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Impact of Integration of Lean Manufacturing with Green Supply Chain Management in Small and Medium Scale Industries

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ABSTRACT: The aim of this paper is to identify the lean and green wastes accruing in the small scale industries in India and recommending the suitable waste reduction methods and techniques for eliminating waste i.e. implementation of Green Supply Chain. Three South Indian companies were taken into account for this paper. It is interpretative research and a brief qualitative case analysis of implementation of Green Supply Chain Management (GSCM) in South Indian SSI's. Primary data was collected through Email and Telephone interviews. The lean wastes were identified in the process which could be eliminated by practicing suitable lean tools and methods. The final disposal wastes were considered to be the green wastes. The methods of disposal practiced by the SSI's in India shows an evidence of how much they have a concern towards the environment. As a result of it a comprehensive lean and green model has been suggested for the industries which includes both lean and green waste reduction techniques and it also helps in achieving both lean and green business results.

KEYWORDS: Green Supply Chain, Small Scale Industries, Lean tools.

I. INTRODUCTION

Environmental pollution is one of the major challenges faced by human beings in day to day life. The emissions of toxic gases are from the industries and automobiles. To overcome these challenges, the industries may introduce Green practices into their business. The industries have to pay more attention in practicing supply chain for a healthier environment. This article focuses on the implementation of Green Supply Chain Management in Small Scale Industries, which contributes much to the Indian GDP. Indian Small Scale industries (SSI) play a crucial role contributing 40 % of its gross manufacture to our economy and also create employment opportunities. 45% to 50% of the Indian exports are being contributed by small scale industries. The sectors taken for this study include food processing, Garment Manufacturing and Automobile accessories manufacturing sectors. The organizations today concentrate more on their sustainability in the market by cost cutting, improving quality and reducing lead time rather than focusing on environmental challenges. Lack of awareness and reluctance has affected the environment to a great extent.

The significance of this article is to provide the organizations with practical and feasible solutions to keep the environment healthier in the future and save the universe from destruction.

Research Questions

“To profound, how does Small Scale Industries in India integrate Lean into Green Supply Chain?” In order to answer the research question authors put limelight into the set of sub questions. There are

- To what extent are the small scale industries in India aware of implementing green supply chain according to their present market demands?
- How is the management of waste considered in the life cycle process of the product and how are they disposed?
- How can these organizations integrate lean manufacturing towards Green Supply Chain Management?



Research Methodology

In order to complete this research, a survey was conducted to collect data from three small scale industries in South India, representing Automobile spare parts, Garment Manufacturing and Food Processing. This study is a descriptive research towards implementation of GSCM in Indian SSI’s. The primary data has been collected from respective respondents through email interview.

Sample and Size of the SSI

The purpose of concentrating on these three industries was able to understand the problems and obstacles they face on implementing GSCM. Only one company has been selected on each stream and deeper study has been done on the each industries.

Business	Primary Product	Position of the Respondent
Automotive spares	Bumpers, Luggage carriers	Production Manager
Fabrics	Coloring yarn and fabric	Proprietor
Food Processing	Jelly and Pudding	Director of Production and Marketing

Table 1: List of Respondents

II. LITERATURE REVIEW

Overview of Green Supply Chain Management: Zhu and Sarkis (2004) even included the concept Reverse Logistics (RL) in to the Green Supply Chain Management. The green supply chain can be practiced in organization through several internal and external drivers. New Zealand Business Council for Sustainable Development (NZBCSD) as described in their practical guide for Business Guide to a Sustainable supply chain (2003) is that the supply chain is mainly focused on three areas as central:

- ❖ Improving the performance of business’s own operations.
- ❖ Ensuring that the goods and services provided by suppliers are sustainable and working with the suppliers increases the efficiency and competitiveness.
- ❖ Working effectively with customers and sales channel to design sustainable products and services.

In Early 1990’s, Industries were exposed to traditional supply chain which focuses on cost cutting and improving the different flows within the organization but the environmental consideration was ignored (Srivastva 2007). So the research scholars and industry people redefined the traditional supply chain by adding the environmental factors in to the supply chain and also making the industries economically profitable by using this extended supply chain. According to Srivastva (2007) Green Supply Chain Management has its roots from Green management and supply chain management. He defined Green supply chain management as — *“integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life”*.

Johansson and Winroth (2009) stated that Green supply chain aims for continuous improvement of industrial processes and products to reduce or prevent pollution in air, water and land. They also suggested that by these improvements, there is a possibility of minimizing risks to human and other species. Many research scholars have conducted studies on initiating Green supply chain and implementation of it. According to the study performed by Lefebvre et al. (2000) on the SME’s in Canada, implementing green strategies into the organization helped in improving organizational innovativeness i.e. product, process and managerial innovation improved and also the organizational competitiveness (cost containment, liability management and export performance) developed. Zhu et al. (2007) addressed that environmental management system such as GSCM has made a positive impact on the organizational economic performance. Sangwan K.S. (2011) conducted a survey on quantitative and qualitative benefits of green manufacturing. Qualitative benefits were increased the market opportunities, improved product performance, decreased liability and enhanced to customer loyalty. Quantitative benefits were related to recycling of waste, reduced waste disposal cost, reduced waste storage cost, reduced waste handling cost, lowered transportation cost, decreased packaging cost and low maintenance cost.

According to Wang et al, (2003) Green supply chain is an effective way for manufacturers to manage the environmental strategies. The basic principle of Green supply chain management is to incorporate the concept of green into their product life cycle. Designing a supply chain concurrently with the product is a supply chain best practice and

the supply chain would be made more eco friendly by implementing the concept of green in each process of their supply chain. Srivastva (2007) has classified Green supply chain management in three broad categories such as green design, green operations and green manufacturing.

Activities in Green supply Chain Management: Ninlawan et al (2010) had conducted a study on Green implementation in electronic industries and intended activities of Green supply chain management starting from green procurement to green manufacturing to green distribution till recycle and waste management of the product.

Green Design of Product & Processes: Green design deals with design for waste minimization (Srivastva, 2007). The main motivation for green design is that it makes to understand how this design decisions help in developing a product more environmentally compatible (Navin-Chandra, 1991). Hazardous wastes are dumped according to their convenience. These problems can be eradicated by incorporating the concept of green in to the design process. Most of the companies believe that the green design plays a major role in cost reduction of the process. The green design implementation reduces the environmental burden and it is more efficient the traditional procedures Hendrickson et al (2001) and Johansson and Winroth (2009) suggested methods and tools used in green design process which are mass balance analysis, green indices, design for disassembly, recycling aids, risk analysis, material selection and labor advisors.

Green Procurement of product and processes: Green Procurement is defined as environmental purchasing which involves activities like reduction, reuse, and recycling of materials in the process of purchasing. It is a solution for environmentally concerned and economically conservative business. This concept minimizes environmental impact by selection of products (Salam, 2008). Supplier selection: The materials and parts should be purchased only from —“Green partners” (Zhu, et al. 2007). The suppliers who have ISO 14000 should only be considered (Sarkis, et al. 2003). The supplier who control hazardous substances in the industries and has obtained green certificate achievements can be considered has efficient supplier (Ninlawan et al., 2010) 3R’s in procurement process: The 3R’s in procurement process are Reuse/ Recycle/ Refurbish.

Green Manufacturing: According to Atlas and Florida (1998) defined Green Manufacturing as input used in production processes which is relatively less in environmental impacts and they are highly efficient and generate little or no waste or pollution. Green manufacturing aims for continuous improvement of industrial processes and products to reduce or prevent pollution to air, water and land. He also suggested that by these improvements, there is a possibility of minimizing risks to human and other species (Johansson and Winroth (2009)). Richards (1994) stated the challenges associated with Green manufacturing like meeting the customer demands for environmental friendly and sound products, development of recycling schemes, minimizing the materials use and selecting the materials causing low environment impacts. Many manufacturing process changes have started occurring in the following categories (Atlas & Florida, 1998): The dependence changes on human intervention and continuous process is preferred instead of batch process, changing the nature of the steps in production process, eliminating the steps in production process, changing cleaning processes, etc., According to Atlas and Florida (1998), when a proper organizational approach is established the initial step of choosing options for green manufacturing is making an inventory by operations of inputs used and the wastes generated. The second step of choosing the option for green manufacturing process is selecting the important non-product output and focusing on the waste streams in the products. The third step is generating the options to reduce the non-product outputs at their origin. They have also categorized these options as product changes, process changes, input changes, increased internal re-use of wastes and better housekeeping. In the next step these options have been evaluated for environmental advantage, technical feasibility and employee accessibility. These evaluations lead to improving different options, mainly in two different categories which are housekeeping and input changes. The last step proposed by Atlas and Florida is the rapid implementation of these options.

Green Distribution of product and processes: Shalishali, et al. (2009) classified Green distribution as Green packaging and Green logistics. According to Ninlawan, et al.,(2010) Green packaging can be practiced by using a —green packaging materials, promoting recycling and reuse programs and cooperate with vendor to standardize the packaging. The system evaluation indicators are used to monitor and control the packaging system (Zhang and Liu, 2009). “Green Logistics is defined as producing and distributing goods in sustainable activities including measurement of environmental impact of different distribution strategies, reduction in energy usage for logistic activities, reducing waste and managing its treatment”(Jiange (2008).



Waste management of Product and Processes: The CCME (1995) has defined waste management as the management of waste and used materials through hierarchy of actions, or the 5R’s: waste reduction, reuse, recycling, recovery and residual waste management.

Overview of Lean supply chain management: A lean supply chain is a dynamic ecosystem which adds value to the entire network by working together smoothly and by delivering the products and services according to the customer requirements in a cost effective manner (Robert & David, et.al.) According to Johanson and Winroth (2009) a strong focus is set on value creation and waste reduction in the manufacturing process. Lean manufacturing depends on certain principles like standardized processes, leveled production, JIT practices, visual inspection and continuous improvement. According to Abdullah (2003) once a company is pinpointed with their major wastes, the lean tools and methodologies should be implemented or practiced to eradicate these wastes. The following tool, “Cellular Manufacturing” is a concept that increases the mix of products with minimum waste. Value stream mapping is a method to visually display the flow of materials and information throughout the production process. Further, it is also identified as value added and non value added activities in the manufacturing process (Hines & Taylor, 2000) like 5’s, Continuous improvement, JIT, and Total Productive Maintenance tools and methods used in Lean Manufacturing.

Integration of Lean and Green Systems: Activities of GSCM, and Lean manufacturing methods has been proposed by the authors towards integration of lean and Green manufacturing system model. This model is considered to work as a guideline for the Small Scale Industries in India who are willing to undertake the lean and green supply chain in to their manufacturing process. According to Bergmiller and McCright (2009) implementing environmental management systems (EMS) (ISO14001) into manufacturing firms is a process in which the organization’s management identifies the controlled and uncontrolled environmental aspects. EMS further helps to develop targets and plans to achieve both significant and incremental environmental improvements. According to the study performed by Russo (2001) it provides a strong correlation between the green management system and green results. Environmental Protective Agency (EPA) has stated that environmental management system is an effective tool for preventing the environmental pollutions, the effect environmental management systems have on the implementations of —“environmental options” like green waste reducing techniques and —“operation performance” on lean results i.e. lead time, quality and cost (Melnyk, et al. (2003)) EPA (2001) developed some core elements for practicing green supply chain which are planning, leadership, metrics and goals, focus on results, Information and Analysis, Process Management, Employee Involvement, Focus on Interested Parties and process management. Initially, a study conducted by Florida R. (1996) explored the application of teams, continuous improvement, supply chain management and improving environmental performance. The best practices used in lean manufacturing strategies are also used in green manufacturing strategies (Florida R, 1996).

Empirical Findings and Analysis:

The first respondent was Automobile spare parts (Manufacturers of Bumpers & Luggage Carriers) manufacturing company. The primary goal was to increase the production and make the firm more profitable. The second respondent was a garment unit (Color yarn and fabric materials). Their primary goal was marketing sales, production capacity and proper disposing of final wastages. The third respondent works on food processing (jellies, & pudding), the main goal is to become market leader. All three respondents were quite knowledgeable about the lean waste parameters and how these parameters influenced their Supply chain process. The authors ranked these parameters from 7 to 1 (7 being very important and 1 being the least important).

Parameters	Respondents			Cumulative Scores
	Automobile Industry	Dyeing Industry	Food Processing Industry	
Over Production	3	5	4	12
Delay/Waiting	7	2	3	12
Transportation	3	1	2	6
Motion	6	3	1	10
Inventory	5	4	7	16
Space	7	7	6	20
Unused Knowledge/Skills of Staff	6	6	4	16

Table 1: Lean Waste parameters and their rate of importance

The table 1 shows that, the over production and delay are the third important parameters and transportation is very less important. The inventory and competence of staff/unused knowledge is the second important parameter influencing these industries and the space is one of the major influencing waste parameter for these industries. The best way of eradicating this problem is by practicing a familiar lean tool Just-In-Time. The process of JIT works according to the customer demand, so that the products get pulled from the assembly process. In this process, the customer is the driving factor. JIT may be a best suggestion for these industries to overcome the problem and to use the space more effectively. The practicing of green manufacturing process would lead to major production changes in the industries that are categorized as, continuous process which is preferred instead of batch process, changing the nature of steps in production process and changes in cleaning process suggested by Atlas & Florida (1998) which would be useful for overcoming these problems. Inventory is considered as a big waste parameter because it occupies more space. The reason behind high inventories is that, there is no proper analysis on the market demand for their products. In general, Kanban is an information system that is used to control the number of parts to be produced in every process (Monden, 1998). This could help in reducing the inventories. While considering the competencies of staff it is really poor in all these industries. According to dyeing industry the competencies of staff was very low because most of the defects identified on the material were due to their carelessness. These issues may be solved by improving employee involvement and following the 5s tool Shitsuke (Self Discipline) strictly. Over production issues may be solved by the continuous improvement. The lack of empowerment and leadership may be a cause for these waste parameters which are associated with product life cycle.

The major wastes produced in automobile industry were solid and liquid wastes like sheet metals, rusted mild steel rods and pipes, used welding rods and broken dies, chemicals which are used in electroplating and powder coating process. In addition, scrapped polypropylene pieces that are obtained from the packing process. Their disposal methods are solid waste and scrapped items are sold in the seconds' market. The liquid wastes are drained directly into the drainage system and the polypropylene waste pieces from the packing are burnt or land filled. The major waste from dyeing industry is the effluent water which comes out after undergoing all the process and the solid waste obtained are the impurities collected from the pressure filter which are formed as a blanket on the surface of the filter. The respondent addressed that normally they don't dry the waste because of more space allocation and so they use to land fill or burnt it. The drained water from the pressure filter is 60% contaminated water i.e. only 40% of the impurities can be removed in the Effluent Treatment Process (ETP). The respondent mentioned that water will be allowed to drain into the nearby canals or river during the night time.

In the food processing industry, the major waste obtained were the defective cups which are identified during the filling process. Some quantities of jellies leaked on the shop floor during the filling process are also considered as a major waste. They dispose their waste cups and jellies by land filling and burning it. At present, they have planned for erecting a distillation plant and the work is under progress. The disposal methods practiced by the company clearly show that they are not aware or concerned towards the environmental issues and effects caused. The respondent from the dyeing industry clearly stated that practicing this method of disposal is only because of low cost investment. The products are burnt or land filled in great extent and this shows that they don't have any proper waste management techniques and don't practice reverse logistics. The problem may also be solved if the government implies strict regulations and rules but, the view of the respondent is that, the government should initially support them for practicing GSCM.

The first respondent understood the lean practices for improving their production by utilizing scarce resources and eliminating wastes. However, they were not able to apply in practically due to high market demands. Dyeing industry respondent was not able to understand lean supply chain as they don't practice it in their firm. Respondent from the food processing industry understood the methods of eliminating wastes in order to improve the quality of their products. The automobile and food processing industry did not have any specific methods for practicing lean, but they just follow general practices like total productive maintenance and visual inspection. All respondents had openly stated that the standard ISO 9000 and ISO14001 is just a sticker which is useful for improving their market and brand name. Sangwan K.S (2011) addressed the obstacles from practicing green supply chain which are listed to these industries, like lack of information, lack of human resources, high cost, weak legal structure, slow rate of return, lack of governmental support and fear of success. All respondents feel that if government supports financially or reduces the taxes or increases some subsidiaries, it would be helpful in practicing green. The respondent of the dyeing industry clearly explained that they need to install Reverse Osmosis (RO) plant for purifying the effluent water after ETP, but the problem is that the cost of installing RO plant is more than the capital invested on the company.



The industries in India believe that the implementation of GSCM would be very expensive (especially in the automobile industry) but it is the matter of knowledge on the concept and the managements’ involvement. The industries should realize that changes mean not merely expenses, and especially for the industries willing to develop GSCM should understand that the expenses spent or not on the process, but it should be utilized on developing the knowledge and creating pollution free environment. Our government has to provide subsidiaries for implementing GSCM and should make some considerations on the taxes imposed on these industries. The government should avoid imposing strict rules/regulations; rather they should concentrate on motivating and initiating the concept.

Implementation of Suitable model: The comprehensive model developed, is derived out from the major models of lean production systems and major models of green production systems which will be helpful and provide a guideline for practicing the concept of GSCM in SSI’s in India. Since the model emphasizes simple techniques which focuses on continuous improvement and development of best environmental performances. The results from the model focuses on quality, cost, profitability, brand value, waste reduction techniques for concern towards the environment and customer satisfaction that are correlated with the company’s goals. The model explicates that management involvement will be the initial priority for implementing and improving the model. The main advantage of this model is that the management has possibilities for considering cost versus performance enhancement as their priority. The model argues to a great extent that by implementing the technique of green manufacturing into the process would cut the expenses and be able to make more profitability. The implementation of the model needs certain level of knowledge. The involvement of management and leadership skills would make the implementation easier. The model is an integration of lean and green system, so it can be more effective for the small scale industries in India to achieve their common goals.



Fig 4.1: Integration of Lean & Green System Model

Conclusion: Small scale industries in India need a sustainable development and hence, the awareness and demand for green products must be encouraged. The industries should initially improve the knowledge on lean and green supply

chain management and adopt the compatible ways of implementing/practicing the supply chain in their manufacturing firm. Funding from the government for implementing the concept and spreading the knowledge on the concept is necessary. The small scale industries experience wastes, so it has to integrate lean for practicing green supply chain, the implementation of lean would pay a way for green supply chain management. As a result of it, a comprehensive lean and green model is suggested for the industries because the model is composed of both lean and green waste reduction techniques and it also helps in achieving both lean and green business results.

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