

SUSTAINABLE MANUFACTURING PRACTICES: A FUTURE DIRECTION

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Abstract

Sustainable manufacturing has become a crucial issue in recent years owing to the impact of global warming, terrorism, earthquakes etc. The movement towards sustainability is seen not only between developed nations, it is considered a key strategy in developing and emerging economies because many big brands are located in transitional nations. The role of sustainable manufacturing in India on the basis of three main aspects social, economic and environmental are considered in this paper. This paper suggests the literature gap in sustainable manufacturing in India.

Key words: *Sustainable Manufacturing, Supply chain*

1. Introduction

Sustainability is an increasingly important requirement for human activity, making sustainable development a key objective in human development. At its core, sustainable development is the view that social, economic and environmental concerns should be addressed simultaneously and holistically in the development process. Hence, a worldwide effort to practice sustainability in businesses, including engineering, design, and manufacturing, exists. Among the businesses with sustainable goals, manufacturing sectors generally require the most change due to their serious negative impact on 3Ps (people, planet, and profit) (Wu et al., 2017).

Improving sustainability and environmental stewardship without compromising profitability and productivity has recently become a primary responsibility for manufacturing companies (Rosen and Kishawy, 2012; Govindan, 2017). Sustainable manufacturing, with its objective of reduced or zero negative impacts to society, environment, and economy, has become a popular research topic. However, there is no standard definition of sustainable manufacturing, relevant terms have evolved with environmentally conscious manufacturing (Govindan et al., 2015), green manufacturing (Govindan et al., 2015a), lean manufacturing (Jabbour et al., 2013), and so on. For successful implementation of sustainable manufacturing, concepts (Molamohamadi and Ismail, 2013), metrics and drivers challenges and indicators are explored.

Sustainability has been applied to many fields, including engineering, manufacturing and design. Manufacturers are becoming increasingly concerned about the issue of sustainability. For instance, recognition of the relationship between manufacturing operations and the natural environment has become an important factor in the decision making among industrial societies.

A sustainability concern with business elements has been widely researched and is seen as a means to pursue sustainability in manufacturing organizations. The literature covers integration of sustainability perspectives (e.g., environmental issues, social responsibility, full sustainability) with different types of business elements, such as a manufacturing strategy

(Ocampo and Clark, 2017), product design, manufacturing, and delivery decisions (Waage, 2007), product development processes (Brones et al., 2014), and process design (Azapagic et al., 2006). Integration of sustainability into the product and process development requires development of new models, frameworks, metrics, and techniques (Molamohamadi and Ismail, 2013). Garetti and Taisch (2012) defined sustainable manufacturing as the capability of using natural resources intelligently in manufacturing for the fulfillment of economic, environment and social aspects and hence preserve the environment and to upgrade quality of life. Sustainability can be viewed as having three parts: environmental, economic and social. As a consequence, achieving sustainability requires an integrated approach and multi-dimensional indicators that link a community's economy, environment and society. The main objective of this paper is to find the current status of sustainable manufacturing in India

2. Literature Review

Integrating sustainability into manufacturing sectors is not a new concept. To formulate the strongest concepts, researchers identified three basic pillars of sustainability, which encompasses economic, environmental, and social issues in a manufacturing context. Some studies frequently argue the status of sustainability issues in an Indian context. An effective deployment of sustainable concepts mostly depends on interaction of sustainable dimensions. In this study, an attempt on assessment through modelling has been suggested. Mostly two factors determine the sustainability performance of organizations the performance of the criteria identified under four dimensions (inheritance) and their interaction (interdependency) among each other.

Banerjee (2008) argues that micro players in the economy are heavily dependent on achieving economic objectives to remain profitable in the marketplace, while social and environmental welfare tend to be viewed as secondary goals. Li et al. (2009) propose an integrated methodology of rough set, Kano's model and AHP for rating customer requirements' final importance. Nepa et al. (2010) present a fuzzy-AHP approach to prioritization of customer satisfaction attributes in target planning for automotive product development. Karpak and Topcu (2010)

present an analytic network process framework for prioritizing factors affecting success in small-medium manufacturing enterprises in Turkey. Vanalle et al. (2011) identify environmental requirements in the automotive supply chain through evaluation of a first-tier company in the Brazilian auto industry. Dou and Sarkis (2010) take an initial step to consider sustainability as a criteria for supplier selection. However, their method does not capture the 'voice' of company stakeholders.

Lin and Ho (2008) examined six factors influencing adoption of green innovations for logistics service providers. Agan et al. (2013) assess the drivers of environmental processes and their impact on firm performance in small- and medium-sized enterprises of Turkey. Mathiyazhagan et al. (2013) pointed out that customers are becoming more and more aware of environmental problems, and government agencies are making strong environmental regulations to reduce environmental damage. Wee and Quazi (2005) identified seven critical factors to implement environmental management practices. Shang et al. (2010) investigated, crucial sustainable capability dimensions and firm performance based on electronics-related manufacturing firms. Habidin et al. (2017) identified critical success factors of sustainable manufacturing practices in Malaysian automotive industry. Govindanan et al., (2016) product recovery optimization in closed-loop supply chain to improve sustainability in manufacturing. Garg et al. (2014) evaluated of drivers in implementing sustainable manufacturing. Brandenburg et al., (2014) identified quantitative models for sustainable supply chain management: developments and directions. Amrina and Yusuf, (2012) identified key performance indicators for sustainable manufacturing evaluation in automotive companies.

3. Environmental, Economic and Social Sustainability.

The main three aspects of sustainable manufacturing are as follows:

3.1 Environmental Sustainability

A company that wants to operate as a sustainable and socially and environmentally responsible

company cannot limit its social and environmental consciousness just to its own operations. It is very rare in today's technologically-advanced economy that a company can itself produce all components that go into its products. Most companies rely on the suppliers and vendors for components, subassemblies and services to make, market, and sell their end products. It has become increasingly important to make sure the suppliers and vendors are also environmentally and socially responsible and have similar corporate and professional values, beliefs, and missions. In addition to the environmental concerns, supply chains increasingly face social performance pressures and commercial and reputational risks (Carter and Rogers, 2008). Not only social issues can threaten the company's brand image but they also impact the economic viability of the entire supply chain. Several instances of this nature have been frequently reported in the past, jeopardising the reputation of large multinational corporations such as Wal-Mart, Nike, Gap, H&M and Mattel (Andersen and Skjoett-Larsen, 2009).

3.2 Social Sustainability

A framework suggested by Dreyer et al. (2006) seeks to become a corporate decision-making tool and incorporates the impacts of products and services on people, specifically promoting human health, human dignity, and basic needs fulfillment. Hunkeler et al. (2008) seek to integrate social considerations to existing environmental analysis, but take different approaches. Schmidt et al. (2004) propose a method to perform and present "socio-eco-efficiency" analysis that corresponds to BASF's eco-efficiency analysis and compares environmental and social performance to economic costs.

Ciliberti et al. (2011) examined how a specific code of conduct can address the principal-agent problem between chain directors and partners, by Italian and Dutch small and medium enterprises (SMEs). Mani et al., (2014) enhancing supply chain performance through supplier social sustainability: An emerging economy perspective.

3.3: Economic Sustainability

Various studies sustainable manufacturing have traditionally focused on the economic aspects of the network with cost minimisation (or profit maximisation) and service level maximisation being the most predominant objectives. The same line of thinking and incorporate sustainable manufacturing cost and service levels as the basic economic and business performance measures. Supply chain costs may include the cost of procurement, production, opening and operating facilities as well as transportation and storage costs. Backordering or backlog costs and the cost of lost sales have also been regarded as the primary measures of service level and customer satisfaction (Fahimnia et al., 2015). Business and economic performance measures in sustainability can be defined based on balanced scorecard dimensions, supply chain operations reference model and tangibility and intangibility categorisations (Bai and Sarkis, 2014).

4. Results and conclusion

Among the studies on sustainable manufacturing, a lot of work has been investigated on sustainable manufacturing practices. Some studies focus on the conceptual development and implementation challenges of sustainable manufacturing. These studies provide some highlights regarding the practices. While the majority of studies focused on concepts and implementation, some recent studies examine what occurs after the implementation of sustainable manufacturing practices. From literature review it has been observed that very few researches have been conducted on sustainable manufacturing practices in India. This paper can be helpful for researchers as future scope in sustainable manufacturing.

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