



## **6. Sustainability Synergy with Lean Green and Six Sigma**

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### **ABSTRACT**

In the last decades, sustainable development has increasingly gained importance to service industry and the integration between Green, Lean and Six Sigma approaches in service systems is necessary in order to balance the need for operational efficiency with environmental commitment and social fairness. Because of that, the purpose of this paper is to critically review the Lean and Lean Six Sigma (LSS) methodologies and highlight their importance to achieve sustainable services. To do this, a systematic literature review of the subjects under investigation was conducted. The study has two major contributions. First, it is one of the first researches that examine the compatibility and divergences of Green, Lean and Six Sigma concepts and implications regarding its sustainable implementation in service industry. Second, it provides a holistic Green LSS framework attempting to help practitioners to find ways of institutionalizing it in numerous kinds of services, by pointing out nine critical factors for its implementation, such as continuous customer satisfaction, ethical relations and regulatory compliance, focus on knowledge management and human behaviors, and effective Jidoka automation. The proposed framework indicates new paradigms and pathways to achieve the balance in technical, economic, social and environmental priorities in services.

### **KEYWORDS**

Index - Lean, Green, Six Sixma, Sustainability.

### **Introduction**

#### **Sustainability**

Sustainable development has been defined as “the development that meets the needs of the present without compromising the ability of the future generation to meet their own needs”.

Building on the scientific rationale that the management of natural resources should be consistent with the preservation of its reproductive capacity, this concept has been broadened to incorporate economic, social and environmental concerns. Environmental protection, economic development, and social development are thus the three pillars of sustainable development.

The emphasis on the needs of both present and future generations (inter-generation equity) with regard to these three dimensions is a key aspect. The achievement of sustainable development requires a balanced integration of environment, economic and social objectives, taking into account the needs and concerns of both present and future generations.

But the links between the economic, environmental and social dimensions are complex, sometimes involving difficult trade-offs between them, which might seem contradictory in the short term though they should be mutually reinforcing in the long term.

### **Green Factor and Sustainability**

With the coming of the Industrial Revolution, humans were able to advance further into the 21st century. Technology developed rapidly, science became advanced and the manufacturing age came into view. With all of these came one more effect, industrial pollution.

As the factories used to work for definite hours a day, the levels of pollution did not grow considerably. But after the subsequent growth of these factories, the industrial pollution has become a factor of high disturbance.

Any type of pollution which can sketch its immediate source to industrial practices is known as industrial pollution. The majority of the pollution on the planet occurs due to the industries of some kind. Also, industrial pollution has taken on the momentous importance for agencies fighting against environmental degradation. Countries with an increase in the industries are finding it difficult to cope with this kind of pollution.

Industrial pollution can affect the environment in a number of ways:

- It may increase the chances of degradation of human health as this pollutants might get into the water sources hence might degrade water quality.
- It may interfere with natural processes. For example, industrial waste could change local climatic conditions or destroy wildlife habitats.

It may impact on people's livelihoods. For example, pollution of the sea will affect people who are involved in the fishing and tourism industries. Thus environmental factors play an important role in today's industrial scenario. To make an industry sustainable to various changes in the industrial working, environment plays an important role. With the proper control of the effects of these environmental factors, the Sustainability of an industry can be further increased.

**Lean and Sustainability:**

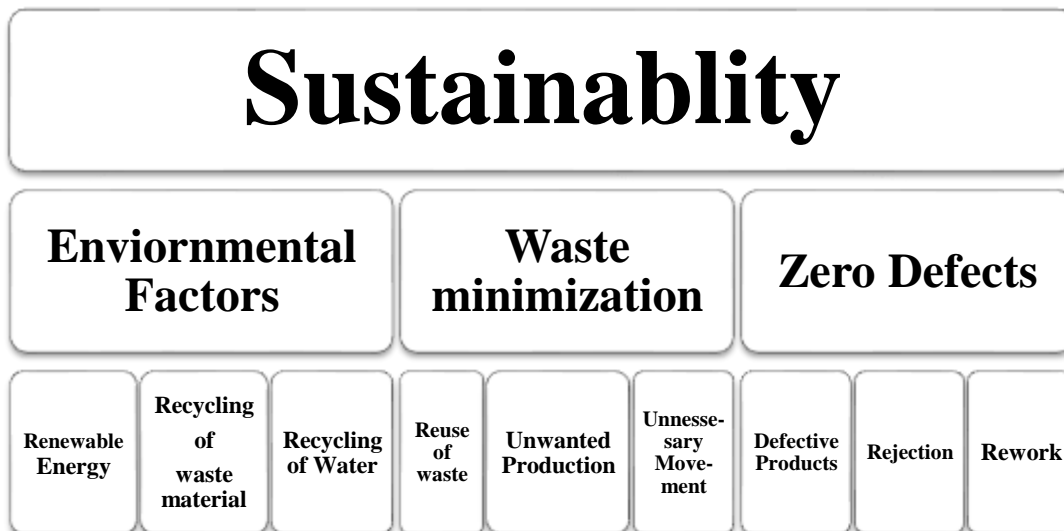
Waste minimization is the phenomenon which works to reduce the wastes produced in an organization. Hence reducing the losses in the organization in the form of wastes. Thus waste minimization is a positive approach to indirectly increase an organizations profit.

Waste management should be considered as a matter of utmost importance. The waste management requires a significant amount of time and resources; therefore, it is important to understand the benefits of waste minimization and how it can be implemented in all sectors of the economy, in an effective, safe and sustainable manner.

Six sigma and sustainability: Zero defects are referred to as a viewpoint, a state of mind, or a movement that targets to reduce the number of defects in manufactured products and service as much as possible. It does not have different steps to follow or rules to stand by, which leaves companies open to customizing how they want it to work for themselves.

Hence, a certain product is said to have achieved quality if and when it meets those requirements. However, this should not be confused with higher standards of products. For instance, it'll be unrealistic to say that a basic mobile phone is of low quality compared to the latest iPhone because they both have to meet different quality standards to pass the quality test. Based on this, Zero Defects means the basic mobile phone is a quality product if it meets the initial requirements set for it. That is, if it can make and take phone calls clearly, send and receive text messages, among other things, then it is only realistic to say it conforms to quality and has (close to) zero defects.

Zero defects help reduce the wastage and losses to the industries. With Maintaining zero defect in all possible industrial processes an improvement can be made in the entire industrial working scenario. Thus Zero defects can be considered as an important tool in making an industrial working more sustainable.



We can see that it can be interpreted that till now the many parameters are considered on the individual basis but here in this project we are using three parameters integrated to find out the sustainability.

### **Objective**

The main focus of this project is to determine the factors which affect sustainability and by what percentage. Three major factors are to be selected and thus these factors are to be prioritized by conducting a survey based on the questionnaire having pair wise comparison amongst the three factors and its sub factors.

### **Conclusions, Limitations and Future Research Directions**

The effect of Lean and Six Sigma on the environment has been examined in detail in this study. The effect of the combination of these methods, i.e., Lean Six Sigma was also discussed. To provide a depiction of what the literature has addressed about Lean and Six Sigma and their green impact. An overview of both methods was then provided, which formed the foundation for this study linking theory and literature together. Using the articles that were shortlisted, the effectiveness of Lean, Six Sigma and Lean Six Sigma as environmentally-friendly methods was discussed. Research aimed to investigate and link the positive impact of these methods on the issues of energy management, global warming, pollution and usage of resources.

The study shows that organisations can engage in these quality and operations improvement methods to support their compliance with environmental regulations and save costs while also meeting quality management and operations standards. Various articles analysed in this study included information on the issues surrounding the impact of these quality and operations management methods on the environment; however, some did not bring forward the issue of sustainability. As such, inferences were made from those that did not provide direct links to the impact on the environment. These inferences provide a new and fresh perspective to this issue, which can fuel further research. In conclusion, it is evident through the comprehensive analysis of sample articles that both Lean and Six Sigma are indeed useful in supporting the conservation of resources, combating global warming and saving energy. Various scholars provide evidence of this and as such, organisations should actively consider these methods to manage quality and meet environmental regulations. As in all studies, this research also faced some limitations.

### **Limitation**

The analysis conducted provides many directions for future research. It is evident from this study that there is a lack of research and therefore scarcity of articles exploring Six Sigma's impact on the environment. The positive or negative consequences on the environment as a result of the Six Sigma implementation have yet to be explored in all industries. Conducting more research in this area can give organisations an insight into the application of Six Sigma. While Lean has a significant amount of articles and information on its environmental considerations, more can be explored in this aspect as well.

These gaps can be filled by examining individual organisation's style and programmes of applying the practices of Lean, Six Sigma and Lean Six Sigma. Thereafter, a common ground can be found between them to build a relationship between theory, methodology and practice. Finally, the conceptual and practical implications of other quality schools of thought, such as that of the 'loss to society' proposed by Taguchi (Ross, 1988), may also be investigated from an environmental perspective. Specifically, the investigation of their synergies and divergences will contribute to the advancement of this area.

**Some specific research questions that can be explored in the future include**

- What aspects of Six Sigma make it suitable as a measure for sustainability?
- What are the environmental incentives for the various organisations aiming to implement Six Sigma?
- Does the implementation of Lean Six Sigma assist organisations to be more environmentally sustainable?
- How environmental sustainability pressures affect the choice of quality improvement programmes?
- What are the challenges of Lean and Green implementation?
- Does the inclusion of the Green dimension calls for a new theoretical foundation for quality improvement?

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