



GREEN MANUFACTURING PRACTICES IN SMES OF INDIA -A LITERATURE REVIEW

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Abstract : Increasing concern about the environment has forced industry to innovate and reduce its environmental impact. Green Manufacturing (GM) is the most emerging sustainable manufacturing practice that has the capability to solve the most of issues that the Indian industry faces now. GM covers all aspect to reduce the environmental impact by optimum use of available resources and reduction of waste. Due to various reasons, small and medium sized enterprises (SMEs) may have been left out of the regulatory and social pressures. The time has come where ignoring environmental impacts of SMEs is no longer viable. Small and medium sized firms are essential to all economies but also have a significant negative impact on the environment. Their collective footprint equates to the major contribution of industrial pollution yet SMEs are not convinced of the necessity for behaviour change. SMEs are often slow to adapt to the changes and are still moving towards better environmental practices. Lots of literatures are available on GM dealing with numerous aspects. This paper is an attempt to systematically review the available literatures and put it in a format which can be easily comprehended. That review paper includes an effort of analysing around 90 papers from various reputed journal spread over last 22 years related the green practices problems corresponding to SMEs.

Keywords - Green Manufacturing (GM), Sustainability, Environmental Impact, Indian SMEs, Review

I. INTRODUCTION

Green manufacturing (GM) differs from traditional manufacturing. It focuses on environmental impact, environment policies of governments, national and international environmental regulations, and competitive pressures. Proper environmental regulations can trigger green innovations that actually decrease cost, increase productivity, or make companies more competitive. Environmental issues are rapidly emerging as one of the most important issues in strategic manufacturing decisions. Increasing concern about the environment has forced industry to innovate and reduce its environmental impact. Future global manufacturing is no longer going to be the competition of capital, resources and labour power but the competition of green technology. It is then that energy saving and emission reduction will become the dominant concern in manufacturing technology. GM is one of the fast emerging as the sustainable manufacturing practices that has the capability to solve the most of issues that the Indian industry faces now. GM covers all aspect to reduce the environmental impact by optimum use of available resources and reduction of waste. GM is a term used to describe manufacturing practices that minimizes waste and pollution. It slows the reduction of natural resources as well as lowering the extensive amounts of waste that enter landfills. Its emphasis is on reducing parts, rationalizing materials, and reusing components, to help make products more efficient to build. Mohanty et al. (1999) stresses on reducing harmful waste. Melnyk et al. (2002) emphasis on managing the flow of environmental waste with the goal of minimizing environmental impact while also trying to maximise resource efficiency. Hicks et al. (2007) stresses on design improvement, utilisation of clean energy and raw materials, the implementation of advanced processes, technologies and equipment. Tan et al. (2008) defines GM as an imperative manufacturing strategy for the twenty-first century, integrating all the issues of manufacturing with its ultimate goal of minimizing environmental impact and resource consumption. The time has arrived where ignoring environmental impacts of SMEs is no longer viable but SMEs are often slow to adapt to the changes and are still moving towards better environmental practices. The objective of this paper is to find out the gaps for SMEs to improve their environmental performance while benefiting the business. This is undertaken through a study of practices of SMEs and review of research literature on competitive advantages of going green.

II. LITERATURE REVIEW

The literature review is organized into three different sub sections. The first provides an overview and details of current attempts made by researchers in the field of GM. We further extend the discussion with our pinpoint focus on related to green practices and SMEs. The third sub section explores the green practices in Indian SMEs. These sub categories ensure an improved understanding of the theory behind the title.

2.1 Overview of Green Manufacturing:

Green manufacturing is a relatively new concept that can be viewed as a product of the 1980s. From the 1980s, activities in sustainable manufacturing started to focus on waste reduction in production. After this, the paradigm for sustainable manufacturing had been changed from process oriented to product oriented; mainly focuses on reduction of resources, energy and toxic materials, as well as development and use of renewable materials (Seliger et al., 2008). In many countries, environmental protection laws, regulations and tax implications are already in place (Gungor et al., 1999). In fact, environmental regulations and public pressure, coupled with economic and technological factors have influenced industry worldwide to become more environmentally conscious and Green. Green manufacturing has been defined as an economically driven, system-wide and integrated approach to the reduction and elimination of all waste streams associated with the design, manufacture, use and disposal of products and materials (Handfield et al., 1997). Jovane et al. (2003) presented sustainable and GM as a future paradigm with business model based on designing for environment using new nano technologies. Burke et al. (2007) presented another framework for sustainability to realize GM. The framework on their study was based on SME manufacturers who achieved ISO 14001 certification. GM also enhance corporate image, competitive advantage, and marketing exposure (Rao et al., 2005), resulting in improved performance. Angell et al. (1999) suggested that GM cause to grow economics, environmental, and social performance through reduction of waste and costs.

2.2 Green Practices and SMEs:

The ways in which SMEs engage in GM practices continue to attract research attention. In recent years, studies in many countries, including Australia, Europe, United Kingdom and the USA, have identified several trends that seem common to most SMEs (Hutchinson et al., 1998). However, there is a growing concern about the effects of SMEs on the environment, as much of the previous researches in the general field of business and GM related to large businesses. In spite of this, SMEs are less likely to have environmental plans or implement environmental management practices than large firms. This is often due to SMEs believing that there is a cost associated with environmental management with no immediate economic benefits flowing back to their businesses (McKeiver et al., 2005). Despite the variety of environmental practices that are implemented, a number of studies have sought to explain the motivations behind the choice of practices and the rationale for environmental practices (Lepoutre et al., 2006). Pertaining to the viewpoint of SMEs, there are three main barriers preventing them from engaging in good environmental practices. These are the characteristics of SMEs, resource availability and their personal interest and knowledge of environmental management (Yacob et al., 2012). Many SMEs do not see environmental issues, or the need to act in an environmentally responsible way, as a significant issue for their business (Revell et al., 2007). Organizations especially SMEs are under increasing pressure to maintain their operations as well as to reduce environmental harm. The majority of studies of GM initiatives have been conducted in large organizations. This is unfortunate, as the SMEs, collectively represents more than 90% of manufacturing establishment and they represent a significant share of the business sector economy. Therefore, SMEs play a crucial role in a country wealth and have the potential to make a noteworthy contribution to a country sustainable industry. Environmental sustainability is a critical issue, yet global research suggests that positive changes in business practices that would help achieve this are limited, especially in SMEs. It is clear that although an individual firm's environmental footprint can be small, collectively they contribute substantially to environmental damage globally. The negative environmental impact of business needs to be addressed and the volume of research that provides innovative and practical approach to drive changes in behaviour and practice does not reflect its significance. Engaging in environmental management is frequently seen as core business for large business but less so for small business (Condon, 2004). Gutowski et al (2005) reviewed the American, European and Japanese industries and saw that the major drivers for environmentally benign manufacturing are: cost reduction, risk mitigation, market advantage, regulatory flexibility and corporate image. Govindan et al. (2014) have analyzed the drivers of GM with fuzzy approach. This study, through literature resources and experts' support, identified

twelve common drivers which include financial benefits, company image, environmental conservation, compliance with regulations, stakeholders, green innovation, supply chain requirements, customers, employee demands, internal motivations, market trends, and competitors. Ammenberg et al. (2005) explored the drivers, barriers, and experiences of environmental management systems. This paper focuses mainly on design for environment and product-oriented environment management systems. Morrow et al. (2002) projected the drivers of environmental management systems based on ISO 14001 and eco management and audit scheme certification. Sarkis et al. (1995) have listed the various expected benefits of ECM as safer and cleaner facilities, lower future costs for disposal and worker protection, reduced environmental and health risks and improved product quality at lower cost and higher productivity. Senthil et al. (2003) developed a life cycle environmental cost analysis incorporating costing into life cycle accounting practice. This model prescribes a life cycle environmental cost model to estimate and correlate the effects of these costs in all the life cycle stages of the product. Massoud et al. (2010) investigated the drivers, barriers, and incentives to implementing environmental management systems with the assistance of a case study in the Lebanon food industry. Drivers of sustainability in the wine industry were established by Castka et al. (2009) with a case study of the New Zealand wine industry. Pun et al. (2002) averred that customer requirements, competitive pressures, and resource conservation opportunities are drivers of green business strategy. Agan et al. (2013) described that state rules and regulations; customers, internal motivation, and firm performance are the drivers of GM. Santolaria et al. (2011) discussed the drivers of GM as business efficiencies, innovation, cost, brand positioning, and business communication. Yacob et al. (2012) believes that economic benefits, financial incentives, stakeholders demand, legislation, resources, motivation and motivation are the major driver for adoption of green practices by Malaysian SMEs. Ghazilla et al. (2015) discussed about the drivers and barrier which encourage and inhibit the implementation of GM practices in SMEs, specifically in Malaysia. Tseng et al. (2006) believes that reducing wastes and emissions at source can improve the environmental, as well as economic performance of an organisation. Routroy (2009) argued that top management commitment, government initiatives, green sourcing, green design, green operations, green packaging, reverse logistics, environmental management system, green innovation, and customer awareness are the critical success factors of the green supply chain in a manufacturing context, very similar to GM. Chin et al. (1999) explained the various attributes involved in the implementation of green practices in manufacturing. The attributes include management attitude, organizational change, external aspects, social aspects and technical aspects. These attributes are further classified into appropriate subordinate issues. Berry et al. (1998) illustrated six critical elements like training and education programs, top management involvement, resources, infrastructure, facilities, and supplier management in order to create an effective proactive environmental management system. Wee et al. (2005) developed and validated seven critical factors for implementation of environmental management systems, for their study they considered top management commitment, total involvement of employees, training, product and process design, supplier management, measurements and information management. Some of the critical success factors have mentioned in table 2.1.

TABLE 2.1

No	Critical Success Factors	Sources
1.	Environmental protection laws and regulation	Ghazilla et al. (2015), Yacob et al. (2012), Seliger et al. (2008), Gehin et al. (2008), Zhu et al. (2007), Gutowski et al. (2005), Govindrajulu et al. (2004), Allen et al. (2002), Durham (2002), Lin et al. (2001), Hui et al. (2001), Andrews et al. (2002), Gungor et al. (1999)
2.	Green image	Govindan et al. (2014), Garg et al. (2014), Agan et al. (2013), Searcy et al. (2012), Castka et al. (2009), Shrivastava (2007), Pun et al. (2002), Gutowski (2002)
3.	Competitors green strategy	Singh et al. (2014), Govindan et al. (2014), Tseng et al. (2013), Agan et al. (2013), Searcy et al. (2012), Deif (2011), Castka et al. (2009), Sangwan (2006), Pun et al. (2002), Chin et al. (1999)
4.	Management commitment and participation	Sangwan et al. (2014), Garg et al. (2014), Williams et al. (2013), Zailani et al. (2012), Daily et al. (2012), Yacob et al. (2012), Kirchoff et al. (2011), Cheng et al. (2008), Lee (2008), Mohanty et al. (2008), Sangwan et al. (2007), Sangwan (2006), Gutowski et al. (2005), Digalwar et al. (2005).
5.	Employee empowerment	Daily et al. (2012), Lee (2008), Sangwan et al. (2007), Sangwan (2006), Gutowski et al. (2005), Digalwar et al. (2005), G

	and involvement	ovindrajulu et al. (2004), Rao (2004), Allen et al. (2002), Hui et al. (2001)
6.	Reduce, reuse, remanufacturing	Seliger et al. (2008), Hosseini (2007), Shrivastava (2007), Cagno et al. (2005), Allen et al. (2002), Durham (2002), Hui et al. (2001), Florida et al. (2000), Mohanty et al. (1999), Gungor et al. (1999)
7.	Disposal of hazardous materials	Cagno et al. (2005), Wossen (2001), Florida et al. (2000), Young et al. (1997)
8.	Green product	Singh et al. (2014), Zailani et al. (2012), Narula et al. (2011), Chen (2008), Cheng et al. (2008), Gehin et al. (2008), Sangwan et al. (2007), Ijomah et al. (2007), Sangwan (2006), Rao (2004), Allen et al. (2002), Lin et al. (2001), Florida et al. (2000)
9.	Current legislation	Ghazilla et al. (2015), Sangwan et al. (2014), Yacob et al. (2012)
10.	Awareness	Ghazilla et al. (2015), Sangwan et al. (2014), Yacob et al. (2012), Madu et al. (2002)
11.	Understanding of green productivity	Ghazilla et al. (2015), Yacob et al. (2012), Chen (2008), Zhu et al. (2007), Hicks et al. (2007), Klassen et al. (1998), Mohanty et al. (1999)

2.3 Green Practices and SMEs

Indian Companies are feeling the pressure to go green, as many of their Western counterparts are building environmental sustainability into their business practices. For Indian companies, there are other compelling reasons to develop GM practices. Here is a list of the top GM practicing companies in India according to Verdurous India Index.

1. Suzlon Energy, 2. ITC Limited, 3. Tata Metaliks Limited (TML), 4. TamilNadu Newsprint and Papers Limited (TNPL), 5. Wipro Technologies, 6. HCL Technologies, 7. Oil and Natural Gas Company (ONGC) etc. To achieve real financial benefits, Indian companies, like those elsewhere, need to follow certain key practices. Above all, they must commit to a green philosophy and incorporate GM practices into their product lifecycle and supply chain operations. Ramakrishna (2006) claims that major industries in India focusing on reducing energy consumption, water consumption, hazardous substances, waste emission also green purchasing network is spreading its wings in India. Sangwan (2006) developed a multi-attribute decision model with 61 indicators to analyse the performance value of a GMS. According to the findings of Sangwan, GMSs offer far better competitive advantages than non-GMSs and the ability to maintain competitive advantage. Sangwan (2011) explored the qualitative and quantitative positive impacts of GM in Indian SMEs with the assistance of the empirical study where 198 SMEs were surveyed and the data was analyzed through statistical software (SPSS). The final quantitative benefits of GM in order of their decreased ranking are improved morale, improved brand value, lowered regulatory concerns, increased market opportunities, improved product performance and decreased liabilities. The quantitative benefits of GM are related to either wastes or life cycle of the product. The virtual status of GM implementation in Indian context was revealed by Rehman et al. (2013a) with their study from the Vidharba region of Maharashtra (India) with the assistance of their survey instrument. Their study clearly defined that there is a substantial gap between virtual and literature resources; their study also confirmed that more effort is needed to establish GM concepts. Rehman et al. (2013b) have also done a literature survey of about 123 papers from around 73 leading journals spread over last 15 years. They have discussed about drivers, critical success factors and various tools of GM. The analysis further reveals several emerging issues and challenges which need to be addressed. Digalwar et al. (2013) made an empirical investigation among Indian manufacturing firms to find the performance measures of GM. In this study, they approached 400 industrial managers and got a response rate of 27%. They found several performance measures, including top management commitment, employee empowerment, knowledge management, employee training, green product and process design, environmental health and safety, production planning and control, suppliers and materials management, quality, cost, customer environment performance requirement, customer responsiveness, and company growth. Sustainable GM emerges the concept of combining technical issues of design and manufacturing, energy conservation, prevention, health and safety of communities and consumers. Many industries are directing their resources to reduce the environmental impact of their produced products and services. Small and medium enterprises around the world have little knowledge about environmental management and do not understand the concept of environmental management. Therefore, it is very difficult for SMEs to see the clear link between environment management system implementation and the benefits (Weerasiri et al., 2012). Jain et al. (2015) explores the multifaceted

relationship between different motivational factors and firms' characteristics to determine the CEP adopted across different industries in India. Seven different motivational factors and three characteristic variables have been investigated for Indian industries. Garg et al. (2014) has attempted to identify and evaluate drivers in implementing sustainable manufacturing in Indian context. Nine possible drivers for successful implementation of sustainable manufacturing have been identified from extensive review. Five drivers (Societal Pressure and Public Concerns; Regulations and Government Policies; Top Management Involvement, Commitment and Support; Effective Strategies and Activities towards Socially Responsible Manufacturing and Market Trends) have been categorized into the cause group and four drivers (Holistic View) in Manufacturing Systems; Supplier Participation; Building Sustainable culture in Organization; and Corporate Image and Benefits) have been categorized into the effect group. In India companies like Godrej, Infosys, Mahindra and Mahindra, Tata group and others have been proactive in their sustainability efforts. Internationally, GE, 3M, Cummins, Wal-mart, Ikea and many others have displayed environmental stewardship in their own industries. While it is understandable that large businesses have the knowledge and resources to undertake sustainable practices in their own businesses, SMEs have neither the resources nor the cash required for setting such practices within their operations. Thus, the potential contribution of SMEs to cleaner environment may not be realized yet. In India, present policy and legal frameworks do not encourage and support SMEs in this direction.

III. CONCLUSION

In this paper an attempt has been made to review the literature on GM practices in SMEs. Currently there is very limited roadmap for GM to implement in Indian SMEs due to lack of awareness of it. There are already strong reasons to build greener businesses for tomorrow. Small firms must respond to the green challenges facing the world. They can no longer remain insulated. Neglect will bring more damage and perhaps a quicker end. The main contribution of this study is to recognize major drivers of GM are employee demands, health and safety, company culture, innovation, financial profit, stakeholder's relation, environment concerns, competitive advantage, regulation, market trend and internal motivations. That paper also shows that the major critical success factors of GM are environmental protection laws and regulations, green image, competitive green strategy, top management commitment and participation, employee empowerment and involvement, 4R's, disposal of hazardous materials, green product, current legislation, awareness, understanding of green productivity and regulation driven motivation. Research had shown that the implementation of GM have failed either due to lack of understanding of how to get started or due to lack of awareness about GM implementation in Indian SMEs. Green practices do not always create a burden for industry. Traditional green practices which have reduced waste and improved industry results must now be taken to strategic focus. Simple change of existing products and improving operational efficiencies must now give way to a leadership focused green strategic approach towards the environment. Implementation of GM practices into Indian SMEs may need of improving the owners environmental knowledge and create awareness through a lot of green conferences, seminars and campaigns.

REFERENCES

- [1] Agan, Y., Acar, M. and Borodin, A. (2013), "Drivers of environmental processes and their impact on performance: A study of Turkish SMEs", *Journal of Cleaner Production*, Volume 51, pp. 23-33 .
- [2] Allen, D., Bauer, D., Bras, B., Gutowski, T., Murphy, C., Piwonka, T., Sheng, P., Sutherland, J., Thurston, D. and Wolff, E. (2002), "Environmental benign manufacturing: trends in EU, Japan, USA", *Journal of Manufacturing Science and Engineering (ASME)*, Volume 124(4), pp.908-920.
- [3] Ammenberg, J. and Sundin, E. (2005), "Products in environmental management systems: drivers, barriers and experiences", *Journal of Cleaner Production*, Volume 13(4), pp. 405-415.
- [4] Andrews, S., Stearne, J. and Orbell, J. (2002), "Awareness and adaptation of cleaner production in small to medium sized business in Geelong region Australia", *Journal of Cleaner Production*, Volume 10(4), pp.373-380.
- [5] Angell, L. and Klassen, R. (1999), "Integrating environmental issues into the mainstream: an agenda for research in operations management", *Journal of Operations Management*, Volume 17(5), pp. 575-598.
- [6] Berry, M. and Rondinelli, D. (1998), "Proactive corporate environmental management: a new industrial revolution", *Academy of Management Executive*, Volume 12(2), pp. 38-50.
- [7] Burke, S. and Gaughran, W. (2007), "Developing a framework for sustainability management in engineering SMEs", *Robotics and Computer Integrated Manufacturing*, Volume 23(6), pp. 696-703.

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- [8] Cagno, E., Trucco, P. and Tardini, L. (2005), "Cleaner production and profitability: analysis of 134 industrial pollution prevention project report", *Journal of Cleaner Production*, Volume 13(6), pp. 593-605.
- [9] Castka, P., Gabzdylova, B. and Raffensperger, J. (2009), "Sustainability in the New Zealand wine industry: drivers, stakeholders and practices", *Journal of Cleaner Production*, Volume 17(11), pp. 992-998.
- [10] Chen, Y. (2008), "The driver of green innovation and green image – green core competence", *Journal of Business Ethics*, Volume 81(3), pp.531-543.
- [11] Cheng, J., Yeh, C. and Tu, C. (2008), "Trust and knowledge sharing in green supply chain", *Supply Chain Management: an International Journal*, Volume 13(4), pp. 283-295.
- [12] Chin, K., Chiu, S. and Tummala, V. (1999), "An evaluation of success factors using the AHP to implement ISO 14001 based EMS", *International Journal of Quality and Reliability Management*, Volume 16(4), pp. 341-362.
- [13] Condon, L. (2004), "Sustainability and small to medium sized enterprises – how to engage them", *Australian Journal of Environmental Education*, Volume 20(1), pp. 57-67.
- [14] Curkovic, S. (2003), "Environmentally responsible manufacturing: the development and validation of a measurement model", *European Journal of Operational Research*, Volume 146(1), pp.130-155.
- [15] Daily, B., Bishop, J. and Massoud, J. (2012), "The role of training and empowerment in environmental performance: a study of Mexican maquiladora industry", *International Journal of Operations & Production Management*, Volume 32(5), pp. 631-647.
- [16] Deif, A. (2011), "A system model for green manufacturing", *Journal of Cleaner Production*, Volume 19(14), pp. 1553-1559.
- [17] Despeisse, M., Oates, M. and Ball, P. (2013), "Sustainable manufacturing tactics and cross-functional factory modelling", *Journal of Cleaner Production*, Volume 42, pp. 31-41.
- [18] Digalwar, A. and Metri, B. (2005), "Performance measurement framework for world class manufacturing", *International Journal of Applied Management & Technology*, Volume 3(2), pp. 83-102.
- [19] Digalwar, A., Tagalpallewar, A. and Sunnapwar, V. (2013), "Green manufacturing performance measures: an empirical investigation from Indian manufacturing industries", *Measure Business Excellence*, Volume 17(4), pp. 59-75.
- [20] Durham, R. (2002), "Environmental benign manufacturing: current practices and future trends", *Journal of Minerals, Metals and Materials Society*, Volume 54(5), pp. 34-37.
- [21] Fijal, T. (2007), "An environmental assessment method for cleaner production technologies", *Journal of Cleaner Production*, Volume 15(10), pp. 915-919.
- [22] Florida, R., Atlas, M. and Cline, M. (2000), "What makes companies green? Organizational and geographic factors in the adoption of environmental innovations", *Economic Geography*, Volume 77(3), pp. 209-224.
- [23] Gandhi, N., Selladurai, V. and Santhi, P. (2006), "Green productivity indexing", *International Journal of Productivity and Performance Management*, Volume 55(7), pp. 594-606.
- [24] Garg, D., Luthra, S. and Haleem, A. (2014), "An evaluation of drivers in implementing sustainable manufacturing in India: using DEMATEL approach", *International Journal of Social, Management, Economics and Business Engineering*, Volume 8(12), pp. 3517-3522.
- [25] Gehin, A., Zwolinski, P. and Brissaud, D. (2008), "A tool to implement sustainable end-of-life strategies in the product development phase", *Journal of Cleaner Production*, Volume 16(5), pp. 566-576.
- [26] Ghazilla, R., Sakundarini, N., Abdul-Rashid, S., Ayub, N., Olugu, E. and Musa, S. (2015), "Drivers and barriers analysis for green manufacturing practices in Malaysian SMEs: a preliminary findings", *Procedia CIRP*, Volume 26, pp. 658-663.
- [27] Govindan, K., Diabat, A. and Shankar K. (2014), "Analyzing the drivers of green manufacturing with fuzzy approach", *Journal of Cleaner Production*, Volume 96, pp. 182-193.