



A conceptual study on impact of green manufacturing practices

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Abstract

The need for sustainable products and raw materials is in line with the ecological degradation that the globe is presently facing at more and higher levels of industrial contamination. As a result, it raises awareness of sustainability in relevant fields. In recent years we have seen a rapid evolution of green manufacturing techniques, and the manufacturing sector's efforts to attain green production have raised concerns on the social, environmental, and economic fronts. Different green manufacturing techniques have different effects on the functioning of organizations. The existing literature contains only a small amount of empirical research on the effects of green manufacturing practices in manufacturing companies. The purpose of this study is to evaluate the literature on green manufacturing methods with the goal of adding to the body of knowledge and how the company managing the green manufacturing practices effectively. The performance of the company in a few industries within the manufacturing sector will be examined in relation to the drivers.

Keywords: Environmental Impact; Firm Performance; Green Manufacturing; Manufacturing Organizations; Manufacturing Practices; Sustainability

1. Introduction

A number of researchers have focused specifically on sustainability in manufacturing, and a number of research papers have been published in this emerging field of study. Nonetheless, sustainability is a generally acknowledged concept with minimal guidance regarding its actual application and effect on a company's performance. A large portion of the global resource consumption and waste production is attributed to the manufacturing sector. However, they could be the catalyst for building a sustainable society. They are able to create and put into action integrated green practices as well as goods and services that improve environmental performance. The manufacturing sector is important, accounting for 25% of the country's GDP in 2011. How businesses maintain their competitiveness while simultaneously protecting the environment is a major factor in determining the long-term viability of the company. Companies also need to consider their external markets in addition to their internal manufacturing operations. A company's need to develop new products that will help it become more economically sustainable should also be taken into account. Environmental sustainability programs have been introduced by many organizations in recent years, but information about their implementation is hard to come by. The emphasis is typically placed on the particular technology rather than a more comprehensive industrial engineering viewpoint in situations where the specifics are known. Furthermore, a lack of mapping exists between present green manufacturing practices. As a result, it remains unclear why changes have been made and how they will affect things. Green manufacturing is an emerging field that is growing quickly. Good reports on the state of green manufacturing practices are hard to come by. Moreover, there is a dearth of literature examining the effects of green manufacturing. Furthermore, has highlighted the fact that there is still some disagreement in the research on how environmental practices affect organizational outcomes. Manufacturers have been urged to adopt green manufacturing practices in order to comply with the national agenda since the National Green Policy was introduced in 2009. This research aims to close this gap by developing a green manufacturing model for

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producers. The variables influencing green manufacturing practices and their effect on manufacturing organizations' performance have not been thoroughly studied up to this point.

This study attempts to identify the relevant questions surrounding green manufacturing, such as the difficulties, methods, and motivators that result in green manufacturing practices in manufacturing companies. Additionally, the goal of this research is to clarify the factors that influence manufacturing sustainability and that businesses ought to be aware of. Furthermore taken into account is their effect on company performance as determined by the triple bottom line concept (economic, environmental, and social impact). Thus, consistent with, this study will put forth a model that shows the connections between firm performance in manufacturing industries and green manufacturing practices. The remaining portions of the paper are arranged as follows: It comprise of the literature on the ideas, difficulties, motivations, and practices of green manufacturing is reviewed and A new conceptual framework for green manufacturing is proposed and its relationship to firm performance and green manufacturing drivers is discussed and also reliability analysis and the final version of the conclusion.

Objectives

- To study the green manufacturing practices.
- To study various factors influence in green manufacturing practices.
- To investigate the potential economic benefits implementing green manufacturing practices.
- To study the challenges and barriers faced by the company in adopting and maintaining green manufacturing practices.

2. Review of literature

2.1. Muhardi MUHARDI, Cici CINTYAWATI, Rabiatul ADWIYAH,(2020)

Numerous research studies have been carried out to provide a deeper knowledge of the SMP idea; nevertheless, since the notion of sustainable manufacturing is constantly evolving and changing, there are currently no agreed-upon definitions among academics. In order to produce manufactured goods in a way that minimizes adverse effects on the environment as a result of production processes, the United States Environmental Agency defined sustainable manufacturing in 2107.

2.2. Mayank dev singh, Dr. G.d.thakar,(2018)

The idea of "green manufacturing," which dates back to the 1980s, is relatively new. Activities related to sustainable manufacturing began to concentrate on production waste reduction in the 1980s. From then on, the paradigm for sustainable manufacturing shifted from being process-oriented to being product-oriented, with a primary focus on reducing energy, resources, and hazardous materials while also developing and utilizing renewable materials (Seliger et al., 2008). There are existing laws, regulations, and tax implications pertaining to environmental preservation in many nations (Gungor et al., 1999). Actually, industry around the world has been encouraged to become more environmentally conscious and green by economic, technological, and public pressure in addition to environmental restrictions.

2.3. Supriyadi, ratna ekawati,(2016)

The understanding of how important it is to preserve environmental sustainability is fundamental to the concept of green manufacturing. The growing concerns about sustainable development are what set this off. The United Nations has defined green development as "a development that provides the needs of the present without endangering the ability of coming generations to provide for their own needs". This definition of sustainability was first used in relation to sustainable development.

2.4. Minhaj Ahamad Rehman, Dinesh Seth,(2016)

The most common definition of green manufacturing is "production practices that do not harm the environment at any point along its journey." This includes using environmentally friendly raw materials, designing products with a focus on sustainability, as well as using eco-friendly packaging, distribution, and product reuse after its useful life has ended. It reduces waste and decreases the loss of natural resources. It places a strong emphasis on component reuse, material rationalization, and part reduction. Reuse, reduce, recycle, recover, redesign, and recycling conservation, waste management, environmental protection, compliance with regulations, pollution control, and other related requirements are only a few of the manufacturing concerns it addresses.

2.5. M.Roni, J.Jabar, M.R.Mohamad,(2014)

The fast evolution of global concern about environmental degradation and green initiatives, coupled with the drive for competitiveness, has drawn attention to and redefined sustainable manufacturing. "Development that provides the needs of the present without endangering the ability of coming generations to provides their own needs" as the Brundtland Commission described green development in 1987, presenting an the early concept.

2.6. O. Molamohamadi and N. Ismail,(2013)

Due to the quick changes in the global awareness of environmental degradation, green initiatives, and the need to remain competitive, green manufacturing has drawn attention and been redefined. The term "Green development" was first used in 1987 by the Brundtland Commission, which described it as "development that provides the needs of the right now without endangering the ability of coming generations to meet their own needs". As research advances, so do the notion and definition of green manufacturing. Providing goods and services to meet the needs of customers in a society while promoting economic growth and reducing environmental damage is the definition of green manufacturing as of late.

2.7. Green manufacturing practices

C. Rusinko,(2007), Many green manufacturing practices that are adopted by organizations have been highlighted in previous studies. These practices include waste management, green manufacturing, pollution prevention, green material, and green manufacturing process. Nevertheless, waste management, green manufacturing processes, and green materials are the only three green manufacturing practices that are the subject of this study.

Waste minimization is the process of maximizing resource extraction from the waste stream prior to recycling or final disposal, or of reducing waste. Waste minimization can lead to a high standard of living and living without causing long-term environmental harm, as globalization raises knowledge and capability standards. Companies that implement lean methodologies have the potential to reduce or eradicate waste in any form. Additionally, by reducing waste and product shipment volumes, lean practices assist businesses in eliminating polluting and harmful emissions.

Another strategy for making an organization more sustainable is to introduce new manufacturing processes into the workplace. Numerous suppliers have created new additive formulations and technologies that can reduce the environmental impact in addition to adopting various strategies to improve the sustainability of their products. Additional innovations include creating systems with special qualities and concentrating on lowering energy and waste production. According to reference, if humanity adopted technology that controlled population growth, reduced pollution, and used renewable resources, collapse would be avoided and high living standards and human welfare would result.

2.8. Firm performance

S. C. Feng and C. B. Joung,(2009), Green manufacturing practices have varying and gradual effects on different industry sectors. In order to accurately evaluate the value of initiatives, manufacturing companies that embrace environmental sustainability must look at the triple bottom line's effects and make a commitment to monitor the environmental impact throughout the whole manufacturing chain. This study examines manufacturing firms' performance, which may be a proxy for manufacturing sustainability, using the Triple Bottom Line (TBL) concept.

The physical footprint of the facility and the manufacturing by products that affect its carbon footprint are the environmental impacts that are of concern. It has been demonstrated that using environmental sustainability practices lowers manufacturing processes' energy and water usage as well as their overall greenhouse gas emissions. Furthermore, by lowering pollution and resource consumption, the strategy may be self-sustaining. Steel companies, on the other hand, incorporate sustainability into the designs of their organizations by promoting research and innovations aimed at minimizing the adverse environmental effects of steels.

Since economic sustainability is, for the most part, easy to quantify, measuring it is also relatively simple; as a result, indicating its impact is simple. Many manufacturers understand that they can achieve high levels of economic growth and increased profitability with a balanced approach to sustainability. The majority of businesses see sustainability as actions that can increase returns on capital, which frequently entails cutting operational costs by managing natural resources better, such as energy use and waste. Lean methodologies, for example, enable businesses to cut costs and

boost profitability and are well-received by customers. Furthermore, cost savings from energy reduction and waste minimization demonstrate the economic and environmental benefits of green manufacturing.

The social well-being is also impacted, both directly and indirectly, by green manufacturing practices. According to a study by, a higher production rate has a greater social impact because it puts employees under more mental and physical strain, which increases the risk of workplace injuries. As an illustration, poor waste management can result in a variety of social and public health issues. It is thought that providing care for employees through fair hiring procedures, workplace justice, and shared accountability is just as important as encouraging an environmentally conscious culture among workers. Better air quality and lower energy costs, for example, would benefit the general public greatly and therefore enhance occupant comfort and health, lessen the burden on nearby infrastructure, and enhance overall quality of life. However, because social sustainability is intangible and many factors that are thought to be beneficial to society are subjective, it is somewhat more difficult to measure.

2.9. Green manufacturing drivers

T. Brandt and M. Lim,(2012), According to numerous literature reviews, policy and regulation, market forces, strategic leadership, and resource availability are some of the factors influencing green manufacturing practices. Government regulations and policies have been found to be the most influential factor in the majority of organizations. According to reference, government incentives, regulations, and laws are important forces behind sustainable operations. Other academics who have studied this topic also concur. Manufacturing organizations are under pressure from government policy and regulation to prioritize green manufacturing practices in order to comply with environmental standards and regulatory frameworks.

The dedication of top management (management support and management role) in the company is also a major driving force behind the successful adoption of green manufacturing practices . Firm strategy is another relevant element that might be taken into account in strategic leadership. Nonetheless, in companies where the majority of executives view the need to become sustainable as a corporate social responsibility that is distinct from the organization's business goals, management has a broader understanding of the concept of sustainability.

2.10. Challenges of green manufacturing

A. Gunasekaran and D. Gallea, (2012),The manufacturing sector is currently facing a significant sustainability challenge as a result of the depletion of natural resources and energy, the catastrophic degradation of the global environment, and human desire for a higher standard of living. In general, businesses in the manufacturing and service sectors face the challenge of designing goods, services, and delivery methods that will reduce their carbon footprint while maintaining their competitiveness in the global market. An unsupportive organizational culture with no institutional incentives is one of the main obstacles to businesses implementing sustainable environmental development programs, or "green practices". Price competition between suppliers and the high cost of adopting green production methods are two other obstacles that global organizations must overcome to implement a comprehensive and integrated environmental program.

3. Research methodology

- **Research type:** Descriptive research
- **Sampling technique:** Simple random sampling
- **Total size of the population:** 900
- **Sample size:** 269

4. Data collection

In this study, secondary data was collected through journals, published books, reports, magazines and the internet. Primary data is collected through a questionnaire survey method.

5. Conceptual framework

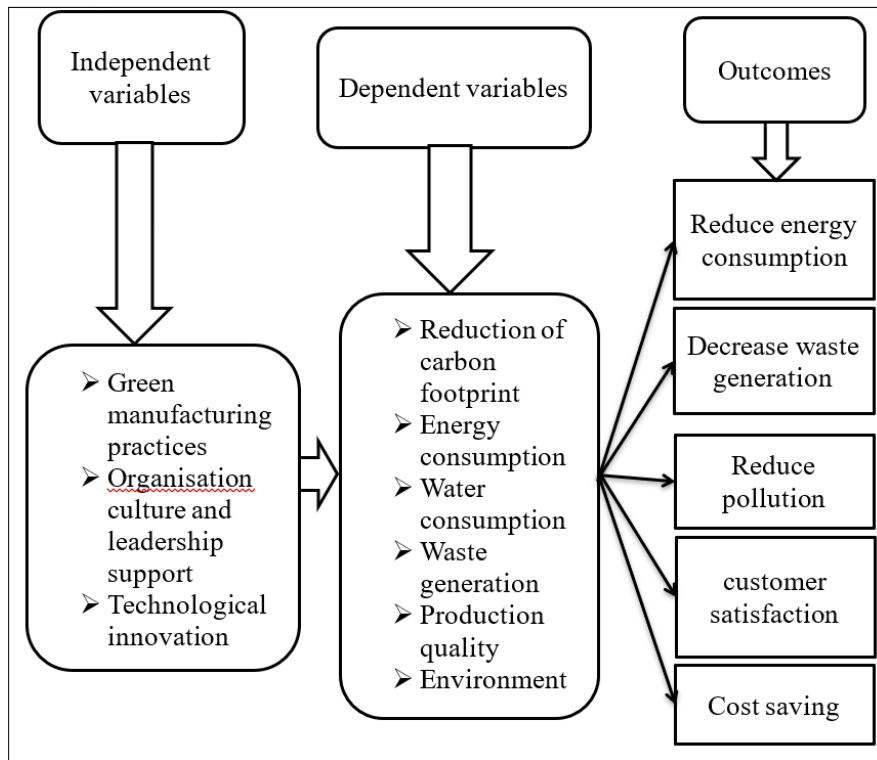


Figure 1 Conceptual framework

6. Reliability analysis

Table 1 Case processing summary

| | | N | % |
|-------|-----------------------|----|-------|
| Cases | Valid | 30 | 100.0 |
| | Excluded ^a | 0 | .0 |
| | Total | 30 | 100.0 |

a. Listwise deletion based on all variables in the procedure.

Table 2 Reliability statistics

| Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|------------------|--|------------|
| .807 | .817 | 20 |

Table 3 Item statistics

| Item Statistics | | | |
|------------------------|--------|----------------|----|
| | Mean | Std. Deviation | N |
| VAR00001 | 2.9667 | .31984 | 30 |
| VAR00002 | 2.3667 | .66868 | 30 |
| VAR00003 | 1.7667 | .85836 | 30 |
| VAR00004 | 2.0000 | .45486 | 30 |
| VAR00005 | 1.0667 | .25371 | 30 |
| VAR00006 | 3.9333 | .36515 | 30 |
| VAR00007 | 1.5000 | .62972 | 30 |
| VAR00008 | 2.6000 | 1.32873 | 30 |
| VAR00009 | 3.2667 | 1.08066 | 30 |
| VAR00010 | 1.0667 | .52083 | 30 |
| VAR00011 | 1.3333 | .60648 | 30 |
| VAR00012 | 1.8667 | .50742 | 30 |
| VAR00013 | 1.8333 | .53067 | 30 |
| VAR00014 | 1.0000 | .37139 | 30 |
| VAR00015 | 1.1000 | .48066 | 30 |
| VAR00016 | 1.2667 | .82768 | 30 |
| VAR00017 | 2.1000 | .92289 | 30 |
| VAR00018 | 1.8667 | .68145 | 30 |
| VAR00019 | 1.8333 | .64772 | 30 |
| VAR00020 | .9333 | .25371 | 30 |

Table 4 Summary item statistics

| Summary Item Statistics | | | | | | | |
|--------------------------------|-------|---------|---------|-------|-------------------|----------|------------|
| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
| Item Means | 1.883 | .933 | 3.933 | 3.000 | 4.214 | .662 | 20 |
| Item Variances | .453 | .064 | 1.766 | 1.701 | 27.429 | .178 | 20 |
| Inter-Item Correlations | .182 | -.830 | 1.000 | 1.830 | -1.204 | .150 | 20 |

Table 5 Item-Total statistics

| Item-Total Statistics | | | | | |
|-----------------------|----------------------------|--------------------------------|----------------------------------|------------------------------|----------------------------------|
| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
| VAR00001 | 34.7000 | 39.045 | -.091 | . | .814 |
| VAR00002 | 35.3000 | 36.562 | .219 | . | .807 |
| VAR00003 | 35.9000 | 35.403 | .259 | . | .808 |
| VAR00004 | 35.6667 | 39.264 | -.121 | . | .818 |
| VAR00005 | 36.6000 | 38.524 | .061 | . | .809 |
| VAR00006 | 33.7333 | 39.237 | -.129 | . | .816 |
| VAR00007 | 36.1667 | 44.902 | -.772 | . | .852 |
| VAR00008 | 35.0667 | 29.168 | .547 | . | .792 |
| VAR00009 | 34.4000 | 29.076 | .733 | . | .769 |
| VAR00010 | 36.6000 | 35.559 | .475 | . | .795 |
| VAR00011 | 36.3333 | 34.713 | .518 | . | .791 |
| VAR00012 | 35.8000 | 33.062 | .936 | . | .775 |
| VAR00013 | 35.8333 | 33.247 | .858 | . | .777 |
| VAR00014 | 36.6667 | 35.333 | .750 | . | .789 |
| VAR00015 | 36.5667 | 35.357 | .559 | . | .792 |
| VAR00016 | 36.4000 | 35.145 | .301 | . | .804 |
| VAR00017 | 35.5667 | 32.116 | .556 | . | .786 |
| VAR00018 | 35.8000 | 32.648 | .728 | . | .778 |
| VAR00019 | 35.8333 | 32.902 | .735 | . | .779 |
| VAR00020 | 36.7333 | 35.857 | .941 | . | .791 |

7. Conclusion

This article provides a broad summary of green manufacturing techniques and suggests a novel framework that suggests connections between firm performance and drivers that are mediated by green manufacturing practices. Green production shows that attention to the environment has increased. For a considerable amount of time, numerous scholars have examined the elements that need to be taken into account while integrating green manufacturing processes inside a business. However, the topic needs to be investigated further by assessing how industrial processes affect the environment, society, and economy.

Managers in manufacturing companies will be able to use the knowledge from this research to better understand how to implement green manufacturing practices. Second, it will give businesses information and real-world proof to guarantee the long-term endeavor's success. Thirdly, the research will assess how manufacturing companies are currently doing with regard to manufacturing practices. The goal of this research is to support the 2009 National Green Policy, which aims to boost sustainable development and accelerate the country's economy. The goal of this study's next phase is to develop a data collection tool that industrial enterprises can test. We anticipate that additional validation of the suggested framework will reveal its practical implications for the industries.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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