

REVIEW OF LEAN 6 σ , FUSION OF QUALITY AND SPEED

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ABSTRACT

Lean manufacturing and 6 σ are two powerful tools used to improve productivity. These tools were used independently with a considerable improvement in output. They both have a great impact on all types of business activities. Six sigma talks mainly about quality and Lean about speed. Lean Six Sigma is a new concept of combining advantages of these two to get added advantage. 6 σ is the latest quality tool, used by experts for the benefit of the organization, is defined as per the purpose it was used for. Six Sigma is a revolutionary business process geared toward dramatically reducing organizational inefficiencies that translates into bottom-line profitability⁽¹⁾. Six Sigma is a philosophy based on setting attainable short-term goals while striving for long-term objectives.

Six sigma is a highly disciplined approach used to reduce the process variations to the extent that the level of defects are drastically reduced to less than 3.4 per million process, product or service opportunities (DPMO). Six Sigma, in many organizations, simply means a measure of quality that strives for near perfection. Six Sigma is a disciplined, data-driven approach and methodology for eliminating defects (driving towards six standard deviations between the mean and the nearest specification limit) in any process; from manufacturing to transactional and from product to service. Six Sigma is a statistical measurement. It tells us how good our products, services, and processes really are. The Six Sigma method allows us to draw comparisons to other similar or dissimilar products, services and processes. In this manner, we can see how far ahead or behind we are. Most importantly, we can see where we need to go and what we must do to get there. In order words, Six Sigma helps us to establish our course and gauge our pace in the race for total customer satisfaction.

KEYWORDS: Customer Value, Traditional Business Systems, Six Sigma

INTRODUCTION

Lean

Although there are instances of rigorous process thinking in manufacturing all the way back to the Arsenal in Venice in the 1450s, the first person to truly integrate an entire production process was Henry Ford. At Highland Park, MI, in 1913 he married consistently interchangeable parts with standard work and moving conveyance to create what he called flow production. The public grasped this in the dramatic form of the moving assembly line, but from the standpoint of the manufacturing engineer the breakthroughs actually went much further.

Ford lined up fabrication steps in process sequence wherever possible using special-purpose machines and go/no-go gauges to fabricate and assemble the components going into the vehicle within a few minutes, and deliver perfectly fitting components directly to line-side. This was a truly revolutionary break from the shop practices of the American System that consisted of general-purpose machines grouped by process, which made parts that eventually found their way into finished products after a good bit of tinkering (fitting) in subassembly and final assembly.

The five-step thought process for guiding the implementation of lean techniques is easy to remember, but not always easy to achieve:

- Specify value from the standpoint of the end customer by product family.
- Identify all the steps in the value stream for each product family, eliminating whenever possible those steps that do not create value.
- Make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer.
- As flow is introduced, let customers pull value from the next upstream activity.
- As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste.

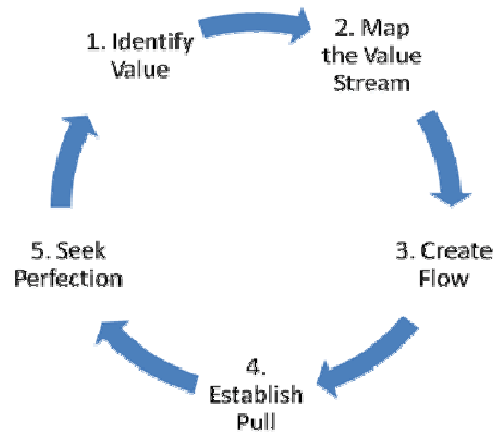


Figure 1: Five Steps Thought Process

The core idea is to maximize **customer value** while minimizing waste. Simply, lean means creating more value for customers with fewer resources.

A lean organization understands customer value and focuses its key processes to continuously increase it. The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste. To accomplish this, lean thinking changes the focus of management from optimizing separate technologies, assets, and vertical departments to optimizing the flow of products and services through entire value streams that flow horizontally across technologies, assets, and departments to customers.

There are typical 8 types of wastages as mentioned in the figure at the end. Lean aims at reducing wastes, which in turn will automatically improve the productivity.

Eliminating waste along entire value streams, instead of at isolated points, creates processes that need less human effort, less space, less capital, and less time to make products and services at far less costs and with much fewer defects, compared with traditional business systems. Companies are able to respond to changing customer desires with high variety, high quality, low cost, and with very fast throughput times. Also, information management becomes much simpler and more accurate.

Lean for Production and Service

A popular misconception is that lean is suited only for manufacturing. Not true. Lean applies in every business and every process. It is not a tactic or a cost reduction program, but a way of thinking and acting for an entire organization.

Businesses in all industries and services, including healthcare and governments, are using lean principles as the way they think and do. Many organizations choose not to use the word lean, but to label what they do as their own system, such as the Toyota Production System or the Danaher Business System.

Why? To drive home the point that lean is not a program or short term cost reduction program, but the way the company operates. The word **transformation or lean transformation** is often used to characterize a company moving from an old way of thinking to lean thinking.

It requires a complete transformation on how a company conducts business. This takes a long-term perspective and perseverance. The term "lean" was coined to describe Toyota's business during the late 1980s by a research team headed by Jim Womack, Ph.D., at MIT's International Motor Vehicle Program.

The characteristics of a lean organization and supply chain are described in *Lean Thinking*, by Womack and Dan Jones, founders of the Lean Enterprise Institute and the Lean Enterprise Academy (UK), respectively. While there are many very good books about lean techniques, *Lean Thinking* remains one of the best resources for understanding "what is lean" because it describes the *thought process*, the overarching key principles that must guide your actions when applying lean techniques and tools.

Lean Six Sigma

In 1996, General Electric CEO Jack Welch praised Six Sigma as "the most important initiative GE has ever undertaken". Yet despite widespread success with Six Sigma, two years later Welch articulated one shortfall (GE Annual Report, 1998):

We have tended to use all our energy and Six Sigma science to "move the mean" to reduce order-to-delivery time. The problem is, as has been said, "the mean never happens, and the customer is still seeing variances in when the deliveries actually occur – a heroic 4-day delivery time on one order," with an awful 20-day delay on another, and no real consistency. 'Variation is evil'.

Lean Six Sigma is a methodology that maximizes shareholder value by achieving the fastest rate of improvement in customer satisfaction, cost, quality, process, speed, and invested capital.

The fusion of Lean and Six Sigma is required because:

- Lean cannot bring a process under statistical control.
- Six Sigma alone cannot dramatically improve process speed or reduce invested capital.

The Principle of Lean Six Sigma

The activities that cause the customer's critical-to-quality issues and create the longest time delays in any process offer the greatest opportunity for improvement in cost, quality, capital, and lead time.

The questions that Lean Six Sigma can uniquely answer, which neither Six Sigma or Lean alone can, are:

- To which process steps we first apply Lean Six Sigma tools?
- In what order, and to what degree?
- How do we get the biggest cost, quality, and lead time improvements quickly?

It is the synergy of Lean and Six Sigma together that has helped companies to reduce manufacturing overhead and quality cost by 20% and inventory by 50% in less than two years.

Critical Success Factors for Six Sigma

Customer Centricity

The Six Sigma culture is customer-centric; its goal is to delight customers. The quality of a product or service is measured from the customer's perspective, by its contribution to their success. This customer focus comes through the Six Sigma drivers.

Voice of the Customer: What the customers say they want.

Requirements: Voice of the Customers input that is translated into specific, measurable elements.

Critical to Quality (CTQ): Requirements that are most important to customers.

Defect: Failing to deliver to a customer's CTQ.

Design for Six Sigma: Designing products and processes based on customer requirements.

Lean Means Speed: Henry Ford was the first person to understand the impact of process speed on cost, the first to understand that inventory slowed down his process, and that slow processes are wasteful processes.

He said: Ordinarily, money put into inventory is thought of as live money, But it is waste – which, like every other form of waste, turns up in high prices. We do not own or use a single warehouse! Time waste differs from material waste in that there can be no salvage.

The Keys to the Kingdom of Lean are founded on two principles that are observed in every factory or process we have ever encountered:

- Material usually spends 95% of its time waiting, which is due to the time delay injected by fewer than 20% of the work stations, which are known as time traps.
- Time traps can be prioritized using MRP data and the spreadsheet calculations or software and eliminated using the Lean Six Sigma improvement methods.

Process Cycle Efficiency = Value – Added Time / Total Lead Time

A marketing executive at a major ERP firm recently asked me for a metric that would tell him if a process was lean or not. The answer is:

A Lean process is one in which the value-added time in the process is more than 25% of the total lead time of that process.

Table 1: Typical and World-Class Cycle Efficiencies

Application	Typical Cycle Efficiency	World-Class Cycle Efficiency
Machining	1%	20%
Fabrication	10%	25%
Assembly	15%	35%
Continuous Manufacturing	30%	80%
Business Processes-Transactional	10%	50%
Business Processes- Creative/Cognitive	5%	25%

The Lean Six Sigma Implementation Process

The purpose of Lean Six Sigma is twofold:

- To transform the CEO's overall business strategy from vision to reality by the execution of appropriate projects.
- To create new operational capabilities that will expand the CEO's range of strategic choices going forward.

Execution of Lean Six Sigma

It Comprises of Three Stages of Activities:

- **Initiation:** Critical steps needed to get off to a good start. Almost all of the work in this stream involves the company's top leaders; the CEO and his/her direct reports become engaged in supporting the initiative, and managers with P&L responsibility are exposed to the benefits of Lean Six Sigma implementation.
- **Resource and Project Selection:** Selecting people with leadership potential to provide the muscle for implementing projects that have the most direct links to customers' critical-to-quality issues and the creation of shareholder value.
- **Implementation, Sustainability, Evolution:** Converting Lean Six Sigma from an initiative to a way of life that serves to constantly improve a company's performance and financial position.

Accelerating your Internal Supply Chain

There are three conclusions from this learning.

- We need to put a maximum cap on the amount of WIP (or "things in process") to be able to even predict lead time.
- Maintaining the velocity of the supply chain means maintaining an even flow of WIP: If WIP stops for any period of time, we won't be able to meet demand. WIP must therefore be related to current demand.
- To prevent excess WIP, we need to release material into the line in amounts consistent with the minimum process batch sizes, etc.

Design for Lean Six Sigma

Design for Lean Six Sigma (DLSS) applies all the Improve methods and tools to the product development process. The objective of DLSS is that products go into production meeting customer performance and cost goals, with

robust performance and with defects prevented. The DLSS process should make further rapid improvement possible as market and cost demands change with time.

Quality Function Deployment

QFD is a highly evolved technique for capturing customer requirements for a product (or service) and translating them into required product/process design changes. Describing QFD in detail could easily consume a whole book by itself, but you can get a flavor for what's involved by revisiting the cause-and-effect matrix.

Applied correctly, QFD is effective in ensuring that customer needs are prioritized, design requirements are established to address all customer needs, design requirements are prioritized to help focus the design effort, and performance targets are established. In short, QFD helps teams know exactly what to solve.

Theory of Inventive Problem Solving (TRIZ)

TRIZ helps increase innovation during the design process by helping teams address technical challenges and resolve contradictions, as opposed to making design compromises or trade-offs.

There are three ways in which designers deal with technical problems.

- Ignore them and hope they go away.
- Make trade-offs or compromises.
- Resolve them.

TRIZ is a structured, technology-based methodology for resolving technical problems. It was developed by a Russian scientist, Dr. Genrich Altshuller, who spent years studying patents worldwide with two objectives in mind:

- How can the time to invent be reduced?
- How can a process be structured to enhance breakthrough thinking?

He studied over 400,000 patents and realized that similar problems in different industries using different science and technology have all been solved by similar solutions.

Final thought on lean six sigma and product development given by Philip Fisher:

It does mean that a company with research (which develops products) like a cluster of trees around each of these divisions, each growing additional branches from its own trunk, will do much better than a company working on a number of unrelated products which, if successful, will land it in several new industries unrelated to its existing business.

We all know very well that **Change** is the only **Constant** thing in this world and we all must be prepared for this change if we want to progress and sustain in this competitive world.

Figures to Understand Lean Six Sigma



Figure 2: Types of Waste

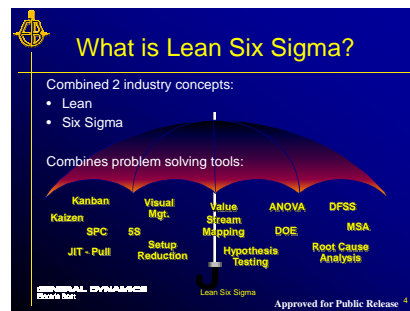


Figure 3: Lean Umbrella

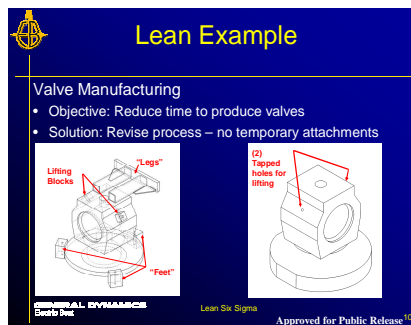


Figure 4: Valve Manufacturing

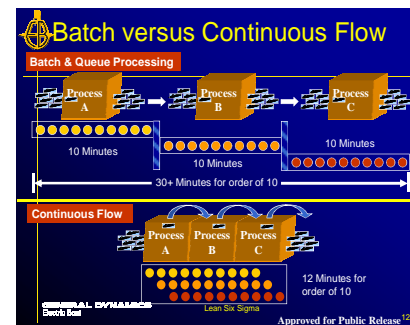


Figure 5: Batch vs. Flow

CONCLUSIONS

It is proved by several experiments that six sigma focuses on quality and Lean focuses on waste free manufacturing. Combined technique helps in reducing wastes as well as maintaining quality of high standard. Future of manufacturing lies in fusion of lean and six sigma.

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