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Adoption of Integrated Lean-Green-Agile Strategies for Modern Manufacturing Systems

Varinder Kumar Mittal^{a,*}, Rahul Sindhwani^a, Vivek Kalsariya^a, Faizan Salroo^a,
Kuldip Singh Sangwan^b, Punj Lata Singh^c

^aDepartment of Mechanical Engineering, Amity School of Engineering and Technology, Amity University, Uttar Pradesh, Noida – 201313, India

^bDepartment of Mechanical Engineering, Birla Institute of Technology and Science, Pilani – 333031, India

^cDepartment of Civil Engineering, Amity School of Engineering and Technology, Amity University, Uttar Pradesh, Noida – 201313, India

* Corresponding author. Tel.: +91-99505-19001; fax: +0-000-000-0000. E-mail address: varindermittal@gmail.com; vkmittal@amity.edu

Abstract

Ever increasing customer choices, environmental concerns and competitiveness among manufacturers across the globe has engaged the industry to embrace newer manufacturing strategies. Predominantly, there are three dimensions to modern manufacturing systems viz. economic, environmental and social. The integration of lean-green-agile manufacturing strategies would be a complete and comprehensive manufacturing system which is the need of the 21st century. The adoption of Lean-Green-Agile Manufacturing System (LGAMS) would be facilitated by few enablers. The influence of these enablers is a matter of investigation which is addressed by the present study. An attempt has been made to prioritize the facilitating capacity of each enabler. The outcome of the research would facilitate the policy makers in the industry and government to frame policies.

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1. Introduction

The present society is craving for a sustainable system that enables growth without compromising the ability of the future generations to meet their needs and demands [1]. Economic prospects, ecological balance and social responsibility are three very important parameters which are indispensable for achieving sustainability [2]. It is the harmonious interaction among these dimensions which ensures balanced growth and development of the society. The collective approach of addressing these three dimensions is referred to as 'Triple Bottom Line' [3].

In the past these dimensions have been studied individually, so the focus lies on green manufacturing or lean manufacturing or agile manufacturing separately. But now the

time has come to amalgamate lean, green and agile manufacturing strategy to build a unanimous structure [4].

The lean manufacturing strategy which acts at system's level saves cost by reducing wastes in the manufacturing system thereby addressing the economic dimension; the green manufacturing strategy which acts at process level saves environment by reducing emissions and resource use thereby addressing the environmental dimension; and the agile manufacturing strategy which acts at product level satisfies the customer in the society by providing the required product of their choice in time thereby addressing the social dimension.

A framework of Lean Green Agile Manufacturing System (LGAMS) developed to integrate lean, green, and agile strategies is presented in figure 1. This provides the holistic

approach to address the three dimensions of 'Triple Bottom Line'.

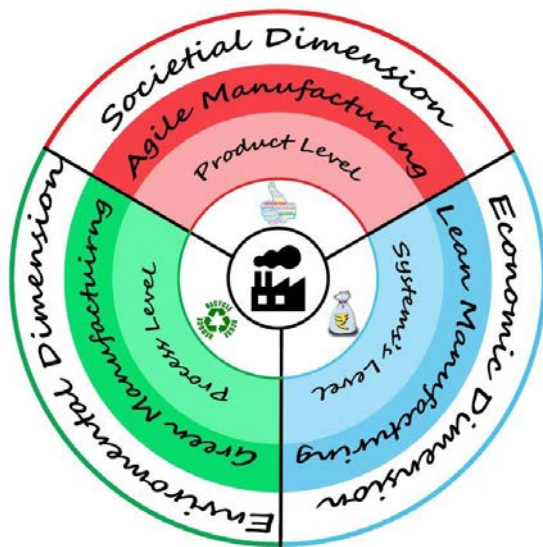


Figure 1: Framework of LGAMS

The implementation of LGAMS in the modern manufacturing system requires facilitation for faster implementation. Particularly, for fortifying the industry, enablers for LGAMS are investigated. So, from the thorough literature survey and with the help of academic and industry professionals 10 enablers have been identified for LGAMS. These enablers are the parameters which can prove very helpful in the establishment of the LGAMS.

The rest of the paper is as follows: section 2 provides research background followed by methodology in section 3. Section 4 provides results and discussion of the research. Section 5 presents the conclusion from the study followed by acknowledgements and references.

2. Research Background

Lean Manufacturing (LM) is defined as an integrated manufacturing system aimed at maximizing the capacity and the utilization without involving any extra cost in it and also minimizing the buffer inventories by applying various techniques in minimizing system variabilities [5]. LM depends on bundles of practices which not only support this system in implementation but also provide a support system. [6]. LM and management system widens its area of influence by covering almost everything starting from product development to product distribution and at the end the customers [7].

During the recent times, the amalgamation of social approach and lean implementation has gained attention in area of academic research [8]. Nevertheless, the results deduced are not systematic. De Treville and Antonakis stated that internal human resources play a major role through which the enforcement of lean practices run into social performance [5].

Many researchers have talked about certain green production practices such as green manufacturing, raw material reduction and environmental design. This has to be delt both quality wise and variety [9]. By doing so, companies can hugely decrease ill effects of their products and production process on the environment.

The interaction between environmental management practices and numerous factors of firm performance which is mainly related to sustainability is very well researched topic [10-11]. Enhanced environmental performance had its benefits on financial performance. A positive impact can be seen on social and environmental performance by implementing environmental management practices and this is achieved by reducing resource consumption as well as improving stakeholder relations.

LM is totally based on the concept of how to response to competitive pressures with limited resources in hand. For the productive use of resources, operational techniques are concentrated upon. But then, agile manufacturing is a response to complexity and dynamism that is brought about by regular change. In this, strategies are developed upon on how to thrive in an unpredictable environment. The prime focus of agile is on the individual customer. Some parameters are exhorted from lean. One such example includes refinement of mass production in which unilateral producer-centered customer-responsive is established. This has been developed as interactive producer-customer relationships in agile [12]. Sharing resources and technologies among companies becomes mandatory and agile enables one to think beyond a single firm. Cooperation with the help of good terms in relationships wins the competitive environment of an enterprise. Flexibility to adopt is the most important key in the agile enterprise which serves as a greater deal for its competitive advantage. However, it is equally important to manage an internal cross-functional team with the inclusion of customers and suppliers. Eventually, this may also be in the form of virtual company or collaborative ventures [13].

Agile manufacturing has started to make a mark in both industrial and academic communities. Extensive programmes are quite beneficial to broadcast certain issues regarding agile manufacturing which ultimately develops agile enterprise prototypes and thus paves the way for an agile industry.

As shown in figure 1, the LGAMS is a system which addresses the triple bottom line dimensions of manufacturing systems. The adoption of the same would enhance the performance and effectiveness of the manufacturing system. The enablement of such new system is required to change the way the manufacturing is done. So, identification and analysis of LGAMS enablers is attempted in the present study.

3. Methodology

Ten enablers are identified through a review of literature and discussion with experts in the industry and academia. The development of these enablers is done while referring to the literature on lean, green and agile strategies to showcase the clear relevance of enablers. Moreover, the actual issues encountered during the implementation of individual manufacturing system by the industry are incorporated

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