



Moving towards Sustainable and Green Manufacturing

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Abstract

One of the major concern areas in the recent past has been regarding conserving and better utilisation of various resources such as energy, water and other vital resources. For achieving which, green manufacturing has evolved as one of the strategic priority. And to attain this, innovation in advanced manufacturing can be a rescuer. The article aims at highlighting the contribution of green manufacturing as a concept that is relevant in the current industrial conditions, together with critically reviewing and highlighting the importance of achieving sustainable development through green manufacturing. The article further tries to indicate towards the modern pattern and guidelines required for achieving the environmental obligations and equilibrium in technical, economic, social and environmental priorities needed to achieve green and sustainable manufacturing.

Key Words: green manufacturing, sustainable development, environmental obligation

Introduction

Green manufacturing can be explained as the procedure of manufacturing which minimises waste production thereby leading reducing the negative impacts on the environment. The aim can be achieved by embracing the practices green manufacturing methods that influences the product designing, development and operational process in the sustainable and way. Therefore, green manufacturing can be explained as a process that integrates the manufacturing process and product designing issues with issues of planning, manufacturing and control. The entire manufacturing process here aims at managing the waste production in a manner that will ultimately influence the self-recovery potential of our planet together with maximising the resource efficiency.

Our world is continuously shifting towards the implementation of green manufacturing in order to achieve sustainable and green development. Most of the organisations have now recognised the importance of sustainability as an important strategy for business practices as well as for answering various consumer requirements and demands, along with maintaining the competitiveness. On the realisation of the fact that in the future, all the requirements related to various goods and services will be largely based on green and sustainable



development. In fact, it may be one of the root causes towards infusing innovation with manufacturing.

Sustainable development is basically gaining more prominence in manufacturing and services industry. Its presence can be felt ranging from the presence of smart factories to the green delivery trucks. As the demand for more green products is continuously increasing, it has exponentially led to the increased the demand from vendors and suppliers, so this can be the right time for the companies for incorporating and embracing the concept of green manufacturing not only for the present situation but also for the coming years.

At the higher domain, this realisation should try to address the conception related to social responsibility in the context of the shifting requirements of sustainable and green manufacturing. In order to achieve this, it is essential to develop the required methodologies and tools, so that organisations and manufacturers will be able to institutionalize the most required socially responsible decision-making procedure and practices.

Why to go for green manufacturing?

Green manufacturing cannot be considered as a fad as this concept started was introduced by Germany in the late 1980's – 1990's and since then it has only increased its place amongst the market place, so we can surely state that this concept has come to stay. Originally this concept required importing companies to take accountability and remove any packaging material being used for the product. In fact, this German thought has established a conventional de facto international manufacturing standard imparting that any company willing to compete globally needs to initiate manufacturing products that will fulfil with the green dictates of the European markets.

Proper understanding of the various dynamic forces and additional benefits of the concept is even indispensable for the purpose of making sustainable and green methodologies beneficial for the present manufacturers.

Tools for green manufacturing

The most commonly used tool for green manufacturing is Life Cycle Assessment (LCA). Life Cycle Assessment tool aims at examining the impact of different activities related to manufacturing of goods and services on the environment. LCA can aptly be functional for any action, either it be at the national or the international level, the purpose being identification of all those burdens resulting from any of the activities done by the individuals, society, locality or industries. LCA is useful in providing an outstanding understanding for the manufacturers and engineers so as to study any given product such that suitable methods could be identified by him/her for the purpose of reducing the adverse effect related to manufacturing of product or the process being used.

Application of LCA permits the manufacturers to develop a quantifiable understanding of the various phases related to the product life cycle and regulate it for the greatest benefits of the



environment benefit and eventually monitor and develop the long-term effect of alterations in design or manufacturing process.

The process-oriented LCA method can be structured into the following steps:

1. Defining goal and scope
2. Analysis of inventory
3. Assessment of impact
4. Interpretation.

Here, it is important to comprehend the various objectives of the LCA and the methods that can be used to achieve those objectives. For a better understanding of it, a deeper level of analysis is required. Consequently, during the first phase, suitable scope needs to be well understood. The phase is trailed by the second phase which leads towards the development of a quantitative study for the energy & material contributions towards the development of product or process at all phases. Here, it is significant to analyse all the prevailing issues related to the environment. It is followed by the third phase, where the output of the system at every phase is linked to its direct influence on the peripheral environment. The last phase in the procedure utilises the various consequences from the preceding three phases. Thus it makes suitable recommendations towards the fulfilment of environment related concerns in relation to the product and process being used. Therefore, this evidence delivers straight input for the practical tactics, such as, designing for the environment initiatives.

Approaches towards achieving Sustainable & Green Manufacturing

For achieve sustainable & green development, all the manufacturing organisations need to aim for the given procedures, as it would benefit the environment through the entire supply chain.

- Reduction in the usage of energy
- Reduction in the usage of water
- Reduction in the usage of waste generation

Green manufacturing must aim at integrating sustainable actions at all the phases of manufacturing, whether it is process, product or system. It should be followed by the various R's commonly known as reduction, reusing and recycling, recovery, redesigning, remanufacturing, repurpose, refurbishment and refuse. In order to be effective it is important that minimisation must start at the foundation phase.

Therefore, the principal share for the effort must be including sustainability during the product designing towards the environmental impacts during the entire lifespan of the product. It is true that products designed to be environmentally caring can give their contribution towards their successful introduction as well as maintenance. Such product also contributes in other process such as repairing, reusing, repurposing and remanufacturing. Further designing green product with easier maintainability helps in the extension and usage of the product much more competently. Sustainable and green manufacturing processes: Process of manufacturing and various systems employed must reflect sustainability at each



phase, so that there can be complete obedience towards the principle of sustainability. All the procedures used should be energy efficient while the maintenance of the required quality. It is also applicable for all the interconnected systems, reduction in the energy emissions and intensity within all the operations as well as the supply chain.

Increasing adoption of sustainable development through green manufacturing

In order to achieve sustainability through standard business practices, we need to incorporate the standard business practices. We require to use the right supplies, the right factories and the right transportation networks to get the products they want to achieve green manufacturing. In other words, we can also state that, companies need to move towards sustainable because of the following three reasons:

1. Public- Public perception relates to companies' image and reputation amongst the public. It states that when a company adopts green marketing, it gets reflected in its customers response. Word of mouth and widespread usage of social media can easily influence any companies profit generation. Public today is much aware and highly supports the companies using green manufacturing
2. Government – The government oversight and policies, influences the companies in going for green manufacturing. Government even helps by giving tax benefits and incentives for companies that abandon waste-producing practices or work to reduce their carbon footprints. Additionally, government imposes rigid fines and punishment in case of violation of anti-pollution legislation. Even if the prevailing political situation changes, the companies should still opt for green manufacturing as a positive reply in the court of public.
3. Profits – As a result of huge support from the previous two factors that is public and government, the company that goes for green manufacturing automatically starts harvesting profits in the long run.

All these driving forces strengthen the argument for sustainable and green manufacturing

Benefits of green manufacturing

An increasing number of companies treat Green manufacturing as an important criterion in their operations in order to achieve increasing growth, global competitiveness and brand awareness. We can state that green manufacturing leads to several benefits, some of them are as stated:

- Cost reduction – Achieving sustainability through green manufacturing also leads to reduction in cost incurred by the company. This includes reduction of cost through sustainable initiatives. Companies adopting green manufacturing reduces their



reliance on utility companies so as to gain power and recycling. The companies that operate by using this method is achieving greater profit

- Tax incentives - As mentioned earlier, tax incentives can be leveraged for investing into latest technologies and increasing a company's size.
- Has an effect of the environment - A company can adopt several ways to help the environment merely by optimizing current operations and reducing its reliance on energy resources. It does not have to be a complete renovation, but it is time to initiate thinking years in advance.
- Adherence to regulations – Companies adhering to laws can avoid the potential setbacks if current changes. Essentially, creating and implementing a sustainability strategy is the only long-term solution companies needs to adopt in order to avoid possible compliance violations.
- Achieving success through long term business practicality
- Lowering the regulatory compliance costs
- Improved sales and brand recognition
- Greater access to financing and capital
- Easier employee hiring and retention

How does the company initiate green manufacturing?

Once it has been decided that sustainability program has to be initiated in the company. Rather than trying to start from scratch, given things can be considered as the methods companies are recently utilizing to achieve green manufacturing initiatives.

- Reduction of waste and redundancies by smart factories
- Usage of cloud-based technologies to reduce energy costs.
- Usage of recycled products as raw materials.
- Creation of bi-directional supply chains.
- Reduction of waste products while transportation of goods.
- Consideration of trucks having lesser impact on environmental.

Future of Green Manufacturing

Million are being utilised to attain Sustainable Manufacturing. An increasing number of manufacturers are recognising the significant financial and environmental benefits from sustainable business practices Increasing number of institutes can be involved for inculcating environmental consciousness amongst the companies leading the companies to achieve sustainable manufacturing in a more feasible way. The usage of green manufacturing minimises negative environmental impacts, conserves energy and natural resources, are safe for employees, communities and consumers and are economically sound.



It has been observed by the organisations that economic pursuit alone would no longer be sufficient in the present era of sustainable development. Thus green manufacturing has evolved as the essence for attaining the overall goals of the business. Today business organisations are evolving, which is considered as a significant industrial revolution with an emphasis on “Green Manufacturing Process”. Companies are readily adopting sustainable business processes.

Thus this increasing adoption is leading towards reduced pollution; more products are manufactured from sustainable materials, while wastage is reduced significantly by re-manufacturing, reusing, and recycling. Other than its benefits to the environment, it can also be helpful in reducing the production cost of businesses allowing them to potentially increase the revenue.

Some of the methods that the companies are increasingly implementing to incorporate green manufacturing are:

- Conducting frequent energy audit
- Including sustainable and manufacturing processes.
- Manufacturing and selling eco-friendly products

Conclusion

Green manufacturing is one of the most significant features that should be considered by the production engineers, as a responsibility towards our planet. Analysis of the product life stages has evolved as one of the tools which are willingly used for establishing the environmental influence of the products being manufactured by us.

There can be numerous fields within the manufacturing sector which can be greatly advanced by the acceptance of practices related to green & sustainable manufacturing. The foremost philosophies that need to be reflected are reduction in the resource being utilised during the entire process, usage of environment-compatible resources, reduction in all types of wastages as well as reusing & recycling as much material as it may be possible, so as to appreciate the objective of self-recovery potential of our planet.

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