A Review of Green Supply Chain Management in Indian Small Scale Industry by using Lean Manufacturing

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Abstract:- ***Environmental pollution is that the major drawback that world faces in present state, the main emission of toxic gases is from vehicles and producing industries. Lean producing is that the system that aims in elimination of the waste from the system with a systematic and continuous approach. This study aims to discuss the lean and green producing conception and its implementation operational management. Lean producing has been used to improve operational performance.***

Keywords- Lean Manufacturing; Green Manufacturing; Operations Management; Waste, Green Supply Chain Management (GSCM), Lean Supply Chain Management (LSCM), Waste management.

I. INTRODUCTION

Today, environmental pollution is that the main drawback that world faces each day, the main emission of toxic gases is from the producing industries. To overcome this drawback and to reduce environmental pollution, the producing industries ought to include ideas of green in to their provide chain. Environmental concern has become a vital consider producing industries, so that they are in would like of active provide chain concern towards atmosphere or additionally called green provide Chain Management. consistent with Srivastava (2007) green supply chain management is outlined as ―integrating environmental thinking into supply-chain management, together with product style, material sourcing and selection, producing processes, delivery of the final product to the consumers additionally as end-of-life management of the product its helpful lifel. The industries subjected to check are the small scale industries in India.

The small scale industries in India play an important role within the Indian economy. The growth of little scale industries (SSI) in India is big in recent years. The small scale industries in India creates a largest employment opportunities for the Indian people, next only to agriculture. It's been estimated that 100 thousand rupees (US $ 2000) of investment in fixed assets in little scale sector generates employment for four persons. The tiny scale industries contribute 400th of gross manufacture to the Indian economy. In spite of this little scale industries play a significant role in India's present export performance. 45%-50% of the Indian export is being contributed by little scale industries sector. There are 3 major kinds of little scale industries that have a lot of revenues; they're food product industries, garment producing industries and metal industries.

The growth of the industries is fast however the growth can't be explicit as vigorous growth due to their awareness and concern towards environmental producing. The industries are experiencing an increased pressure to reduce price, improve quality and reduced time of delivery to sustain within the present market, so that they are narrowed on focusing to the factors of their property and different influencing factors to the surroundings are ignored. The lack of awareness and since of high recklessness the surroundings is affected to great extent by these industries.

According to study by Rao (2002) show that a majority of worlds producing domain would be administered in Asia for many reasons within the approaching decades. This could motivate the industries to suppose on GSCM so as to maintain their competiveness. The various actions of the construct is restrained because of economic reasons, thus there's a desire necessarily to point out the guidance and proof of economic advantages that will help for the broader appliance of the conception.

According to Simons and Mason (2003) lean and green thinking have a good deal in common, each difficult the method resources are currently used and promoting initiatives designed to "do additional with less". Lean and green methods are usually seen as compatible initiatives due to their joint focus on waste reduction (Mollenkopf et al., 2010; Ravet, 2011). Lean and green producing will have a additional vital, positive impact on multiple measures of operational performance once implemented concurrently instead of separately (Miller et al. 2010). Lean methods coincidentally benefit the surroundings, while not the need for special "environmental" toolkits or a separate focus on environmental issues (Kidwell, 2006)

Nomenclature

LM	lean manufacturing
LSCM	lean supply chain management
GM	green manufacturing
GSCM	green supply chain management
OM	operation management
WM	waste management
GL	green lean
LOT	longest operation time

I.I. *Lean manufacturing*

Lean is a systematic approach for waste reduction or minimization within a manufacturing process without affecting the productivity. It is an management philosophy founded by Taichi Onho [T. Onho 1988] from Toyota production system. The main aim of this philosophy is described by various authors. Some authors maintain internal focus like increment in profit and productivity etc. On the other hand some authors accept it as an approach which is helpful for customer's satisfaction by improving quality.

I.II. *Green manufacturing*

The term Green manufacturing refers to that manufacturing techniques and approaches which is helpful in increase production as well as reduce the environmental pollution. Basically the word 'Green' represent all those things which are environment friendly and do their own work without affecting or less affecting on environment. So the green manufacturing is like a bunch of technologies and planning which is helpful for increase productivity by reducing both industrial and environmental waste.

II. Literature Review

Cory R.A. Hallam et al. [1] "The Interrelation of Lean and Green Manufacturing Practices: A Case of Push or Pull in Implementation", the findings of the literature review show that a variety of authors have researched the relationship between Lean and Green manufacturing during the last few decades. The majority of the studies that found a relation between Lean and Green manufacturing are highly optimistic in their findings, based on varying levels of evidence that Lean and Green manufacturing practices have in fact a positive contribution in the improvement of environmental and organizational performance.

Three types of relationship between Lean and Green manufacturing were observed from the review. The first relation indicates that Lean and Green manufacturing complement each other since both concepts share objectives such as waste reduction, value creation, and supply chain scope. The second relationship is related with the synergy between the two concepts; different authors stated that when combined together organizations achieved greater performance gains. The third relationship is the push interrelation between Lean and environmental wastes reduction; that is, when Lean wastes are reduced, environmental wastes can be directly or indirectly reduced as well.

The causal relation model developed based on the literature review illustrates these relationships. The equations developed based on these relations show that organizations can maximize their performance gains when performance indicators are improved through Lean and environmental wastes reductions. However, the model is neither complete nor exhaustive, and offers a starting point for further developing a theory for optimizing firm performance through Lean and Green implementation.

J. R. Jadhav et al. [2] "Practice Bundles for Integrated Green-Lean Manufacturing Systems", the major implementation issues are related to the human, cultural, facilities and resources factors. For fruitful GL implementation, an organization must accept GL as a philosophy, change or modify - processes, production system and organizational culture. Organizations have to cultivate mutually beneficial relationship with suppliers and customers. Organizations that implement and maintain integrated GL systems will reap viable rewards in terms of improved financial performance.

This paper makes two broad conceptual contributions. First, it explores GL practice bundles for successful implementation and second, it provides concise description of six GL practice bundles that will be helpful for further studies. Another contribution is the transmission of compiled information from researcher to their peers to assist in designing the structurally robust GL implementation strategies. The overall effort put in the present research has ensued in identification of significant GL practice bundles for sustainable implementation in manufacturing organizations. The success of global eco-friendly manufacturing strategies such as GL will not be completely based on application of apt tools and techniques alone but also on the relationship between top management and employees. Top management may play significant role in how the integrated GL strategy is understood, implemented, and deployed effectively throughout the organization.

Suresh Prasad et al. [3] "Lean and Green Manufacturing: Concept and its Implementation in Operations Management", Lean and green manufacturing concept is one of the best recent trends in operation management. The main focus of operation management is on waste reduction. So now a day the modern management approaches like lean manufacturing become the best practices in operation management for reduction of waste. Lean manufacturing is a technique which can give a positive impact on environment without any additional strategies or planning. But this achievement may not maximized in current planning of lean because environment waste and pollution is not a main focal point of the organizations. Thus it is necessary to merge two strategies (lean and green) can integrate and implement simultaneously in operation management to reduce industrial waste as well as environmental pollution. This will certainly increase productivity and profit of the organization. Higher productivity is critical for the long- term competitiveness and profitability of organizations. It can be effectively raised if it is managed by lean manufacturing tools. For implementation of both lean and green concept in the operation management, some tools and techniques have to be implemented in operation according to requirement.

Ravikumar Marudhamuthu et al. [4] "The Development of Green Environment through Lean Implementation in a Garment Industry", finally, this research has the proof of advantages when applying lean principles on the shop floor of garment industry. According to our research and experience, it is the correct time that lean thinking has successfully implemented in the shop floor of garment industry. We hope that this paper contains its worth for practitioners in the garment industries.

Due to severe global competition and increased expectations of customer, the Indian garment industries try to increase productivity by producing a product at lower cost and to produce with best product and service quality. To fulfil the demand of customer and increase the productivity, the authors have implemented lean manufacturing techniques and achieved expected results such as improvement in process environment, drastic reduction in human fatigue and cost with reasonable investment. In this paper, the successfulness of lean principles is validate in systematic manner with the help of different kind of tools, such as 5S, Value Stream Maps and SMED. We also suggest that lean production is supportive to environmental performance. Adoption of lean may lower the marginal cost of pollution reduction. It is clear that lean is associated with greater source reduction (pollution prevention). Finally we say that lean is associated with lower emissions. So we say it as lean is green. Even though, the complete success of the application of lean thinking in the extensive run depends on close understanding between the management and shop floor personnel. Effective management information systems are required for instilling proper organizational values and continuous improvement programs. If these management principles are fully integrated with shop floor principles, then lean systems can be achieved with green. We suggest that technological experience (lean production and source reduction) may allow the firm to move in surprisingly different performance domains (quality improvement and environmental performance).

Naga Vamsi Krishna Jasti et al.[5] "Lean To Green Supply Chain Management : A Case Study", In this research study, an integration of lean principles with green supply chain management has been demonstrated for maximizing space, better material utilization, reduction of fuel consumption and wastes, increasing efficiency and improving response time. This study has contributed to the body of knowledge by providing a means to integrate lean principle with green operations and giving the detailed step by step guidelines for organization to reduce carbon foot prints by reconstituting the plants, lines and divisions.

Lean SCM helps in implementing green supply chain management by heightening supplier and distributor collaboration, with objective of delivering correct item at correct place at correct time leading to reduction in run times, enhanced utilization of material, improved vehicle utilization, reduction in fuel consumption and decrease in carbon emission and other pollutants (CO, HC+NOX, particulate matters). The re-structuring the plant layout in alignment with lean principles helps in reducing congestion of vehicles inside the company premises,

decrease in waiting time, increase in safety, cost reduction and streamlined truck movement. In addition, the increased availability of material will reduced waiting and thus improving effectiveness and efficiency of the organization

By means of this study, it has been presented that lean can be an important pillar to accomplish green goals of reducing carbon foot prints, minimizing costs and wastes, enhancing brand image, environmental responsibility and cost saving with respect to transportation. The results incurred from the study will help other organizations to go green.

III. Method

There are many techniques to continuously improve quality and reduce operation costs; SALBP is one among these techniques. For decreasing production time, maximizing the output or minimizing the value of a product, it's quite a necessary tool. When the product has several operations and therefore the demand is high, the method of leveling the line becomes more and more difficult. Therefore it may be said that line leveling is the drawback of assigning tasks to workstations.

III.1. *Heuristic Method*

Heuristic strategies may be a procedure that may find a decent feasible solution for a given form of problems, but which isn't necessarily an optimum or correct solution. Heuristic strategies, or those that's supported the easy rule, are used to develop good and proper solution to the leveling problem of assembly line. In spite of not getting the result in the form of optimum solution, the obtained solutions are very advantageous. In heuristic methods Kilbrideg-Wester Heuristic Approach is most effective than other methods. The procedures projected by Kilbridge and wester numbers are assigned to every operation describing how many predecessors it's. Operations with the lowest predecessors are assigned 1st to the workstations. The procedure consists of the following steps:

- Construct the precedence diagram for the work components
- Select a possible cycle time
- Assign work components to the station so the total of elemental time will no exceed the cycle time (Step 3)
- Delete the assigned components from the total no of work components and repeat the step three
- If the station time exceeds the cycle time because of the inclusion of a particular work components this work element should be assigned to the next station
- Repeat step three to five until all components are assigned to workstations

No matter how tired you're a competent, if not achieved excellent performance can't raise prices, a measure of the process output quality, efficiency and cost of, by increasing the line balance rate, will improve production efficiency

III.2. *Longest Operation Time (LOT) Method*

The longest operation time (LOT) method is usually employed in the analysis work. This is often a line leveling heuristic that gives top assignment priority to the task that has the utmost operation time. The steps of lot are:

LOT1: To assign 1st, the task that takes the most of time to the first station

LOT2: after assigning a task, it's necessary to determine how much time the station has left to contribute.

LOT3: If the time contribution of station is more, assign it to task in keeping with the need as much time as possible.

III.3. 5S+S Implementation

It's a set of techniques start with letter 'S'. The use of this technique is to improve facilities at workplace and make a safe and easy to handle environment for the employees to lean implementation. It means Seiri (Sort, remove unwanted things), Seiton (Set an Order, proper arrangement of equipment), Seiso (Shine, clean), Seiketsu (Standardized, make standard), Shitsuku (Sustain, regularly implementation of standard) and Safety (no harm to workers).

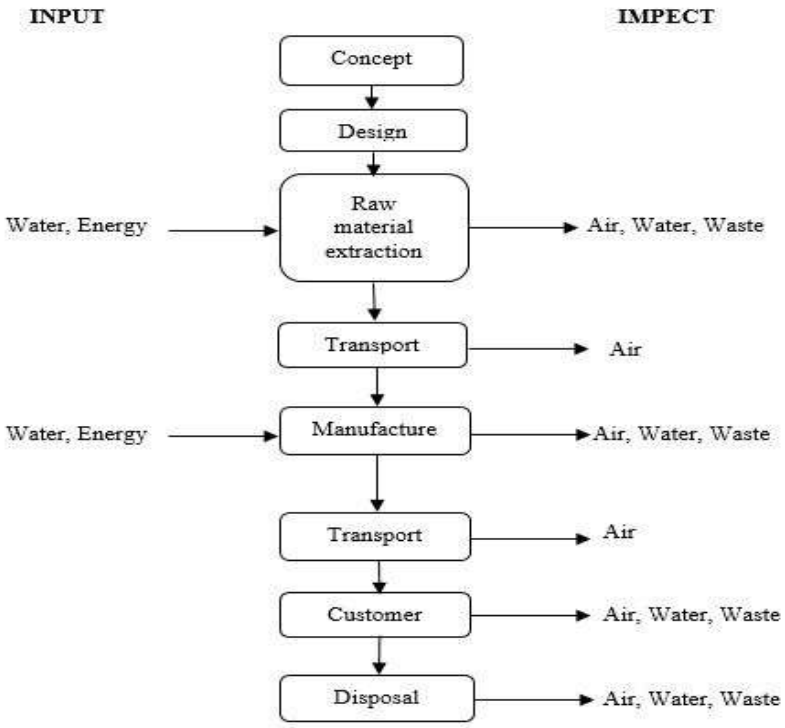

Fig. 1. Input and its impact on environment

IV. Conclusion

The findings of the literature review show that a number of authors have researched on the relationship between Lean and Green manufacturing during the last few decades. Lean and green manufacturing is a best combination concept and one of the best trend in operation management. Green manufacturing is a new and latest concept which consider all the element during manufacturing processes which is harmful for the environment as well as organizational performances. In this review, there are three points were observed. First one is the concept of Lean and green manufacturing share their objective like reduction of waste, scope of supply chain and creation of value of any product. The second is the cooperation between the two different concepts. Most of the authors are agree at this statement that when both concept combined together, the organization will be achieve great performance gain. The third one is about waste reduction. When the waste of any organization or lean waste reduce, environmental waste are also will reduced directly or indirectly. Because of green supply chain, the emission of greenhouses gases and toxic waste will be reduce which helps us to save our environment.

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