

# Integration of Lean management for the growth of Green manufacturing

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**Abstract.** The transition to green products or operations has forced companies to find solutions to balance their activities, services and products. This has increased business challenges due to rising costs. The quest for a way to reduce costs has become a necessity for companies. In this article, we will shed light on several definitions given by different researches, and we will focus on the relationship between lean and green, see if we can combine them and discuss the relationship between them. We will also investigate the benefits for the industry, especially the manufacturing sector. Furthermore, we will answer how can the integration of lean management contribute to the growth of green manufacturing.

## 1. Introduction

Today, companies are confronted with many challenges that can impact their efficiency; poor environmental performance can negatively impact economic performance.

These latters have a significant negative effect on economic growth, human health and business performance. Among the main business challenges, we find that costs, mainly the cost of energy and resources are constantly increasing due to increased demand and it is practically impossible to predict supply price trends. succeed in producing with a wide range of energy and resource prices. We also find the costs spent to reduce environmental damage caused by pollution by increasing investments in pollution control, many of which sacrifice efficiency and increase operational costs.

## 2. Terminology

In order to prepare an understandable literature review, a terminology sequence will be used to facilitate the understanding of the article:

### 2-1. Green management:

Green management, or eco-management, refers to the management methods of an entity (company, department, etc.) aimed at considering the environmental impact of its activities, assessing this impact and



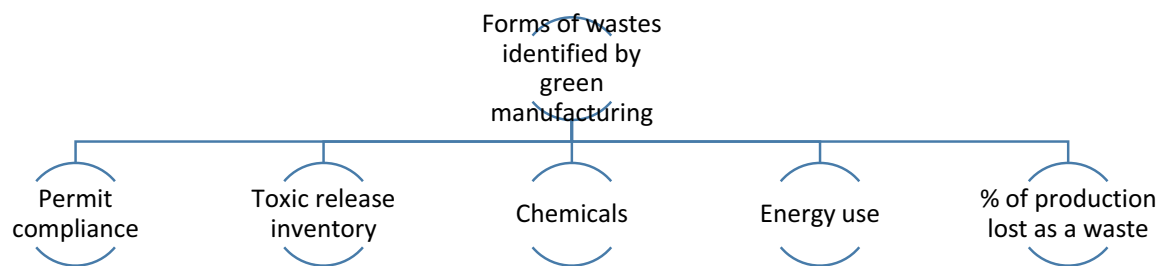
reducing it. Environmental management is part of a sustainable development perspective, i.e. a sustainable development perspective. It strengthens product stewardship capacity by integrating stakeholders into the procurement process and considering environmental concerns, which improves environmental performance, integrates environmental protection techniques into the product life cycle. However, it requires specific investments in green practices, which are time-consuming and cost-effective.

### 2-2. Green manufacturing:

Green manufacturing has been created to describe any manufacturing that uses different green strategies and techniques, the objective is to become more eco-efficient by creating systems or products that consume less equipment and energy, or by changing old resources and equipment to reduce unwanted outputs or converting outputs into inputs (recycling)[1].

In general, green technology is the application of one or more of the environmental sciences, to monitor, model and conserve the environment and natural resources, and to reduce the negative effects of human participation. Researchers and managers are debating the importance of investing in green technologies and green transformation. *Heinkel R et al.* [2] argue that environmental and green testing should change an environmental strategy. This will lead to a win-win situation. Manufacturers could improve performance while achieving environmental objectives.

Below is a figure showing the losses most detected by green manufacturing:



**Figure 1.** Some types of wastes identified by green manufacturing.

The addition of green to anything certainly reflects an ecological conscience; similarly, when it comes to manufacturing, we are talking about production that respects the environment. Moving towards green production is the result of the market and technological drivers.

### 2-3. Lean manufacturing:

Lean manufacturing has its origins within the Toyota Production System where it was integrated with just-in-time practices in order to improve quality and delivery time (*Krafcik1988*). And because of the company's high production rate, Toyota has adopted a production policy, as well as a new management system, which aims to reduce losses in all these aspects [3], Since then, lean manufacturing has gained notoriety in many industries around the world [4].

Today, lean manufacturing is seen as the most influential new paradigm in production industry. It leads to a competitive organization [5] by reducing wastes and time production, and improving productivity and quality at all stages of the supply chain [6]. Lean is also an operational management approach that aims to eliminate waste.

The five main elements of lean manufacturing are: Flow Manufacturing - Organization - Process Control- Logistics and Metrics.

These components represent the various facets necessary to support the activities of a strong lean manufacturing program, and it is the full deployment of these components that will propel a company on the path to becoming a world-class manufacturer.

The following is a basic definition of each of the five primary elements:

- **Manufacturing flow:** Volume produced per unit of time. All the steps taken by the product up to the final stage of its production.
- **Organization:** This allows the identification of the identity of people, their functions, roles, as well as training in new working and communication methods.
- **Process control:** The aspect oriented towards monitoring, control, stabilization and finding ways to improve the process.
- **Logistics:** The aspect that provides the definition of operating rules and organization and mechanisms for planning and controlling the flow of materials.
- **Parameters:** The visible, results-oriented performance aspect of measures, targeted improvements and team rewards/recognitions.

These main elements make it possible to cover all the challenges that can be encountered in setting up lean production. Each element focuses on an area of interest and compartmentalizes activities.

While each element is important for the deployment of a successful lean manufacturing program, energy comes from the integration of the following elements. For example, the manufacturing flow provides the basis for redesigning. In this sense, the Lean concept has not only been consistent with organizational objectives such as profitability and efficiency, but also with customer satisfaction, quality and responsiveness.

#### *2-4. Lean management:*

Lean management is a method that aims to improve the company's performance by developing all employees. The method makes it possible to find the ideal operating conditions by working together with personnel, equipment and sites in such a way as to add value with as little waste as possible[7].

Lean management (LM) aims to improve productivity and waste reduction, (LM) has several other impacts on the company.

- Demonstrate strong leadership and governance.
- Engage staff in daily improvement.
- Coaching.
- Make the measures more effective and show the results on a permanent basis.
- Integrate standard work into the company's culture.

The dual objective of Lean management is the complete satisfaction of the company's customers translated into turnover and the success of each employee translated into motivation and commitment.

### **3. Research method**

The purpose of the present study is to identify and evaluate the current states of the art of research to see the points of convergence and divergence of lean and green, and how can lean integration influence on the growth of green manufacturing, then identify the different gaps in order to see if the result of integrating lean is always the in terms of the growth of a green policy.

### **4. Finding and discussion**

In this paragraph we will mainly examine what the literature says about the subjects mentioned above and then discuss the data found.

#### 4-1. Points of convergence and divergence of lean and green management:

During the last 10 years, many articles cited several times have dealt with the divergence and convergence between lean and green. Organizations were forced to meet several regulations for the control of environmental impacts [8], their environmental initiatives became a key factor in market differentiation. Lean management (LM) was adopted by firms to reduce waste and to achieve such improvements. Its practices are more likely to be adopted by large enterprises than small and medium-sized companies

LM focuses on eliminating waste within organizational processes [9], its implementation requires a customer–supplier relationship capable of encouraging a continuous learning and a high level of trust. Green management was also adopted for the same reason, it aims to reducing environmental risks and negative impacts, while improving the eco efficiency of companies and their partners [10]. Both approaches aim to reduce waste, through the adoption of preventive initiatives [11]. The integration of both Lean management and green management results in an innovative approach called lean green.

In both approaches, suppliers are no longer treated only as entities that must comply strictly with customers' requirements; they are essential to increase value-added to goods and services through a proactive relationship [12]. Both concepts provide approaches to manage organizations and their supply chains with the aim of improving organisational performance. The literature confirms the convergence of both approaches, lean & green, waste reduction techniques.

The two approaches do not always go in the same direction, sometimes they diverge. according to the literature, there is still a gap regarding the assessment of the level of integration between both approaches. The researchers found that some successful Lean methods should be evaluated because they are not “eco-friendly” [13] and that only judoka and Frap had positive environmental effect.

#### 4-2. The influence of lean integration on the growth of green, or in general on environmental performance:

The Green Lean research concludes that the use of Lean methods seems to have a positive influence on environmental performance[13], These methods include 5S, Cellular Manufacturing, Lean Supply Chain Management, Total Productive Maintenance, and Value Stream Mapping. The integration of lean and green concepts is promising for addressing the sustainability performance or triple bottom line: economic, environmental and social dimensions. Lean manufacturing practices (LMPs) have been a subject of interest for organisational and operational completeness for decades [12]. Key principles of LMPs include the identification and elimination of all non-value-added activities, or waste, and involve employees in efforts toward continuous improvement [14].

Research on lean manufacturing suggests that while LMPs do not necessarily incorporate environmental responsibility, such practices can contribute to mitigate some of these environmental impacts because of their intrinsic focus on waste elimination [15].

LMPs may not have a direct intent to reduce environmental impact, their implementation had improved energy efficiency, reduced waste and emissions, and reduced inventory waste [16]. Several researchers have investigated the link between LMPs, operational and environmental performance [11]. The literature has reported mixed findings for the green and lean linkage; LMPs are positively associated with environmental performance.

*King and Lenox* found it evident that lean manufacturing, as measured by ISO 9000 adoption and low chemical inventories, is complementary to waste reduction and pollution reduction [17].

Other researchers postulate that LMPs show similar positive effects on both operational and environmental performance [18]. It has been argued that LMPs lead to environmental efficiency due to the core principle of zero waste [19]

#### 4-3. Different gaps in the relation between lean and green:

As already mentioned, lean and green do not always converge towards the same results, in many cases, the objectives of lean management are not in line with those of green, nor with respect for the environment. Some Lean Management Practices do not positively relate to environmental performance [11]; *Rothenberg, Pill, and Maxwell* found that lean management and reduction of air emissions of volatile organic compounds (VOCs) are negatively associated [18]. For example; the objectives of just in time (JIT) are to produce only the products that are needed, when needed and in the amount needed. It aims to reduce cycle times and eliminate unnecessary delays in processing time [20], [21].

When these objectives are achievable, JIT does not appear to respect any environmental principles. The JIT makes it possible to ensure a fluidity of flows, but also a significant emission of gases, especially CO<sub>2</sub>, caused by the increase in the frequency of transport [22]. This will consequently reduce environmental performance.

This means that firms may adopt Lean management practices that are valuable for improving operational results without thinking too much about respecting the environment, so automatically without having to be green [15].

#### 5. Conclusion

Lean management goes in most cases in the same context of green, i.e. in the respect of the environment. But there are cases when being green becomes an option that does not go with the company's lean objectives. Several questions arise, which may be the subject of future studies:

- What are the lean unfriendly environment approaches?
- How can they be replaced by green approaches?

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