

BRANDING LEAN SIX SIGMA AND ENVIRONMENT IN INDUSTRIAL SECTOR. WHAT'S IN THE NAME? AN OVERVIEW

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ABSTRACT

Lean and Six Sigma are the two powerful business improvement systems that are rapidly being deployed across multiple manufacturing and service sectors. The paper describes how Lean and Six Sigma relate to the environment and provides guidance on how environmental professionals can connect with such activities to generate better operational and environmental results. The aim of this paper is to showcase why the business terms are becoming a brand terms now-a-days? And even to get more awareness for many industrialists through environmental professionals and Lean and Six Sigma Practitioners.

Keywords – *Environment, Industries, Lean manufacturing, Six Sigma.*

I. INTRODUCTION

Since from the past few years, many environmental professionals have observed the rapid expansion of Lean and Six Sigma activities sweeping across diverse commercial and manufacturing sectors. A growing number of environmental professionals see an exciting opportunity to leverage this trend to achieve better environmental results more quickly. It is important for environmental professionals to understand how to talk to Lean and Six Sigma practitioners in a way that maximizes the likelihood of successful partnerships. There are many ways how environmental professionals can improve results by Lean and Six Sigma efforts. "Lean and Environment" approaches refer to strategies for integrating environmental considerations and tools into Lean and Six Sigma implementation.

II. LITERATURE REVIEW

2.1. History

After World War II, the Toyota motor company, with the help of Japanese engineers Taiichi Ohno and Shigeo Shingo, pioneered a collection of advanced manufacturing methods that aimed to minimize the resources it takes for a single product to flow through the entire production process. Inspired by concepts developed by Henry Ford in the early 1900s, Toyota created an organizational culture of continual improvement. The pillars are just-

in-time production and jidoka (built in quality), while the foundation is standardization. Toyota's success has led thousands of other companies across numerous industry sectors to tailor these advanced production methods to address their operations. In the U.S., lean implementation began in the 980s in the automotive and aerospace sectors. Today, numerous companies of all sizes and across multiple sectors are implementing lean production. According to the 2007 manufacturing process improvement census of manufacturers, nearly 70% of all U.S. plants have adopted lean, manufacturing as an improvement methodology [7]

The use of Six Sigma as a tool for improving manufacturing processes and eliminating defects can be traced back to the 1920s; however, it was not widely used as a quality control technique until the late 1980s. Motorola engineers, interested in more closely measuring defects in products and eliminating them, developed the six sigma continual improvement philosophy and many of the statistical tools used to implement this philosophy. Since Motorola's development of six sigma, the techniques have been widely adopted by companies in a variety of industrial sectors. General Electric's CEO Jack Welch adopted six sigma's techniques for his business strategy in 1995, which helped to expand the use of the six sigma philosophy even further [9].

2.2. Lean Manufacturing

The term "Lean," coined by James Womack, et al. in the 1990 book, *The Machine that Changed the World* describes the manufacturing paradigm set by Toyota. In the lean context, waste is any activity that does not lead directly to creating the product or service a customer wants when they want it. Lean manufacturing is an efficiency based system on optimizing flow to minimize bring the wastage and using advance methods to improve manufacturing system by modified or change pre-existing ideas [3]. Another definition say that Lean Manufacturing is a philosophy that aims to maintain smooth production flow by continuously identifying and eliminating waste resulting in increasing value of activities in the production process. Lean Manufacturing aims for Identification and elimination of waste (any activity that does not add value to customer) [1]. Lean manufacturing aims to continuous flow of all manufacturing processes with minimum as minimum wastage. The Basic Elements of Lean Manufacturing System are [2]: KANBAN, TPM (Total Productive Maintenance), JIT (Just In Time), KAIZEN (Change For Better), Quality Circles, TQM, Employee Involvement and 5's. The Main benefits of Lean Manufacturing System are [6]: Improve productivity, Overall wastage reduction, Cost reduction, Reduce defects, and Overall quality improvement.

2.3. Six Sigma

A term (Greek) is used in statistics to represent standard deviation from mean value, an indicator of the degree of variation in a set of a process, so "six sigma" denotes a target level of quality that is six times the standard deviation. This means that defects only occur approximately 3.4 times per million opportunities, representing high quality and minimal process variability. If Higher sigma capability, better performance. A highly disciplined process that enables organizations delivers nearly perfect products and services. The figure of six arrived statistically from current average maturity of most business enterprise. Six sigma refers refers to a set of well-established statistical quality control techniques and data analysis methods used to identify and reduce variation in products and processes. By using six sigma statistical tools, companies are able to diagnose the root

causes of performance gaps and variability, thereby improving productivity and product quality. Six sigma borrows material arts ranking terminology to define practitioner roles [4].

Six Sigma typically involves implementing a five-step process called the DMAIC (Define, Measure, Analyze, Improve, and Control) process. This process is used to guide implementation of Six sigma statistical tools and to identify process wastes and variation. It is similar to the Plan-Do-Check-Act business process improvement method.

III. IMPORTANCE TO INDUSTRY ENVIRONMENT

The challenge, and opportunity, for environmental professionals is to productively engage with lean and six sigma practitioners-meeting them where they are, to translate environmental opportunities and concepts into the lean and six sigma methods and to make environmental improvement a seamless, integrated aspect of delivering value to meet customer needs. Dramatic progress has been made during the past twenty years in commercial and industrial sector environmental management. Focus on end-of-pipe clean-up and regulatory compliance has expanded to preventing pollution at its source and considering broader environmental sustainability objectives in organizational decisions. Advances in four key areas are helping organizations across diverse sectors realize compelling industrial environmental and economic results [6].

1. Environmental tools and expertise help business and other organizations minimize waste, prevent pollution, and move towards more environmentally sustainable processes and products.
2. Environmental management systems (EMS) institutionalize environmental management activities and foster continual improvement.
3. The business module for environmental activities influences an increasing number of business decisions, as case studies and analysis demonstrate the benefits of proactive environmental management on bottom line performance.
4. Businesses are increasingly experimenting with paths to sustainability incorporating corporate social responsibility and three bottom line thinking into the core fabric of business strategy and operations.

Despite the progress, there is still significant opportunity to improve environmental performance further reducing the environmental footprint of production processes, products and services.

3.1. Characteristics of Lean and Six Sigma

Lean and Six Sigma both incorporate a continuous improvement culture that is meant to waste minimization and pollution prevention. Some companies place more emphasis on lean, while others focuses on six sigma as an organizing framework. Increasingly, organizations merge the methods as "Lean Six Sigma". Lean and Six sigma process improvement methodologies work well together. Lean's focus on eliminating waste and improving speed of processes is complemented with six sigma's focus on eliminating variation and improving product quality [5].

TABLE1: Characteristics of Lean and Six Sigma

Sl.No	Lean	Six Sigma
01	Provides tools for analyzing process flow and delays at each process step.	Recognizes the variation hinders the ability to reliably deliver high quality services
02	Focuses on maximizing product flow and variety	Emphasizes the need to recognize opportunities and eliminate defects.
03	Centers on the separation of value added from non-value added work with tools to eliminate root cause of non-value added activities.	Requires data-driven decisions and incorporates a comprehensive set of quality tools under a systematic framework for problem solving.
04	Provides a means for quantifying and eliminating the cost of complexity.	Provides a highly perspective cultural infrastructure effective in obtaining sustainable results.

Lean and Six Sigma have legs. Businesses, organizations, and government agencies are aggressively expanding the use of Lean and Six Sigma as core strategies for addressing competitive market pressures affecting cost, quality, and customer demands. Lean is driving change in many commercial and industrial sectors, ranging from automotive, aerospace, and metal finishing to health care, construction and wood products. Commitment to Lean and Six sigma varies significantly across organizations, many view implementation as a long-term journey that will require sustained leadership and organizational commitment .Lean and Six sigma seek to create a very similar , and highly complementary improvement ideas compete more effectively and embed them in culture changing process improvement practices. They are not replacements for environmental management approaches and tools, but powerful delivery mechanisms. Lean and Six Sigma do not focus on process improvement alone, but can be applied to product design by using methods such as Production Preparation Process (3P) and design for Lean six sigma. The challenge, and opportunity, is to harness the collection of Lean and Six sigma methods to drive environmental improvement and sustainability ideas deep into core business strategy and operations.

IV. BRANDING OF LEAN SIX SIGMA AND ENVIRONMENT: IT'S STRATEGIES

4.1. Learn the Language

Environmental professionals' don't need to become experts to learn the language of lean. Listening combined with reading and training can equip you to talk effectively with lean practitioners about environmental issues. Just as a terminology of lean may initially be unfamiliar to environmental professionals, lean audiences may not be familiar with environmental terms and acronyms [6].

4.2. Frame "Environment" in lean terms

It's not necessary to convince lean practitioners to become environmental experts to integrate lean and environmental initiatives. Lean practitioners love nothing more than finding and eliminating waste. If one can

help them see wastes that were previously hidden, they will often become zealous partners in improving environmental performance. It is also useful to look for the specific places, or entry points, within lean methods where asking a simple question can help lean practitioners see environmental wastes.

4.3. Learn how to say “yes”

When environmental professionals are viewed as only saying “No” to potential lean projects, invitations to participate in lean events can be scarce. Instead, think creatively about how to address challenges and meet both environmental and operational objectives. Some lean facilitators even ban the word “can’t” and suggest reframing concerns by saying “We could if...” by working collaboratively to develop solutions that can reduce environmental wastes, eliminate worker health and safety hazards, and avoid environmental risks associated with regulatory compliance obligations [6].

Bridging the “Lean” universe and the “environmental” universe can yield substantial benefits for all parties involved. Fortunately, it doesn’t have to be difficult to overcome these differences, break down organizational silos, and work together to achieve common objectives such as waste elimination, continual improvement, and creating a good working environment for employees. More work lies ahead to connect Lean with environmental improvement efforts, how should environmental professionals refer to or “brand” integration efforts? A variety of terms have been used, including “Lean and Environment”, “Lean and Green”, and “Lean and Clean”. These terms can be useful in drawing attention to efforts to integrate the parallel universes of Lean and environment, and for technical assistance providers, in making a distinction between standard lean services and integrated services that combine Lean and environment expertise. At the same time, these “Lean and Environment” terms can imply that environmental considerations are an add-on, something distinct and separate from lean, when the real goal is more seamless integration. Furthermore, efforts to “paint Lean green” may not get far with all Lean practitioners and promoters. The caution to environmental professionals is, they should think carefully about what to call lean and environmental integration efforts. Branding lean and environment using terms such as those described above may be fully appropriate and useful when communicating with other environmental professionals. Many businesses and operations personnel, however, may be skeptical of the value of incorporating environmental issues into lean. In addition, as noted, saying lean or six sigma are the same as pollution prevention can lead operational personnel to dismiss the ideas of the environmental professional. When communicating with operations personnel at business, a subtle approach to describing lean and environment may work best. Rather than elevating environmental issues to be on par with lean, environmental professionals may be better served by leading with lean and discussing how environmental professionals can help these methods find and eliminate even more waste. The idea of adding one more waste “environmental waste” to lean’s deadly wastes is a powerful concept that may increase receptiveness and lower barriers to connecting lean and environment [10].

4.4. Value of Lean and Environment

Practitioners and service providers with Lean Six Sigma and environment experience have shared the following suggestions on how to talk with companies about the value of Lean and environment. It’s very important to

speak the language of business and explain how Lean and environment efforts will address core business needs, which includes reducing costs, decreasing production lead times, Increasing value to customers, Staying in business and retaining jobs, and addressing key problems and areas of pain at work places [6].

Furthermore, when environmental improvement opportunities are included with Lean initiatives, those ideas receive more management attention and become higher priorities for implementation. Effective integration of Lean and environmental efforts creates a powerful approach to find hidden cost savings, identify and eliminate all forms of wastes, reduce business risks, and improve organizational performance.

V. ENVIRONMENTAL RESULTS

5.1 Bridging six sigma, lean and Environmental efforts at facilities

Lean is a powerful vehicle for generating environmental results, the environmental health and safety personnel should not be the only employees looking for environmental wastes and improvement opportunities. There are several ways that environmental professionals can help to integrate environmental considerations into lean efforts at companies. The three important steps include

5.1.1. Learn about Lean

Learning about lean principles and methods is a good first step for understanding how these efforts can advance environmental objectives. Another useful way to learn is to listen to lean practitioners and to observe lean implementation efforts. Consider participating in the lean events and attending the seminars of lean events. A little time spent listening and observing can be much more effective than just relying on books and training courses to get a practical understanding of Lean [10].

5.1.2. Get involved with Lean Efforts

If you work at an organization implementing Lean or Six sigma, set up time to meet with Lean leaders in your organization or geographical area. Often the greatest benefits come from simple conversations and relationships. With lean focus on eliminating “waste” in all its forms, there should be some natural synergies and places where EHS personnel could offer to help with lean efforts. Lean teams often look for people with outside perspectives to participate in events, and directly participating in lean efforts is one of the most powerful ways to influence them.

5.1.3. Bringing a “Problem Solving” Orientation to Lean teams

The rapid time frames of Lean mean that there is a bias for quick and simple solutions. Working effectively with lean efforts may require environmental professionals to operate in different ways, focusing on quickly identifying simple solutions to reduce wastes as part of cross-functional teams. There may be a need to think creatively about ways to proactively address potential regulatory compliance issues, in order to enable process changes that could improve both environmental and operational results. By understanding the schedule and scope for upcoming lean projects, environmental professionals can identify information that can reveal

environmental wastes and anticipate regulatory and compliance issues that may affect changes made during the events. Environmental agencies can help facilitate the integration of Lean, Six Sigma and environmental efforts at facilities in number of ways. The potential roles for environmental agencies include [11]:

- Translate or “adapt” existing environmental tools for lean and six sigma audiences and applications.
- Making partnerships with lean organizations to integrate environmental considerations into lean training curriculums, publications, and other efforts.
- To support Lean and environment technical assistance and training programs.
- Address uncertainties or regulatory barriers with applying lean tools to environmentally sensitive processes.
- Disseminate results and best practices from lean and environmental efforts.
- Develop lean and environmental educational materials and tools.

The growing prominence of lean presents a window of opportunity for professionals to help manufacturing companies generate better environmental results while supporting business competitiveness initiatives.

5.2. Providing Technical Assistance

To integrate environmental considerations into business improvement initiatives, the technical assistance providers like government agency technical assistance programs, non-profit pollution prevention centers, and private consulting firms are trying to provide more value to business, and reach new audiences through lean strategies. Environmental service providers can do this in two possible ways:

5.2.1. Partner with Lean Service Providers

Environmental service providers can partner with lean service providers to offer lean and environment services to facilities. There are several models for this type of joint service delivery.

5.2.2. Provide direct support to facility Lean efforts

Companies implementing lean approaches may request assistance or “pull” services of outside environmental professionals to address wastes in the context of lean. For example; companies have invited environmental agency staff to participate in lean events on processes with significant environmental impacts.

5.3. Involving Manufacturing Extension Partnership Centers

Many organizations have developed technical assistance programs involving partnerships with National Institute of Standards and Technology (NIST) centres. Manufacturing extension partnership is a national network of manufacturing assistance centers that provide lean manufacturing and other services to small-to-medium sized businesses to make them more competitive. There are some programs involving in MEP centres are:

5.3.1. Green Suppliers network (GSN) Program

Here the EA[8] providers work with lean providers at MEP centers to conduct “lean and clean” value stream mapping events with small and medium sized companies in the supply chains of large manufacturers. The review teams develop confidential reports that identify a range of improvement opportunities at each participating facility and estimate the potential cost and environmental savings from those recommendations.

5.3.2. Washington State Lean and Green assistance program

The Washington state department of ecology partners, to offer partially subsidized, implementation-oriented lean and environment services to facilities. The three initial pilot projects each involved lean and environment training, a 3-5 day value stream mapping event, and at last three kaizen events. The projects resulted in \$1.6 million in cost savings and multiple environmental benefits.

5.3.3. California Value and Energy Stream Mapping program

This has been collaborated with major California utilities and separate energy efficiency analysis consultants to measure energy use in value stream mapping events and conduct process improvement events that reduce energy use and costs for manufacturing and distributors.

5.3.4. New York LE2 Program

The New York State Pollution Prevention Institute offers integrated lean, energy, and environment analytic services to New York manufacturers. The detailed, in depth value stream analysis involves a lean practitioner, an EHS professional, and an energy expert taking a critical look at the process and identifying inefficiencies, safety and environmental issues, and energy wastes. The LE2 assessment includes as LE2 value stream map, recommendations, a written final report, and a presentation to management and stakeholders [6].

VI. CONCLUSION

Lean and Six Sigma methodologies are highly positive in their findings, resulting in strong evidence that lean has in fact a positive contribution in the improvement of the environmental performance. Furthermore, Lean, Six Sigma, and environmental professionals often operate in “parallel universes”, using other languages and adding different categories of people, despite having synergistic goals and using some similar tools. In the long term, we hope environmental professionals will see the value of lean for achieving environmental objectives and will integrate lean into their core activities. We hope the Lean Six Sigma and environment gave a broader meaning and made a new sense for Industrialists to incorporate these into their facilities.

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