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An Overview of Lean Six Sigma for Process Improvement in Precise Machining

Rohit Dhrupeshkumar[1*], Makwana Amitkumar[2], Patange Gajanan Shankarrao[3]

[1]PG Student CHAMOS Matrusanstha Department of Mechanical Engineering, Charotar University of Science & Technology, Changa, Gujarat, India, dhrupeshr@gmail.com
[2]Ph.D. Scholar CHAMOS Matrusanstha Department of Mechanical Engineering, Charotar University of Science & Technology, Changa, Gujarat, India, amitmak30@gmail.com
[3]Assistant Prof. CHAMOS Matrusanstha Department of Mechanical Engineering,Charotar University of Science & Technology, Changa, Gujarat, India, gajananpatange.me@charusat.edu.in

ABSTRACT

Lean and Six Sigma are the latest developments in the ongoing improvement methodology popularized by many well-known companies. The success and complementary nature of these methodologies are typically combined into a single methodology called Lean Six Sigma or Lean Sigma. Although there are many references and consultants related to Lean Six Sigma, a rarely published study deals with the actual experience of companies implementing Lean Six Sigma. The objectives of this paper were to have an overview of Lean Six Sigma in precise machining. It was found that twenty papers were very much relevant for process improvement in precise machining. These paper reveals that value stream mapping and 5s along with six sigma is very much useful.

KEYWORDS: Lean; Six Sigma, Continuous Improvement, Productivity, VSM, 5s

***Corresponding author**

Mr. Dhrupeshkumar Rohit

CHAMOS Matrusanstha Department of Mechanical Engineering,

Charotar University of Science & Technology,

Changa, Gujarat, India

Email: dhrupeshr@gmail.comMob No – 9033987276

INTRODUCTION

Henry Ford first developed the concept of manufacturing assembly lines in a way that is the first method for mass production. Henry Ford's model for the simplest and most repetitive workforce has been largely replaced by job rotation and teamwork to improve employee morale, but it offers significant benefits in terms of employee quality and proposal to improve processes. This model is changing the way managers see production and focuses on the specialization of information work by unskilled labour. Mass reduction per unit, standardization of work, school-sponsored volume products, and scientific management Frederick Taylor founder dissemination. Until the Japanese Toyota Group Taiichi Group pointed out some flaws in the model, the managers did not face the effects of the model. Mass production has a lot of capital and space, poor quality of products, high inventory levels of materials required for product standardization, and related organizations are strong in change and very flexible to customer needs.

The Lean Six Sigma (LSS) method facilitates continuous improvement of products (and / or services) and processes that align with your business strategy to maximize the value of your products in your organization. LSS can be defined as a working philosophy adopted by companies that using methods and tools to reduce the variety of processes used to eliminate waste and improve perceived quality for customers. This philosophy is in line with the company's strategic plan, providing more opportunities in the marketplace. It combines several tools to provide a unique capability to support business strategy development. It also supports the achievement of the stages and planned results of the improvement project.

Strategic planning plays a critical role in business operations, anticipating future forecasts of current decisions, preparing for changes in political, economic, social and technological areas, capturing opportunities, and addressing the unique threats of these environments. To be able to. Making your organization more efficient requires ongoing planning and investment that aligns the process with your company's strategy. While these behaviours do not produce immediate results, they can differentiate you from your competitors over time.

Standardization is an important factor in reducing process variability and increasing efficiency. In Harrington, statistical process control is the source of information for managers and supports continuous improvement of operational performance and processes in a sustainable manner. Organizations must adapt to market needs, identify opportunities and maximize three factors, such as efficiency. Produce with fewer resources, effect: achieve desired result, flexibility: adapt to market and meet customer expectations.

The Lean Six Sigma (LSS) concept is an integration of two quality management concepts, Lean Manufacturing and Six Sigma, to increase the extent and size of improvement achieved with

just one of two concepts. However, other individuals and companies see LSS in a different way. Some people recognize LSS as a fully integrated system between Lean Manufacturing and Six Sigma and two different concepts that apply LSS in parallel (Assarlind et al., 2012). In addition, the integration between the two quality management concepts varies between each integration, such as Assarlind. al. (2012) points out that each integration can deliver different tools, ideas, and philosophies. This presents many theories about how Lean and Six Sigma can be integrated. Some authors encourage Six Sigma to lead the initiative and other authors advise Lean to be the backbone of the framework and Six Sigma should lead the initiative by encouraging it to be used to reduce or eliminate variation.

LITERATURE REVIEW

Lean manufacturing is a technology that reduces human effort and produces defective products.Smith and Sharma were the first person to initiate the case of lean six sigma in the year of 2003. As per smith there were 2 cases related to lean six sigma. 1. The case study was about playground equipment manufacturer. 2. The other one was related to the commercial refrigeration equipment. For the initial year and half, lean principal was practiced. Further then the problem was narrowed using six sigma and lean principal. In the second problem lean was adopted where the six-sigma existed. Kaizen team reduced the quality related failures by 75%. This can be concluded that lean and six sigma can be helped to achieve a better result.

Table No 1: Literature review of Lean six sigma implementation

Sr. No.	Author	Year	Contribution
1	Jafri Mohd Rohani et al.	2015	This article uses time frame formulations through teaming, product selection, and concept design and time calculation to identify and eliminate waste. Change some lean technologies over time and 5 seconds, shorten lead times from 8.5 days to 6 days, and shorten the value hour from 68 minutes to 37 minutes
2	Tomas Rohac et al.	2015	They have used 5-why & Ishikawa chart to apply sparse tools to the demonstration using value-flow mapping for healthcare plastic products and reduce lead time and inventory management.
3	Smith et al.	2003	Discussed the ongoing business improvement that can be sustained through the integration of Lean and Six Sigma. Sharma (2003) noted that the implementation of the lean manufacturing program is still enjoying full achievment in many parts of the world. To achieve this goal, you must implement a lean manufacturing program with Six Sigma implementation. This is because Six Sigma Foundation, Measurement, Analysis, Improvement and Control (DMAIC) methodologies such as "Leadership" and belt-based training infrastructures have a major impact on the successful implementation of Lean Manufacturing programs.
4	Roger W. Hoerl et al.	2004	Argued that Lean's core application is critical to Six

Sr. No.	Author	Year	Contribution
			Sigma Quality Metrics (CTQ) for implementing Lean Six Sigma.
5	Edward D. Arnheiter and John Maleyeff	2005	Reported that by implementing Lean or Six Sigma separately, Lean Six Sigma approach can achieve optimal competitive benefit at high value and low price.
6	Deepak Kumar et al.	2006	Contributed to the framework for implementation of Lean Six Sigma, which encapsulates lean principle tools using Six Sigma's DMAIC methodology.
7	Andersson et al.	2006	In order to strengthen TQM organization, it is essential to implement principles such as Six Sigma and Lean, either in turn or jointly.
8	Henk de Koning et al.	2008	In two Dutch insurance companies lean six sigmas was implemented. The first insurance company reduce the number of requests for information from 5.5 to 2.6 per request, reducing the average waiting time from 21.5 days to 12.3 days, resulting in savings of 0.26 million euros. Reduction by 8% to 12% of mistake in internal and external checks resulted in savings of around 0.18 million euro respectively, Lean Six Sigma's first implementation success has announced two other implementation projects. The component of the Lean Six Sigma approach is an important contribution to this research report. These are Belt-based organization made up of champions, master black belt, black belts and green belt machinery. DMAIC methodologies and concept like takt time, path and waste. The champion is one of the leaders of the Lean Six Sigma project. Experienced staff are designated as master black belt, black belt, and green belt. The skilled team is generally regarded as an employee of the belt.
9	MingNan Chen and Jr Jung Lyu	2009	Reported an example of Lean Six Sigma implementation in touch panel manufacturing. They have conducted this case study mainly by applying Six Sigma's DMAIC improvement methodology. These authors have argued that Lean Six Sigma is useful when manufacturing other products to improve quality. Lean Six Sigma is also useful for achieving optimized production in these cases.
10	Stephen W. Carleysmith et al.	2009	Presented a Lean Six Sigma case study in pharmaceutical research and development. They argued that Lean Six Sigma could provide research and development requirements with innovation.
11	Thomas et al.	2009	Reported a Lean Six Sigma case study applied by a small engineering firm. This implementation was completed in 10 steps. In the first five steps, DMAIC was applied. Lean tools and techniques were applied in the second five steps. With this implementation, the company achieved cost saving of 55% through reduced rejection rates.
12	Fu-Kwun Wang and Kao-Shan Chen	2010	Implemented Lean Six Sigma with TRIZ and saved banking service costs by $ 828,000, waiting for an account to be established, and maintaining efficiency and profitability while eliminating waste.
13	Barnes and Walker	2010	Explained how to apply Lean Six Sigma in the communications industry. They proposed adopting the DMAIC approach while applying Lean Six

Sr. No.	Author	Year	Contribution
			Sigma in the communications sector.
14	S. Michael Gnanaraj et al.	2010	They contributed to the management model they named as a drawback to overcome lean fixed DMAIC and stabilization (DOLADMAIC). DOLADMAICS can only be used in small and medium sized enterprises to implement Lean Six Sigma.
15	Alessandro Laureani Jiju and Antony et al.	2010	Applied Lean Six Sigma to their organization's human resources development activities.

Some of Lean's manufacturing tools include Value Stream Mapping, Kaizen, Kanban, 5S, Poka Yoke, and Total Production Management (TPM). Most researchers have added Lean Manufacturing tools to the DMAIC of Six Sigma to develop the Lean Six Sigma framework (Kumar et al., 2006; Natarajan et al., 2011). This formed the basis for creating synergies between Lean and Six Sigma principles. This foundation has increased the advantage of implementation the Lean Six Sigma program compared to Lean and Six Sigma implementations. These benefits benefited organizations that implemented Lean Six Sigma and business. These benefits are listed in this subsection.

Table No 2: Literature review on benefits of Lean six sigma implementation

Sr. No.	Author	Year	Contribution
1	Tao yang yiyo kag	2014	Proposed and implemented a Lean production system for finishing nets, using various Lean tools, and applying simulation and custom under (MTO) processes to general shipments. In addition, using VSM tools to generate future state maps, increase service levels, and shorten lead times provide guidelines for implementing value stream mappings. After telling you how to implement the VSM, what factors to consider, and how lean manufacturing is successfully applied to all manufacturing industries and the cost of waste removal is reduced.
2	K. Venkataraman	2014	This article uses value stream mapping to reduce the cycle time of the crankshaft. Various tools are applied to create a future state map to gain benefits, create a current state map of the crankshaft assembly line, and improve the crankshaft assembly process. There are three assemblies that can be used to create the crankshaft. In order to improve the process and reduce waste, we apply three types of crawlers and apply analytical hierarchical processes (AHP) for decision making to obtain the results of the crankshaft assembly, reduce inventory, and prepare two stages for manufacturing a single crankshaft Provide flow and respond quickly to customer needs.
3	Boppana v. chaudhary et al.	2012	Implementing a dry manufacturing in pharmaceutical companies, take a case study of the product line in this newspaper is cream and ointment. Also, due to industry problems, operating costs and product availability are not fixed. This document improves work with the help of Lean manufacturing, so it detects the problem where it is

Sr. No.	Author	Year	Contribution
			wasted and Lean tools use the VSM. VSM is a mapping method that helps detect processes without added value and value added. Prepare a current status map and use the 5-why method for collection information. And with the help of the 5s tool, create a future state map for improvement. It can also be achieved when using cellular manufacturing and results in reduced inventory and customer satisfaction, reduced total cycle time on time delivery, and reduced non-value-added time. Reduced footprint.
4	Horacio Soriano-meier et al	2001	This article applies lean management to hospitals, improves quality of service, and provides customer satisfaction and patient services. All improvements succeed with a dry tool. In this study, the lean tool for improving service levels applies now and applies 5 seconds to cleaning and systematic activities.
5	Dinesh Seth et al.	2018	This paper minimizes waste in the cotton seed industry with the help of value flow mapping tools. The methodology of this paper is to conduct a survey of the Indian cotton seed industry and bring samples from India to prepare a questioner and receive feedback by phone and email. It also prepares the overall supply chain mapping, identifies waste, and eliminates it with some modifications to improve productivity.

CONCLUSION

There are several papers, also known as Lean, and some of them in all fields to apply sparse manufacturing such as the five issues debate on the automotive industry, the pharmaceutical industry, the confectionary industry, the cotton seed industry, the health care hospital, etc. It is considered that Lean Six Sigma, Value Stream Mapping, and 5s are the tools which are very general and that cannot be much useful in precise manufacturing but these techniques and tools are equally applicable in tolerance manufacturing.

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