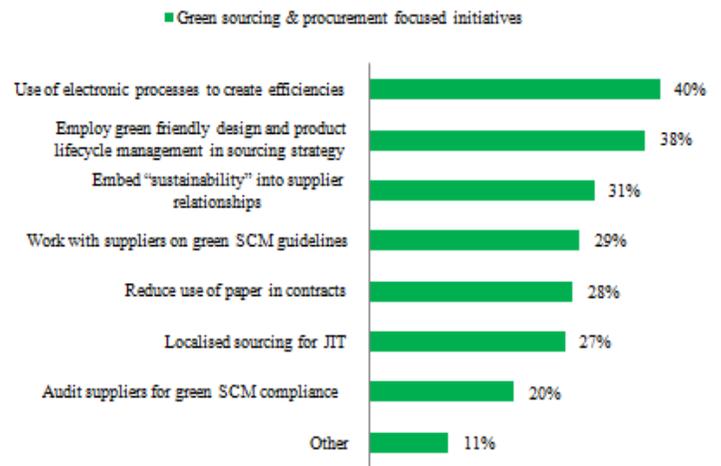


Fig. 2 Green sourcing & Procurement focused initiatives of Indian manufacturing sectors

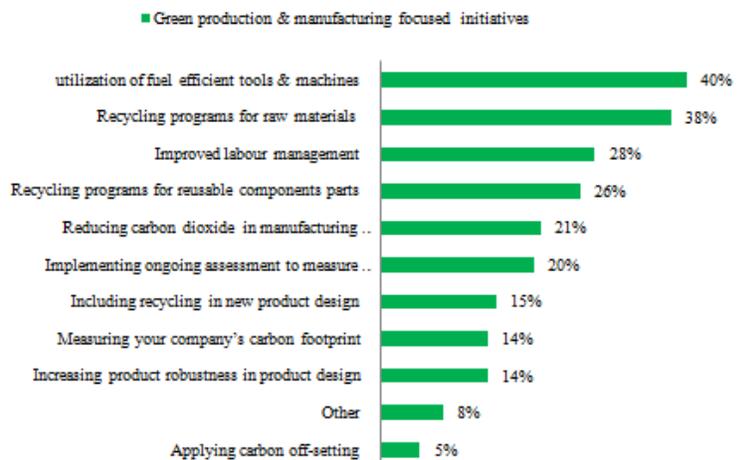


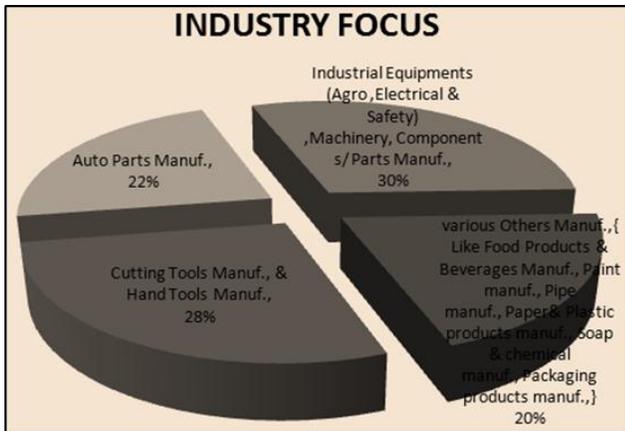
Fig. 3 Green Production & Manufacturing focused initiatives of Indian manufacturing sectors

4. Conclusions

Unveiled at the Copenhagen summit on global climate change in December 2009, India's plans to reduce carbon emissions by up to 45% by 2020 are a telling sign of where the country is headed in terms of green initiatives. While we have seen a lot of hype around the topic of "green" in India, there is still considerable fuzziness about how action is being taken. In order to gain a better understanding of the reality of green supply chain management in India, we teamed up to research the topic. Insights were not surprising and confirmed that green SCM (Supply Chain Management) awareness is high and is perceived as a competitive advantage for companies in India. Adoption of green SCM practices is highest in areas where there is a correlation to efficiency and cost savings are lowest in areas where there is no direct cost or efficiency benefit. Overall, the results show that the market is shifting and having a green supply chain is becoming a top priority.

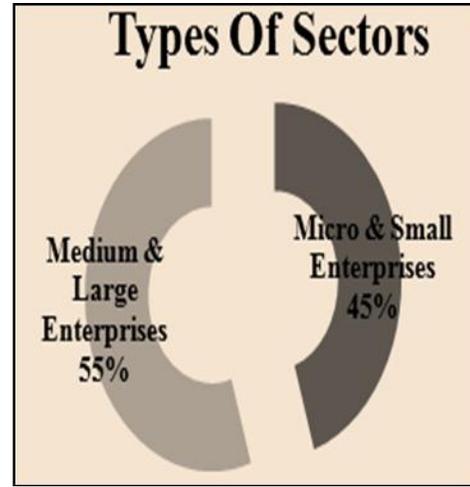
METHODOLOGY

A total of 145 respondents took part in the Green Supply Chain in Indian Manufacturing Sectors Survey. The survey part was done between the period of mid- Oct to Mid – Nov. Due to the time constrains to complete the project on time we covered the manufacturing sectors of the Major Punjab region various Industrial cities. Questions were geared toward understanding current awareness, perceptions, practices and the future direction companies are taking towards green supply chain management in Indian manufacturing Sectors.



INDUSTRY FOCUS: - Respondents to the survey came from a variety of industry sectors {Micro, Small, and Medium & Large Enterprises}. Major Categories we covered are Hand Tools & Cutting Tools Manuf. [28%], Auto Parts Manuf. [22%], Industrial Equipments (Agro, Electrical & Safety), Machinery, Components/ Parts

Manuf. [30%], & various Others Manuf. [20%], { Like Food Products & Beverages Manuf., Paint manuf., Pipe manuf., Paper, Rubber & Plastic products manuf., Soap & chemical manuf., Packaging products manuf., }



Future Scope for Green Supply chain Research

As like above there are so many qualitative and quantitative techniques and methods needs to be developed to evaluate the performance of the various clusters of the sectors. Even if others researchers followed the same research methodology that is applied above needs to finds more possible factors which will helps to evaluate the environmental impact and also needs to involve more supply chain activities and also have to develop the list of questioners involving that new factors and activities.

References

[1] Ashish.Kumar.Bhateja, Rajesh. Babbar, Sarbjit. Singh, Anish. Sachdeva, " Study of Green Supply Chain Management in the Indian Manufacturing Industries: A Literature Review cum an Analytical Approach for the measurement of performance ", IJCEM International Journal of Computational Engineering & Management, Vol. 13, July 2011 ISSN (Online): 2230-7893.
 [2] M.Atlas, and R.Florida, Green manufacturing : Handbook of Technology Management, 1998.
 [3] Qinghua.Zhu ,Yong.Geng, Joseph.Sarkisand Kee.hung .Lai , " Evaluating green supply chain management among Chinese manufacturers from the ecological modernization perspective " , Transportation Research Part E: Logistics and Transportation Review , Vol. 47, Issue 6 , Nov 2011.
 [4] G.J.L.Micheli, E.Cagno & Zorzini, " Green supply chain management in Italy: pressures, practices and performance " EurOMA Conference: Cambridge, 2011.
 [5] Xianbing.Liu & Jie.Yang. " Sustainable Production: Practices and Determinant Factors of Green Supply Chain Management of

Chinese Companies “, Business Strategy and the Environment, vol. 20, issue 6, 2011.

[6] DJ.Closs & C.Speier , " Sustainability to support end-to-end value chains: the role of supply chain management " , Journal of the Academy of Marketing Science , Vol. 39, Number 1, 101-116, 2011.

[7] Francesco.Ciliberti, Pierpaolo.Pontrandolfo & Barbara .Scozzi, " Small Business Social Responsibility in the Supply Chain: A Literature Review " , The International Society of Business Economics and Ethics Book Series, Vol. 2, Part 4, 291-311,2011.

[8] Ali.Diabat & Kannan.Govindan , " An analysis of the drivers affecting the implementation of green supply chain management Resources, Conservation and Recycling " , Environmental Supply Chain Management , Vol. 55, Issue 6, Pages 659-667 , April 2011.

[9] Anne.Parmigiani , Robert.D.Klassen , " Efficiency meets accountability: Performance implications of supply chain configuration, control, and capabilities " , Journal of Operations Management, Vol. 29, Issue 3, Pages 212-223 , March 2011.

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