Available online at www.sciencedirect.com

ScienceDirect

Procedia Materials Science 6 (2014) 1644 – 1649

Procedia Materials Science

www.elsevier.com/locate/procedia

3rd International Conference on Materials Processing and Characterisation (ICMPC 2014)

A review on Green Manufacturing: It's important, Methodology and its Application.

"I.D.Paul[a*], G.P.Bhole[b], J.R.Chaudhari[c]"

[a,b,c]*Assistant Professor, SSGBCOET, Bhusawal,425201,India*

Abstract

The paper gives the survey of green manufacturing, what is green manufacturing why it is needed and methods of green manufacturing that reduces the waste and even pollution. The paper focus on the green design for environment of green manufacturing system, energy conservation, development of product with less wastage. The paper also highlights the use of green manufacturing to form a sustainable product and to reuse the product, shorter life cycle. We also tried to discuss about the green accounting and green supply chain management. The main objective of the green manufacturing is to save the environment and to reduce the cost of the product.

Selection and peer review under responsibility of the Gokaraju Rangaraju Institute of Engineering and Technology (GRIET)

Keywords: green manufacturing, green accounting, green supply chain, etc

1. Introduction

In this global world environment, resources and population are major problems. Environment is crucial one with and change in climate at any point leads to the imbalance of the earth. The ISO has proposed the new quality management system for products and even for Environment management system. The main era is to minimize the environmental damage due to industries. There is a need of new manufacturing process i.e. Green Manufacturing which is suitable a sustainable development strategic X.C.Tan.,et.al(.2002). The cost of energy and resources are constantly increasing due to rising demand and limited supply. Furthermore, price trends can hardly be forecasted, so companies aim to successfully produce within large price ranges of energy and resources. One strategy to accommodate price fluctuations consists of passing mark ups to the customer. However, a price mark-up may require that improvements be made to the product. Alternatively, stable prices may be facilitated with increased production efficiency, which can be achieved by reducing resource consumption and improving the organization of the manufacturing system Nancy Diaz-Elsayed.,et.al.(2013).

This paper main objective is to bringing the attention of the manufacturer who are manufacturing the product with the mass production. We have seen that a lot of energy is using day by day and lots of waste is available, the waste are hazardous and can lead the human being to a termination point. Toxic hazards are really crucial for human being.

Selection and peer review under responsibility of the Gokaraju Rangaraju Institute of Engineering and Technology (GRIET)
doi:10.1016/j.mspro.2014.07.149

This paper points all the waste and the methodology of green manufacturing that we can applied and can reduce the wastage and increase the use of sustainable energy. The implementation of Green Manufacturing may not only be good for the environment — it is often good business, as well. The same is often true of other efforts to reduce the energy- and material-intensiveness of manufacturing processes; what is good for the environment is typically good for the balance sheet as well.

2. Literature

Nowadays, environmental consequence are considered strategically essential for business operations with the aim to reduce costs and develop quality products Atasu etal.,(2008); Kleindorfer et al.,(2005). The scope of green operations (GO) spans from product development to management of the entire product life cycle involving such environmental practices as eco-design, clean production, recycling, and reuse with a focus on minimizing the expenses associated with manufacturing, distribution, use, and disposal of products Lai and Wong, (2012); Guide and Van Wassenhove, 2001; Kleiner, (1991). According to the environmental management literature, GO is concerned with both product- and process-oriented environmental practices Ferguson and Toktay, (2006); Gilley et al., 2000; Rogers and Tibben-Lembke, (2001) to reduce the damage of products and supply chain processes on natural resources Dechant and Altman, (1994); Porter and van der Linde, (1995a, 1995b). In product management, GO ensures quality and environmental conformance, preventing negative corporate reputation by environmentally negligent products. In process management, GO emphasizes closed-loop operations involving practices like recuperation and recycling with the objective to reduce waste, capture residual value of products Ferguson and Toktay, (2006); Rogers and Tibben-Lembke, (2001), and deploy environmental technology and cleaner transportation in the downstream supply chain for pollution prevention. These two distinct components of GO are helpful for firms to comply with environmental regulations, reducing the risk of legal fees, liability costs, and fines (Hunt and Auster, 1990). By embracing GO, firms will reap financial gains by capturing the residual values of their products and promote product innovation through analysis of the returned products for possible design improvement Rogers and Tibben- Lembke, (2001). Past research on GO is confined to identifying the antecedents (e.g., institutional pressures, regulations, and customer requirements), their influences on the implementation Lai et al., 2011; Zhu et al., (2011), and the business and environmental values of implementing GO King, (2007); Min and Galle, (2001); Rothenberg et al., (2001); Zhu et al., (2007). There is a general belief on organizational capability for successful environmental practices and sustainable operations Bowen et al., (2001); Christmann, (2000); Handfield et al., (1997); Russo and Fouts, (1997); Sarkis et al., (2011), without which the performance outcomes of GO can be compromised Kovacs, (2008); Porter and van der Linde, (1995a). The literature has acknowledged the value of GO and the internal capability of firms for its success Corbett and Klassen, (2006); Dechant and Altman, (1994); Handfield et al., 1997; Lai et al., 2010), but the complementary role of upstream suppliers to enhance performance remains under-explored Pagell et al., (2007); Vachon and Klassen, (2007). A recent study by Lee and Klassen (2008) highlighted the importance of environmental management capabilities (EMC) of suppliers, which reflect the ability of suppliers to improve their performance on environmental issues. Nevertheless, how such capability influences the GO of buying firms was not considered. While the negligent behaviors of suppliers can devastate the GO of their downstream partners Preuss, (2001), a systematic investigation on supplier role in GO is timely and an important environmental management topic. The green manufacturing can lead to shorten the life cycle of product and this reduces the cost of the product. Due to environmental and ecological responsibility, enterprises are trying to reuse, remanufacture and recycle the used products to reduce the negative impact on environment, especially the manufacturers of the electrical consumer products. Therefore, the reverse manufacturing problem, which is strongly related to all stages of a product development, nowadays is a critical problem to all levels of the electrical and computer industry. The optimal inventory system is developed to comprehend the importance of related factors in the policy and to find the influence of cost components in a semi-close green supply chain. A short life-cycle Vachon, S., Klassen, R.D., (2007). Several countries at all levels are developing waste handling prohibitions, regulations or incentive programs to encourage alternative disposition of electronic waste Callahan et al., (1997). Such policies ensure the producer and the consumer greater responsibility for the safe disposition of their products Boks et al., (1998). Green product design has received numerous attentions recently. Product design changes can significantly influence the cost of disassembly, component inspection and repair, remanufacturing and recycling the reusable materials. Owing to some regulations and international proposals, such as European Union's proposal for a

directive on Waste Electrical and Electronic Equipment (WEEE), some manufacturers seeking to reduce product recovery and remanufacturing costs have begun modifying product designs and incorporate EOL product reuse concept into product and component design Toffel, (2002). Environmental impact (e.g. air emissions) occurs at all stages of a product life cycle from resource extraction to manufacture, use, reuse, recycle, and disposal Zhu et al., (2007). Hervani et al. (2005) proposed that green supply chain management (GSCM) practices which include green purchasing, green manufacturing, materials management, green distribution/marketing and reverse logistics refer to the involvement of environmental thinking into the supply chain management from the extraction of raw materials to product design, manufacturing processes, delivery of the final products to the consumers and end-of life management Srivastava, (2007). Hence, (GSCM) has emerged as an important approach to reduce environmental risks and environmental burdens in manufacturing and disposal as well as enhance profit and competitive advantages van Hock and Erasmus, (2000). This purpose focuses on reflecting automobile manufacturing industry as well as the environmental performance of enterprises in developing countries while evaluating the GSCM performance's criteria. The contribution of this study is to help automobile manufacturers improve their environmental images and enhance competitive position worldwide in the context that automobile industry is still a potential industry in developing countries. Boks.,et.al.1998.

3. Green Manufacturing.

In today's world the e-waste the major issue, green technology is the application of one or more of environmental science, green chemistry, environmental monitoring and electronic devices to monitor, model and conserve the natural environment and resources, and to curb the negative impacts of human involvement. The term is also used to describe sustainable energy generation technologies such as photovoltaics, wind turbines, bioreactors, Biofiltration, Bioremediation, Desalination etc. We don't always have time, or take time, to learn more, read fine print, decipher complex ingredients, and seek alternatives. The word "natural" has become an over-used and inaccurately-used BUZZWORD in today's marketing; it's practically lost all value.

3.1. Environmental Management Tools

The environmental management tools include. Mass balance i.e. consideration of input and outputs of a process and to determine its effectiveness and wastage. Full cost accounting is related with the costs of materials, energy, labour, waste disposal and other sundry item cost. Product life cycle is also an important part of these tools less the life cycle less is the environment loss. The systematically engineering process of a product consists of three stages: (1) conceptual, preliminary and detail design, (2) production construction and (3) operational use and system support Blanchard and Fabrycky, (1997). In the development of this study, the relevant cost functions are derived in sequence with a point view of systematical engineering process. Imposing extended producer responsibility on manufacturers is a means to achieve a critical leverage point between environment and business benefits. Manufacturers have the unique ability to facilitate product recovery and remanufacturing by designing their products for easier disassembly and reuse of component. Through the product life-cycle value design, the suitable materials are selected and those decisions (such as employing easily recyclable materials and avoiding the unusual materials, components and hazardous materials) can reduce the negative impacts on environment Fishbein,(2000); Toffel, (2002). The supplier's component life-cycle design cost, Y(MT) is a function of MT, where T is the product life cycle. Although there are many parameters influencing the design and production cost of a component, from the product design life point of view, it is appropriate to take it as a function increasing with product-design life.

3.2 Sustainable Manufacturing

The concept of sustainability emerged from a series of meetings and reports in the 1970s and 1980s, and was largely motivated by environmental incidents and disasters as well as fears about chemical contamination and resource depletion. As pointed out in the 1987 Brundtland Report, Our Common Future David A. Dornfeld. Et.al.,(2013). The phrase sustainable manufacturing is sometimes used carelessly to describe the actions related to characterizing and reducing the environmental impacts of manufacturing. Sustainability, however, implies a great deal more than the simple act of analyzing and modifying the environmental performance of manufacturing processes and systems.

In spite of this caveat, this interpretation is likely to be maintained. A system might be thought of as unsustainable when society consumes resources and produces wastes at a rate that exceeds nature's ability to transform industry and society wastes into environmental nutrients and resources. Strictly speaking, sustainability can only be discussed in the context of a closed system, such as that displayed in Fig. 1. Manufacturing subsystems coexist alongside human, ecological, and natural subsystems. Therefore, sustainable manufacturing is a philosophy that cannot be considered independent of broader environmental and socioeconomic systems David A. Dornfeld. Et.al.,(2013).. Sustainable Manufacturing Fundamentals Manufacturing is a business function, and, as such, engineers are well-versed in establishing the economic value of engineering solutions for manufacturing. Measuring environmental and social performance presents a more challenging engineering and business task. Sustainability-related impacts result from operations and activities that manufacturing processes and systems employ to convert input materials and energy into marketable products. Material and energy are necessary inputs of manufacturing processes and systems; wastes and emissions, which are generally classified as outputs, are, in turn, inputs to other industrial and natural systems, where their impact is felt socially, environmentally, and economically David A. Dornfeld. Et.al.,(2013).

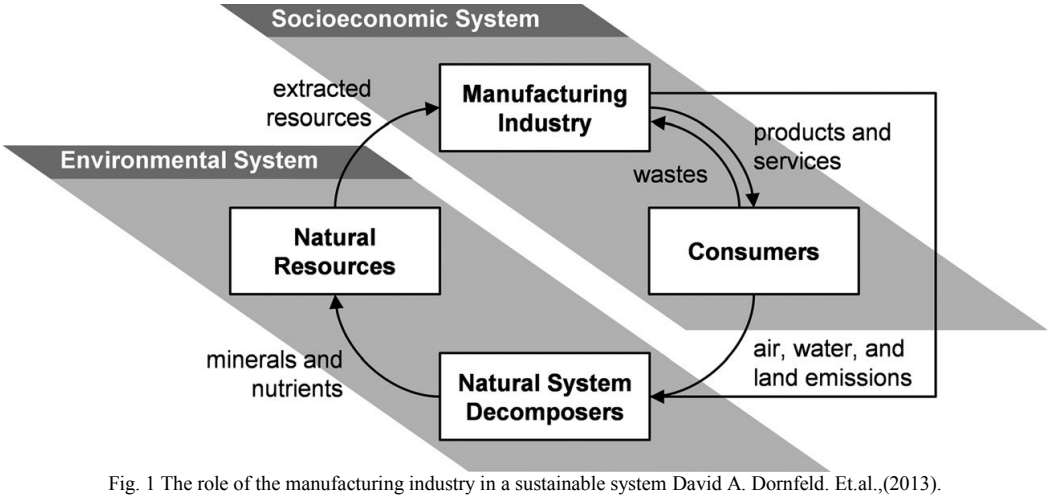

Fig. 1 The role of the manufacturing industry in a sustainable system David A. Dornfeld. Et.al.,(2013).

3.3. Sustainable Green operations

Sustainable green operations As an innovative environmental management approach, GO serves to ensure the quality and environmental compliance of electronics manufacturers' inputs (e.g., electronics components and metals) and outputs (e.g., finished products, carbon emission, waste) Zhu etal.,(2008). GO emphasizes product-and process- oriented environmental practices to balance and improve financial performance as well as pollution reduction. Product-oriented environmental practice of GO, also referred to as product steward- ship, is concerned with reducing environmental burden with less use of hazardous and non renewable materials in products development, considering the environmental impact in product design, packaging, and material used Snir, (2001). Specifically, it promotes recycling and reuse of product components with eco-design, and us in green cycle parts and packaging Lamming and Hampson,(1996); Reinhardt, (1998). Product stewardship of electronics manufacturers considers the environmental impact of products and their packaging from raw materials acquisition to end-of-life product disposal Dechant andAltman,(1994). Such practice is geared towards reducing the environmental damage arising from all product-related parts and components Christina W.Y.Wong.,et.al., (2012).

3.4. Green supply chain management

GSCM is defined to be the addition of green issues into supply chain management Hervani et al., (2005). In addition, Zhu and Sarkis (2004) state that GSCM supply chain involves from suppliers to manufacturers, customers and reverse logistics throughout the so called closed-loop supply chain. Hervani et al. (2005) indicate there are various activities involving GSCM such as reuse, remanufacturing, and recycling which are embedded in green

design, green procurement practices, total quality environmental management, environmentally friendly packaging, transportation, and various product end-of-life practices. In the global economy, the automobile industry transforms rapidly with the dramatic expansion of leading automobile manufacturers (e.g. Honda, Toyota, General Motor, Ford, Daimler Chrysler, Suzuki, Hyundai, and Fiat) into the Asia region Kumar and Bali Subrahmanya, (2010). Greening the automobile industry has been disputed in international energy and environmental policy studies. Green supply chain in automobile industry has become the main interest in many industrial fields. The evaluation and measurement of its performance is essential when environmental issues have been addressed all over the world Olugu et al., (2010). However, there have been few studies exploring the issue of GSCM performance evaluation. Hence, applying green concepts into automobile manufacturing is essential to reduce environmental impacts, enhance market competition, and ensure regulation compliance Gan, (2003). Zhu et al. (2008) claim that the automobile manufacturing industry in developing countries is a potential and promising industry because it creates a huge market, especially after entering WTO. However, automobile supply chains are lagging. For instance, Zhu et al. (2007) indicate that Chinese automobile industry is quite nascent and the recycling of used cars is not paid enough attention to. Facing environmental burdens, the Chinese government has enacted tighten environment regulations Zhu et al.,(2007). Hence, Chinese automobile enterprises have started to study GSCM experiences from international partners Zhang and Peng, (2000). Other example is that Malaysia government has not been addressed environmental issues, especially end-of-life vehicles recovery Amelia et al., (2009). Since Malaysian automobile industry develops rapidly, GSCM forces local automobile manufacturers and government to become concern about their environmental burdens Eltayeb et al., (2011). For these reasons, GSCM is emerging as an important approach to reduce environmental risks and brings economic benefit to manufacturers Diabat and Govindan, (2010).

3.5. Green Application

Fuel is the major issue in the world, the fuel used in our day to day life is non renewable and it will get finish soon because of this the need of new fuel is necessary. The only hope is Renewable energy i.e. solar, wind, tidal, bio diesel etc. which are green products. Therefore Sustainable energy can be used as fuel Qinghua Zhu.,et.al.,2004.
Water purification is the another issue of human life as water is our most important need but due to population and due to chemical process the water is not hygiene for drink. The solar distillation process is very useful for the water purification process Qinghua Zhu.,et.al.,2004.
Air purification, the Basic and common green plants can be grown indoors to keep air fresh because all plants remove CO2 and convert it into oxygen. Due to this the air pollution will reduce and the life on earth will get the more oxygen and less CO_2. Sewage treatment is conceptually similar to water purification. Sewage treatments are very important as they purify water per levels of its pollution. The more polluted water is not used for anything, and the least polluted water is supplied to places where water is used affluently. It may lead to various other concepts of environmental protection, sustainability etc. Solid waste management is the purification, consumption, reuse, disposal and treatment of solid waste that is undertaken by the government or the ruling bodies of a city/town Qinghua Zhu.,et.al.,2004.
Energy conservation is the utilization of devices that require smaller amounts of energy in order to reduce the consumption of electricity. Reducing the use of electricity causes less fossil fuels to be burned to provide that electricity Qinghua Zhu.,et.al.,2004.

4. Summary and Outlook

This paper discussed about the green manufacturing, the paper try to impart the attention of the researcher to use green manufacturing i.e. green technology for the environmental development. The paper described the use of green manufacturing its application and even the methods of green manufacturing. The sustainable energy is the better option for our daily and industrial uses the application of sustainable energy even for manufacturing. The green operations GO also mentioned in the paper which explained the environmental management concept and its tools.
The green supply chain is very useful tools as it improves green image and competitive advantage; it increases the performance in industry.
Future collaborative research efforts will focus on including a broader variety of quantifiable green strategies within the factory, e.g., lighting, HVAC, or pressurized air consumption, and identifying a means of involving fixed costs in the decision-making process.

References

Boks, C., Nilsson, J., Masui, K., Suzuki, K., Rose, C., Lee, B.,1998. An international comparison of product end-of-life scenarios and legislation for consumer electronics. In:Proceedings from the IEEE Symposium on Electronics and

Bowen, F., Cousins, P.D., Lamming, R.C., Faruk, A.C., 2001. The role of supply management capabilities in green supply. Production and Operations Manage- ment 10 (2), 174–189.

Callahan, J.S., Dunne, R.A., Stanaback, S., 1997. New Jersey county dismantles recycling and emissions problems. World Wastes 40 (3), 7–8.

Christina W.Y.Wong, Kee-hungLai, Kuo-ChungShang, Chin-ShanLu, T.K.P.Leung, Green operations and the moderating role of environmental management capability of suppliers on manufacturing firm performance, Int. J. Production Economics 140 (2012) 283 -294.

Christmann, P., 2000. Effects of ''best practices'' of environmental management on cost advantage: the role of complementary assets. Academy of Management Journal 43 (4), 663–680.

Chun-Jen Chung, Hui-Ming Wee, Green-component life-cycle value on design and reverse manufacturing in semi-closed supply chain, Int.J.Production Economics 113 (2008)528-545

Corbett, C.J., Klassen, R.D., 2006. Extending the horizons: environmental excellence as key to improving operations. Manufacturing and Service Operations Management 8 (1), 5–22.

David A. Dornfeld, I. S. Jawahir, Andres F. Clarens, A Review of Engineering Dechant, K., Altman, B., 1994. Environmental leadership: from compliance to competitive advantage. Academy of Management Executive 8 (2), 7–20.

Ferguson, M.E., Toktay, L.B., 2006. The effect of competition on recovery strategies. Production and Operations Management 15 (3), 351–368.

Handfield, R.B., Walton, S.V., Seegers, L.K., Melnyk, S.A., 1997. 'Green' value chain practices in the furniture industry. Journal of Operations Management 15 (3), 293–315.

Hunt, C.B., Auster, E.R., 1990. Proactive environmental management: avoiding the toxic trap. Sloan Management Review 31 (2), 7–18.

Karl R. Haapala, Fu Zhao, Jaime Camelio, John W. Sutherland, Steven J. Skerlos Karthik Ramani, Devarajan Ramanujan,William Z. ernstein,Fu Zhao, John Sutherland, Carol Handwerker, Jun-Ki Choi, Harrison Kim, Deborah Thurston, Integrated Sustainable Life Cycle Design: A Review, Journal of Mechanical Design, Vol 132 September 2010

King, A., 2007. Cooperation between cooperations and environmental groups: a transaction cost perspective. Academy of Management Review 32 (3), 889–900.

Kovacs, G., 2008. Corporate environmental responsibility in the supply chain. Journal of Cleaner Production 16 (15), 1571–1578.

Lai, K.H., Lun, Y.H.V., Wong, C.W.Y., Cheng, T.C.E., 2011. Green shipping practices in the shipping industry: conceputualization, adoption and implications. Resources Conservation and Recycling 55 (6), 559–566.

Lee, S.-Y., Klassen, R.D., 2008. Drivers and enablers that foster environmental management capability in small- and medium-sized suppliers in supply chains. Production and Operations Management 17 (6), 573–586.

Min, H., Galle, W.P., 2001. Green purchasing purchases of US firms. International Journal of Operations and Production Management 21 (9), 1222–1238.

Nancy Diaz-Elsayed, Annabel Jondral, Sebastian Greinacher, David Dornfeld, Gisela Lanza, Assessment of lean and green strategies by simulation of manufacturing systems in discrete production environments, CIRP Annals – Manufacturing Technology 62 (2013) 475-478.

Qinghua Zhua, Joseph Sarkis, Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises, Journal of Operation Management 22 (2004) 265-289.

Pagell, M., Krumwiede, D. W., Sheu, C., 2007. Efficacy of environment and supplier relationship investments—moderating effects of external environment. International Journal of Production Economics 45 (9),2005–2028.

Porter, M.E., van der Linde, C., 1995a. Green and competitive: ending the stalemate. Harvard Business Review 73 (5), 120–134. Porter, M.E., van der Linde, C., 1995b. Toward a new conception of the environment–competitiveness relationship. Journal of Economic Perspectives 9 (4), 97–118.

Preuss, L., 2001. Is dirty chains? Purchasing and greener manufacturing. Journal of Business Ethics 34 (34), 345–359.

Research in Sustainable Manufacturing, Journal of Manufacturing Science & Engineering, Vol 135, August 2013 review. International Journal of Management Review 9 (1), 53-80.

Rogers, D., Tibben-Lembke, R., 2001. An examination of reverse logistics practices. Journal of Business Logistics 22 (2), 129–148.

Ru-Jen Lina, Rong-Huei Chen, Thi-Hang Nguyen, Green supply chain management performance in automobile manufacturing industry under uncertainty, Procedia - Social and Behavioral Sciences 25 (2011) 233 – 245.

Russo, M.V., Fouts, P.A., 1997. A resource-based perspective on corporate environ- mental performance and profitability. Academy of Management Journal 40 (3), 534–559.

Sarkis, J., Zhu, Q.H., Lai, K.H., 2011. An organizational theoretic review of green supply chain management literature. International Journal of Production Economics 130 (1), 1–15.

Srivastava, S.K., 2007. Green supply-chain management: a state- of- the- art literature the Environment, p. 19–24.

Toffel, M.W., 2002. End-of-Life Product Recovery: Prior Research and Future Directions. Haas School of Business, University of California, Berkeley. Working Paper, http://www.toffel.com.

Vachon, S., Klassen, R.D., 2007. Supply chain management and environmental technologies: the role of integration. International Journal of Production Research 45 (2), 401–423.

van Hock, R.I., Erasmus, 2000. From reversed logistics to green supply chains.

X.C.Tan, F.Liu, H.J.Cao, H. Zhang, Adecision-making framework model of cutting fluid selection for green manufacturing and a case study, Journal of Materials Processing Technology 129 (2002) 467-470.

Zhu, Q., Joseph, S., Lai, K.H., 2007. Green supply chain management: pressures, practices and performance within the Chinese automobile industry. Journal of Cleaner Production 15, 1041-1052.

Zhu, Q.H., Sarkis, J., Lai, K.H., 2007. Initiatives and outcomes of green supply chain management implementation by Chinese manufacturers. Journal of Environ- mental Management 85 (1), 179–189.