

LEAN MANUFACTURING AS A KEY TO SUCCESS

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Abstract

Changing market environments, market globalization, increasing competition and complex products requires new technologies, methods and processes. The shorter life cycle and the complexity of final products and new customer requirements require efficient operation of supply chains. The optimization of supply chains result in new models, concepts of value chains and new organization and cooperation forms of members. This paper shows new supply chain paradigms and summarizes the advantages of the application of lean production philosophy in the manufacturing and service sectors. Lean manufacturing techniques and typical wastes are also detailed.

Key words

supply chain, lean production, lean techniques, value adding activity, waste

INTRODUCTION

Stevens (1) defined supply chain as a system whose constituent parts include material suppliers, production facilities, distribution services and customers linked together via a feed forward flow of materials and feedback flow of information.

Due to the fast changing market environment, globalization and global competition, supply chains have become more and more complex networks.

NEW SUPPLY CHAIN CONCEPTIONS

Besides the traditional supply chains, three new supply chain conceptions are used, which are known as lean-, agile- and leagile supply chains (2-4).

Lean Supply Chain

Lean supply chain focuses on eliminating wastes or non-value adding activities along the chain.

Lean supply chains operate in a stable, controllable and predictable environment, based on long-term trading relationships between the chain members.

In the case of lean supply quality, lead-time and service level are the market qualifiers and cost is a market winner.

Agile Supply Chain

The purpose of the agile concept is to quickly respond to the fast changing market demands. This paradigm relates to the relation between companies and markets. Agile supply

chain needs to be flexible and can respond to rapidly fluctuating end customer demands (in terms of volume and variety) and unpredictable market changes. Typically the supply chains of innovative and new products are designed to be adaptable to changing customer requirements.

Agility means using market knowledge and virtual corporations to exploit profitable opportunities in a changing market place.

Leagile Supply Chain

Leagile is a combination of the lean and the agile paradigms. Lean supply chains cannot quickly respond to changing customer demands, thus leagile supply chains which combine the advantages of lean production and agile manufacturing have been used in manufacturing industries.

MASS PRODUCTION vs. LEAN PRODUCTION

Mass Production Thinking

Mass production is a way of thinking that starts with the principle of economies of scale. Bigger is better and making large batches of parts makes more efficient use of individual equipment than small batches with time consuming changeovers. The focus on mass production is individual efficiency – efficient use of individual machines and individual operators.

Lean Thinking

Lean thinking focuses on value-added flow and the efficiency of the overall system. The goal is to keep products flowing and add value as much as possible. The focus is on the overall system and synchronizing operations.

Lean manufacturing is a manufacturing philosophy that shortens the time between the customer order and the product build/shipment by eliminating sources of waste. *Waste* is anything that does not contribute to transforming a part to your customer’s needs.

The results of the lean approach are illustrated in Figure 1. Lean manufacturing will take some waste out of the value-added activity shrinking it down as in the mass production approach, but more importantly, it reduces the pure non-valued added activities, which have the largest impact on lead-time.

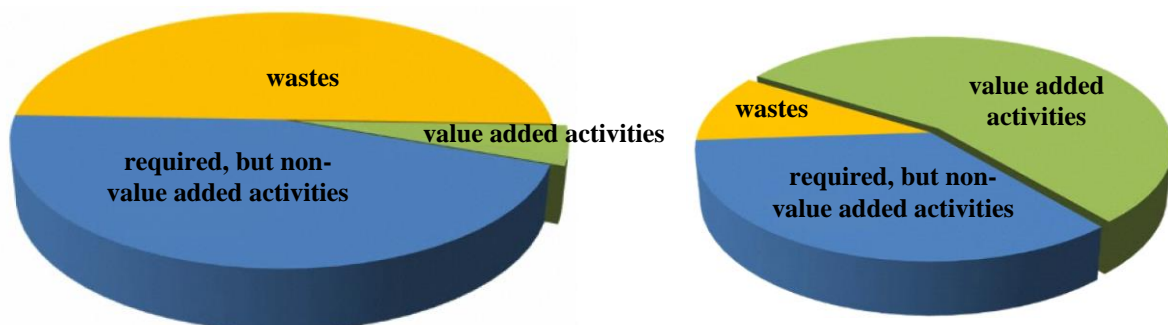


Fig. 1. Traditional manufacturing vs. Lean manufacturing

Inefficiencies of mass production:

- Long lead times due to inventory buffers.
- Imbalances in the timing of operations hidden - bottlenecks are hidden.

- Feedback from later operations (customers) to earlier operations is delayed. When a defect is discovered it is not clear when or why it was produced.
- Little motivation for improvement.
- When shifting to a new product (e.g., from A to B) there is a large buffer of parts to be moved and handled.
- Extra handling is necessary (potential damage).
- Extra floor space is needed.
- Extra inventory costs.

Advantages of lean manufacturing:

- Production lead times are short.
- Imbalances in operation timing (bottlenecks) are apparent – improvement can focus on bottlenecks.
- Defects are immediately apparent and the underlying cause can be quickly determined.
- Constant motivation for improvement – problems have an immediate production impact.
- Operations can quickly shift to a new product (e.g., A to B) without interrupting the flow, each operation makes just what is needed when it is needed.
- There is minimum part handling.
- Inventory holding costs are minimized.

LEAN ENTERPRISE – LEAN SUPPLY CHAIN

Lean manufacturing is a performance-based process used in manufacturing organizations and service sector to increase competitive advantage in an increasingly global market.

Nowadays this philosophy (originating from the Toyota Production System) is applied in many sectors including automotive, electronics, white goods, and consumer products manufacturing, etc.

The focus of the approach is on cost reduction by eliminating non-value added activities. In today's increasingly global marketplace, many manufacturers are adopting lean manufacturing practices in order to optimize quality and costs, thereby gaining a competitive advantage.

Lean enterprise is “an enterprise with a focus on waste elimination and the customer’s needs in all parts of its operations, manufacturing and administration. Emphasis is given to lean structures and processes, flexibility of response and methods and techniques to continually seize new opportunities as they arise.” [APICS Lean SIG]

A **Lean Supply Chain** defined by Lamming [5] was “. . . an arrangement [which] should provide a flow of goods, services and technology from supplier to customer (with associated flows of information and other communications in both directions) without waste”.

Now, lean thinking not only has been applied in manufacturing industries, but also is being adopted by service industries.

Figure 2. Shows the comparison of lean, agile, and leagile supply chains (6).

Distinguishing attributes	Lean supply chain	Agile supply chain	Leagile supply chain
Market demand	Predictable	Volatile	Volatile and unpredictable
Product variety	Low	High	Medium
Product life cycle	Long	Short	Short
Customer drivers	Cost	Lead-time and availability	Service level
Profit margin	Low	High	Moderate
Dominant costs	Physical costs	Marketability costs	Both
Stock out penalties	Long term contractual	Immediate and volatile	No place for stock out
Purchasing policy	Buy goods	Assign capacity	Vendor managed inventory
Information enrichment	Highly desirable	Obligatory	Essential
Forecast mechanism	Algorithmic	Consultative	Both/either
Typical products	Commodities	Fashion goods	Product as per customer demand
Lead time compression	Essential	Essential	Desirable
Eliminate muda	Essential	Desirable	Arbitrary
Rapid reconfiguration	Desirable	Essential	Essential
Robustness	Arbitrary	Essential	Desirable
Quality	Market qualifier	Market qualifier	Market qualifier
Cost	Market winner	Market qualifier	Market winner
Lead-time	Market qualifier	Market qualifier	Market qualifier
Service level	Market qualifier	Market winner	Market winner

Fig. 2. Comparison of lean, agile, and leagile supply chains (6)

LEAN PRINCIPLES AND WASTES

The challenge to organizations utilizing lean manufacturing is to create a culture that will create and sustain long-term commitment from top management through the entire workforce. There is much literature on the topic of lean production principles and its application (7, 8, 9, 10).

Lean manufacturing techniques are based on the application of five principles to guide management's actions toward success.

1. **Value:** The foundation for the value stream that defines what the customer is willing to pay for.
2. **The Value Stream:** The mapping and identifying of all the specific actions required to eliminate the non-value added activities from design concept to customer usage.
3. **Flow:** The elimination of all process stoppages to make the value stream "flow" without interruptions.
4. **Pull:** The ability to streamline products and processes from concept through customer usage.
5. **Perfection:** The ability to advocate doing things right the first time through the application of continuous improvement efforts.

All processes can be categorized into three groups:

- **value added activities** (e.g. manufacturing, assembly, ...),
- **required but non-value added activities** (e.g. exchange of die),
- **wastes** are "any element that does not add value, or that the customer is not prepared to pay for" (e.g. over-production, transportation...).

Seven types of wastes can be identified in processes: 1. Over Production; 2. Waiting; 3. Motion; 4. Transportation; 5. Inventories; 6. Over-processing; 7. Defects; 8. Other.

1. **Over production** – Producing more final products than is needed or before it is needed for the customer is a fundamental waste in lean manufacturing.

- 2. Waiting** – A worker or machine is waiting for material or information. Material waiting is not material flowing through value-added operations.
- 3. Motion** – Any unnecessary motion that does not add value to the product is waste.
- 4. Transportation** – Moving material which does not enhance the value of the product to the customer.
- 5. Inventories** – Material sits taking up space, costing money, and potentially being damaged. Due to stocks problems are not visible.
- 6. Over- processing** – Extra processing not essential to value-adding from the customer point of view is waste.
- 7. Producing defective products** – Defective products impede material flow and lead to wasteful handling, time, and effort.
- 8. Other additional wastes** – Underutilized worker creativity and resource, application of non-adequate equipment and systems, wasted energy and water, damage to the environment.

These wastes are readily apparent in every manufacturing facility in the business world. Companies which identify, manage, and minimize these wastes are able to succeed the best in very competitive marketplace.

A central element of the Lean philosophy is the relentless and systematic elimination of unneeded resources, or waste.

The basics of lean manufacturing employ continuous improvement processes to focus on the elimination of waste or non-value added steps within an organization and production.

MAIN TOOLS AND TECHNIQUES OF LEAN MANUFACTURING

The main tools and techniques of lean manufacturing are for example Value Stream Mapping, JIT, One-piece flow, Takt-time analysis, Heijunka, Single Minute Exchange of Dies (SMED), Jidoka, Pull system, Kanban, Supermarket, Kaizen, Standardized processes, 5S, Total Productive Maintenance (TPM), 6 σ , Cell design and layout for flow (Cellular production, U-shaped cells), Work group team error proofing, Zero defects (ZD), Station and operation process control, Error proofing (poke-yoke), Balanced flow-, Synchronous flow, Mixed flow lines, etc.

Each of these tools and techniques focuses on certain aspects and areas of the manufacturing process in order to help improve costs and efficiencies at the company.

Lean manufacturing and a lean enterprise or business mean that the company is focused on supplying exactly what the customer wants, in the form they want it in, free of defects, at the exact time that they want it, with minimal waste in the process.

CONCLUSION

This paper explored new supply chain paradigms. The Lean-, Agile- and Hybrid Supply Chains were introduced.

The essence and the advantages of the Lean production philosophy was also discussed which is a performance-based process used in manufacturing organizations to increase competitive advantage. The author defined the most typical wastes and emphasized the importance of application of lean manufacturing, lean techniques and tools.

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