Research Journal of Engineering Sciences ISSN 2278 – 9472
Vol. **9(3),** 19-22, September **(2020)** *Res. J. Engineering Sci.*

Approach of green and lean manufacturing study of the small industries in Bangladesh

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Available online at: www.isca.in, www.isca.me
Received 13th May 2020, revised 24th August 2020, accepted 20th September 2020

Abstract

The economic outgrowth rate of Bangladesh is on the rise drastically, day by day. Productivity is the main engine, and modernism is the fuel for operating and expanding this market. To boost up the productivity and quality of product lean methodology is one of the paramount methods. Lean and green manufacturing can simultaneously be used to enhance operational efficiency and mitigate waste and emissions. Moreover, Green manufacturing integrated with lean can ensure the lowest environmental effect, it also helps the sustainable development of modern manufacturing companies. The main aim of this research is to implement the "Eco Value Stream Mapping" approach in a smaller context in 5 industries and try to assess incremental progress. Finally, some obstacles are also found in the implementation of green-lean technology, for those problems several salient suggestions are suggested.

Keywords: Green manufacturing, Lean manufacturing, Value Stream Mapping, Recycle, Small Scale Industry, Reuse.

Introduction

In industries, lean techniques are mainly emphasized on waste minimization. To be a strong competitor, all the firms are now given more importance on lean philosophy. The Toyota production system (TPS) was the embryo of the lean manufacturing concept from the early 1990s which is still now on demand[1]. By combining both lean and manufacturing individually we simply find the basic knowledge of lean manufacturing. To tie this all together, we can say that both industry and customers are valued by lean[2]. To ensure what customers really prefer, lean is the best-preferred tool to use, which will ensure lesser consumption of resources, workers' energy, time, space, and miscellaneous. Green manufacturing is the redesign of production processes and the setting up of environmentally sustainable manufacturing operations. Preventing pollution and minimizing the consumption of energy by new innovations and developments is the main aim of green manufacturing.

In designing, manufacturing, and other application of chemical processing, it minimizes the generation of toxic substances and also the use of such materials. On the performance of each operation, both lean and green manufacturing has a definitive dominance when it's implemented simultaneously[3,4]. The combination of Green Lean (GL) manufacturing approach is successfully applied in the big industries, but not in the small scale industries. At present, Bangladesh has achieved a tremendous growth rate in its industrial production and small industry played a major rule in becoming its economy. But using green manufacturing to ensure lean production is a big challenge for those small industries.

Literature review

Lean manufacturing, a process improvement technique is practiced to raise the efficiency and quality of the product on service. It can be called a core thrust of lean production that it not only enables creating a streamed system but also a high-quality system. It helps to produce finished products at the pace of customer demand with a negligible or zero waste[5]. In lean philosophy, the main beneficiary is it's reducing lead time for customers, reduces inventories for manufacturers, and also improving knowledge for management[6]. In industry, lean manufacturing is considered or desired as a set of approach that mainly emphasizes on the reduction of wastages and more importantly the activities which added value from a firm's manufacturing operation[7]. To be more eco-efficient, green manufacturing has been coined to reflect the new paradigm of manufacturing that uses a variety of green strategies (it contains objectives & principles) and techniques (it consists of technology and innovations)[8]. Firms embracing a lean production system will have a natural tendency to move into green programs as part of their drive to achieve ever-increasing leanness[9]. Lean and green models are more eco-efficient and they ensure sustainable production[10]. Moreover, lean and green manufacturing doesn't create any problem in making value. Value can also be made with less environmental impact and lean manufacturing is behind this [11].

Small industries in Bangladesh are facing a lot of trouble with a proper resource, energy, integrated policy, and technological problem. Around 80% of the managing director of the garments sector told that, diesel and power crisis is the core important obstacle for the development of readymade garments[12]. In the

cable industry, the aggregate planning model can be implemented so that the net profit changes in a positive manner[13]. Likely to other sectors, pharmaceutical industries are facing a massive problem that hinders their production, which is power generation problem[14]. In leather industries, about 49300 tones of solid waste generated. The Govt. should try to facilitate growth in industries which can use these wastages to make the value-added product[15]. There are some lacks in ceramic industries such as low production, not a good implementation of industrial engineering techniques, adequate required machinery, and more often the international standard laboratory for testing and quality control[16]. In this paper, it was mainly based on the research development of lean and green manufacturing processes of the small scale industries of Bangladesh. The lack of implementation of green and lean manufacturing concepts is the main theme and problem at this research work. This research will access incremental progress by the implementation of "Eco-value Stream Mapping" containing both lean and green techniques in the 5 small industries – Textile industry, Cable industries, Pharmaceuticals Industries, Leather industries, and Ceramic industries.

Methodology

In this study, we had chosen five small industries shown in Table-1. Five workers are working in the textile industry. They were appointed in two sections; research and development, generally all the materials are supplied in the morning and products are produced and dispatched in the evening of the same day. The factory has followed just in time a lean tool. To get ideas for green manufacturing a well, a structured questionnaire is circulated among the local small scale industries of this similar type. All the information of the workers is gathered from the questionnaire survey and benchmarking is conducted to identify the best idea followed by the leading competition.

The main origin concept of lean manufacturing was redundant activities should be eliminated and the improvement on the product will be continuous and incremental. It ensures maximum consumption, of all resources and a green product from the design to recycle the product. For conducting this research, Make-To-Order (MTO) concept is applied. All the procedures are properly applied so that the consumer can receive the product as soon as possible. Full production, Value Stream Mapping (VSM), Supplier Maintained Machine (SMM), and Just in Time (JIT) techniques are used. The types of machinery are maintained in a good working environment by properly scheduled maintenance methods. Products are engineered in such a way so that at the end of the useful life cycle, material quality, process parameter, easy delivery, recycling of the product components are absolutely renewable. After considering multiple alternative Environmental Impact Index (EII), manufacturing delivery to customers to product disposal all are decided. It is calculated through stage by stage and the environmental effect should be least. Due to the good quality of raw materials and subcomponents the end life of the recyclability of the product is achieved without dumping as waste.

High-quality tools, reliable machineries, and process trained operators are used to ensure conditions piece flow. The eco-value stream map is drawn by determining the cycle time for each process and the environmental impact is also noted by identifying the waste. A future state will be drawn with an improved waste reduction process. Different ideas are applied to find the best process for reducing pollution.

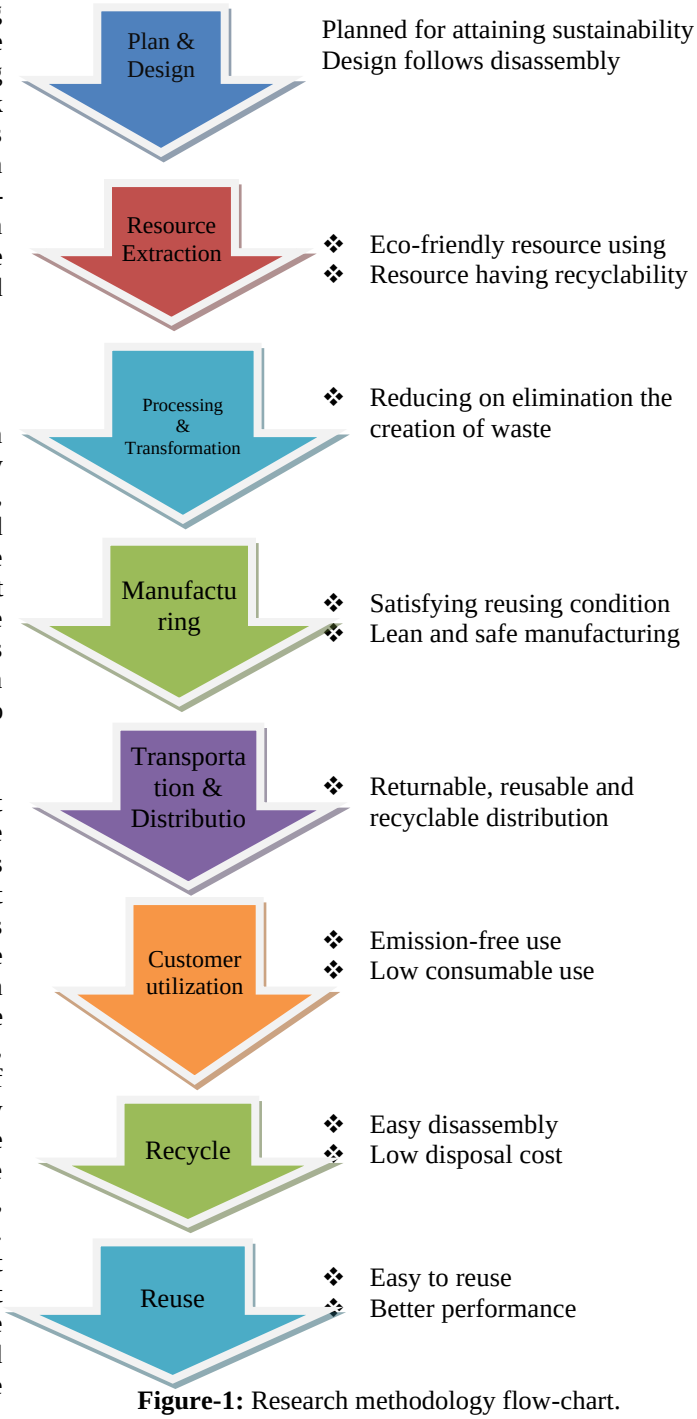

Figure-1: Research methodology flow-chart.

Results and discussion

The following observations are made, according to the suggestions from the employees of the different industries. In the cable industry, the disposal of manufactured products are focused, this stage has the most environmental impact. In the pharmaceutical industry, the methods and chemical substances used in drug manufacturing are highly toxic, not cheap and a lot of waste is also produced.

For this reason, new and more efficient screening methods are used to find more enzymes that can be used as biocatalysts for chemical reactions. In leather industries, eco-friendly leather is produced by natural tanning without using any chemicals. Finally, the waste materials of the ceramic industry are highly used in the high volume applications of low technology materials such as road construction, roof tile, cement, and concretes.

Conclusion

The approach of Green Lean (GL) methodology creates a pathway to the achievement of corresponding green output. This will bring the next revolution but there are some barriers to implementing green and lean manufacturing in small industries; it's an expensive process and in production, they create incremental improvements not a breakthrough. But products have much more durability and a much more positive impact on the environment. Moreover it will also save the resources of the earth. Reusability and recycling can be a great incentive for small industries in a country like Bangladesh. Though, Lack of funding is a concerning issue at using it. Green Lean (GL) manufacturing will solve the problem of energy shortages, water, and other natural resources and further it will definitely ensure a way of boost up the profit margin in long run businesses.

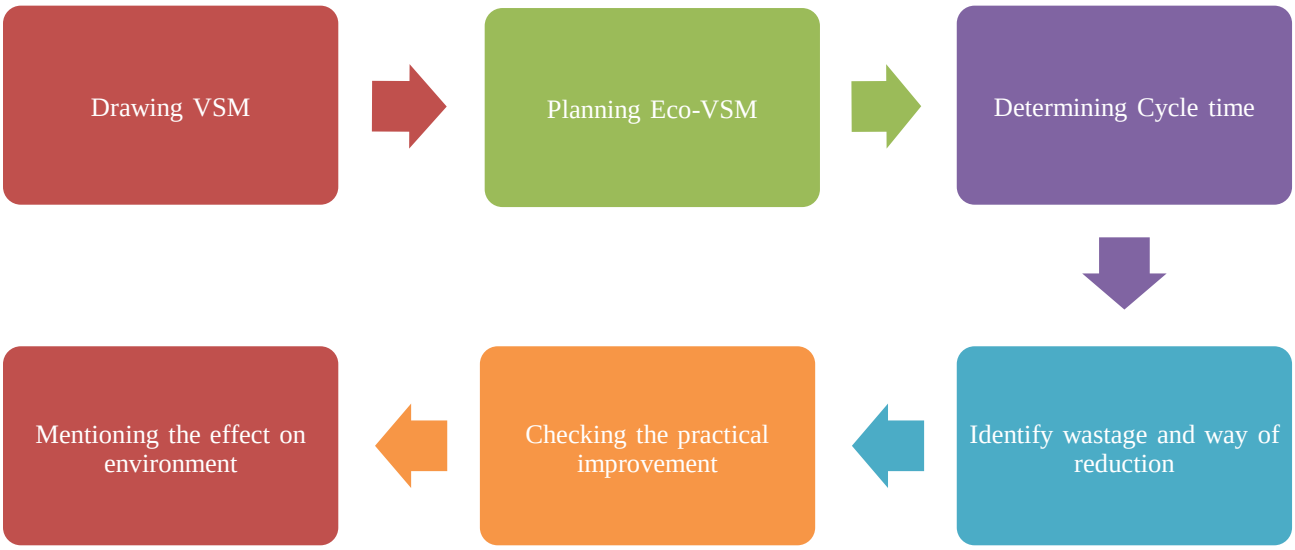

Figure-2: Research Methodology block diagram

Table-1: Results of the Study

Types of Industry	No. of Respondents	Suggestions	Barriers
Textile Industries	5	To train operators for creating awareness for green manufacturing.	Financial, administrative, and resource.
Cable Industries	5	Low-quality raw material, inadequate quality control should be avoided.	Absence of integrated policy.
Pharmaceuticals Industries	5	The revolutionary drug delivery method is more effective, less toxic, and helpful for the patient.	Resource and Chemical barriers.
Leather Industries	4	More eco-friendly production.	Technological, financial.
Ceramic Industries	4	Pollution in the environment should be avoided	Lack of management commitment.

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