

Implementation of Lean Manufacturing In Automotive Industries

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Abstract : - In the Internet world, automotive manufacturing and process industries face the challenge of a highly dynamic and interactive business environment. Industries that have traditionally delivered manufactured goods must streamline their processes and focus on the rapidly changing needs of their customers and the capabilities of their suppliers. Now, more than ever, the capability to deliver quality, cost-effective products determines the success of the world's automotive manufacturing and process industries.

The variety of motor vehicles is expanding and the market is no longer dominated by a handful of very high volume automobiles. The automakers have been able to respond much more quickly to this demand for a range of models with the adoption of lean production. One of the most critical issues for the automotive industry today is competitiveness in cost, quality, and product offerings. Companies cannot survive in today's market if they neglect any of these areas.

Lean is one of the promising alternative strategy for achieving continuous improvement in business performance through identifying a company's value stream and then systematically removing all waste. The implementation of lean management principles in automotive industries can increase efficiency, reduce project costs and also reduce revenues. Given the current pressure on product margins, lean manufacturing principles provide an excellent framework for squeezing costs out of manufacturing.

1.0 INTRODUCTION

When Henry Ford introduced mass production techniques for manufacturing cars, in 1930's, he changed the manufacturing paradigms from craft to mass. The focus shifted from small job shops of highly skilled technicians to high investment factories with high-speed single-

purpose machines with conveyors & to the performance measurements in terms of asset utilization. As the complexities in the production volumes & variants grew, this system of production management needed sophisticated production planning tools & methods. Invariably, these led to large buffers, high inventories in the processes & long throughput times. The time taken to convert raw material into finished goods increased and consequently the response time to customers' complaints lengthened leading to high inspection, rework or scrap costs.

The Customers are demanding shorter & shorter lead times, more customized variants, perfect quality and at lesser prices. Toyota Production Systems (TPS), Total Quality Management (TQM) & Total Productive Maintenance (TPM) have evolved in Japan as the management philosophies for satisfaction of ever changing customer needs & expectations in an efficient manner. In the west Motorola & GE developed "Six Sigma" to pursue the similar goals. Quality management systems such as ISO9000 & QS9000 also came into existence to guide industries in their quest for continuous improvement and waste elimination.

Lean Manufacturing is a philosophy, based on the Toyota Production System, and other Japanese management practices that strive to shorten the time line between the customer order and the shipment of the final product, by consistent elimination of waste. All types of companies, Automotives, manufacturing, process, distribution, software development and financial services can benefit from adopting lean philosophy.

2.0 LEAN MANUFACTURING

2.1 Definition

A philosophy of production that emphasizes the minimization of the amount of all the resources (including time) used in the various activities of the enterprise. It

involves identifying and eliminating non-value-adding activities in design, production, supply chain management and dealing with the customers.

2.2 Objectives of Lean Manufacturing

Lean Manufacturing, also called Lean Production, is a set of tools and methodologies that aims for the continuous elimination of all waste in the production process. The main benefits of this are lower production costs, increased output and shorter production lead times. More specifically, some of the goals include:

1. Reduce defects and unnecessary physical wastages.
2. Reduce manufacturing lead times and production cycle times.
3. Minimize inventory levels at all stages of production.
4. Improve labor productivity.
5. Use equipment and manufacturing space more efficiently.
6. Have the ability to produce a more flexible range of products with minimum changeover costs and changeover time.
7. Increase output.

2.3 Key Principles of Lean Manufacturing

Key principles behind Lean Manufacturing can be summarized as follows:

1. Recognition of waste - Any material, process or feature which is not required for creating value from the customer’s perspective is waste and should be eliminated.
2. Standard processes - Lean requires an the implementation of very detailed production guidelines, called Standard Work, which clearly state the content, sequence, timing and outcome of all actions by workers. This eliminates variation in the way that workers perform their tasks.

3. Continuous flow - Lean usually aims for the implementation of a continuous production flow free of bottlenecks, interruption, detours, backflows or waiting. When this is successfully implemented, the production cycle time can be reduced by as much as 90%.

4. Pull-production - Also called Just-in-Time (JIT), Pull-production aims to produce only what is needed, when it is needed. Production is pulled by the downstream workstation so that each workstation should only produce what is requested by the next workstation.

5. Quality at the Source - Lean aims for defects to be eliminated at the source and for quality inspection to be done by the workers as part of the in-line production process.

6. Continuous improvement - Lean requires striving for perfection by continually removing layers of waste as they are uncovered.

TABLE 1. Key implications of Lean Manufacturing

Characteristics	Traditional batch manufacturing	Lean Manufacturing
Orientation	Supply driven	Customer driven
Batch size	Large	Small
Quality inspection	Checking of samples by QC inspectors	In-line inspection by workers
Inventory	Buffer of work-in-progress between each production stage	Little or no work-in-progress between each production stage
Handoff of works	Materials after each stage accumulate	Materials handed off directly from one
Production cycle time	Total production cycle takes significantly longer than actual time spent processing the materials.	Total production cycle shortens to approach time spent actually processing the materials.
Planning	Orders are pushed though factory based on production plan/forecast	Orders are pulled through factory based on customer/downstream demand

3.0 LEAN MANUFACTURING TOOLS & METHODOLOGIES

The Lean Manufacturing tools & methodologies are,

1. Standard Work
2. Communication of Standard Work to employees
3. Visual Management
4. Value Stream Mapping
5. Batch Size Reduction
6. The Five S’s
7. Preventative Maintenance
8. Total Productive Maintenance

4.0 STATUS OF THE AUTOMOTIVE INDUSTRY

The automotive industry is the world’s leading advanced manufacturing technology industry producing complex products.

The industry uses a lot of physical capital in plant and equipment, but also employs a large workforce.

The automobile industry is the portal by which new manufacturing technologies enter India.

The automobile manufacturing industry has gone through wrenching times in the past 10 to 15 years.

Nevertheless, the U.S. industry is still home to the two largest vehicle manufacturers in the world, General Motors and Ford that has been responsible for 20 to 25 percent of world vehicle production in several years since 1980.

The Automotive Industry,

- Represents about 7% of manufacturing value added and about 1% of GDP.
- Is a very substantial degree dominated by foreign-owned companies.
- There are a number of consequences of this situation.
 - ❖ Pressure for global integration.
 - ❖ Pressure to achieve global performance benchmarks.
 - ❖ Ability to tap the parent company’s resources of knowledge and technology.

TABLE 2. 1994 Vehicle Production (In Thousands)

Company	Country	Passenger Cars	Light Trucks and Commercial Vehicles	Total
General Motors	U.S.	2,604	1,845	4,450

Ford	U.S.	1,661	2,073	3,734
Toyota	Japan	2,769	739	3,508
Chrysler	U.S.	551	1,142	1,693
Renault	France	1,395	261	1,656
Nissan	Japan	1,341	268	1,609
Volkswagen	Germany	1,516	85	1,601
Fiat	Italy	1,231	127	1,358
Mitsubishi	Japan	891	414	1,306

Source : American Automobile Manufacturers Association.

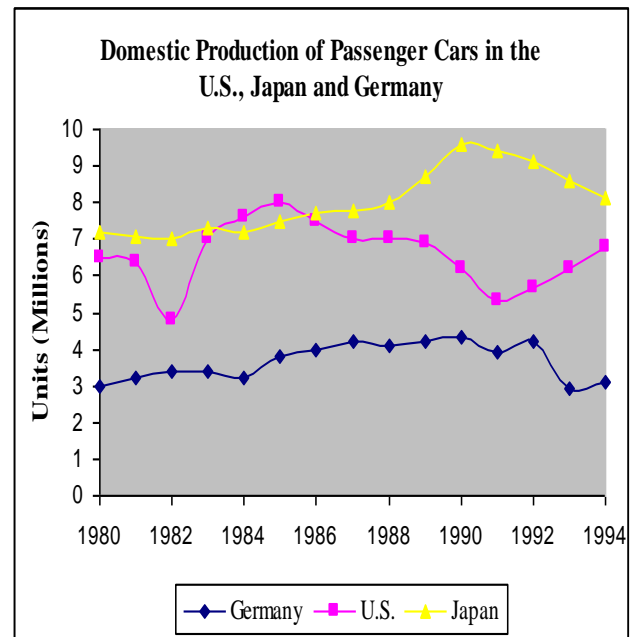


FIGURE 1

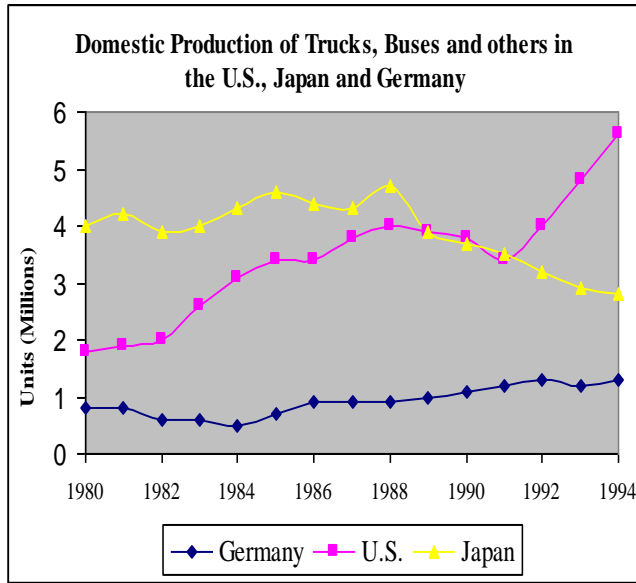


FIGURE 2

4.1 MAJOR TRANSFORMATION NEEDS IN AUTOMOTIVE INDUSTRY

- Rationalization of companies, plants and models.
- Meeting world standards of product quality.
- Adopting lean manufacturing principles.
- Major investment in plant and equipment.
- Upgrading the workforce.
- ❖ Higher standards for recruitment.
- ❖ Multiskilling / training.
- Re-organizing supply chains.
- Large investments in R&D.

4.2 VEHICLE TECHNOLOGIES ARE CHANGING IN RESPONSE TO CUSTOMER DEMANDS FOR STYLE, SAFETY AND SUSTAINABILITY

The vehicle: Technology hot-spots

Performance

Environmental Impacts

Engine technology

Engine Systems (hybrids, fuel cells)

Braking systems Weight reduction (light steels, aluminium)

Aerodynamics

Emission filters

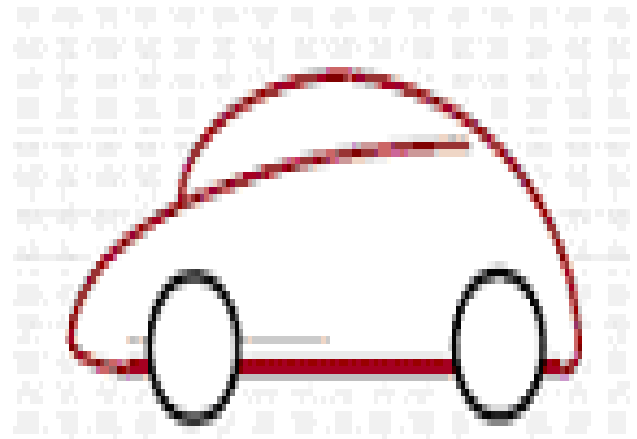


FIGURE 3

5.0 IMPLEMENTING LEAN: THE ONLY VIABLE SURVIVAL STRATEGY

Lean Manufacturing philosophy is an outcome of Japanese manufacturing systems especially Toyota Production Systems. The lean manufacturing is a philosophy based on the following principles:

- ❖ Teamwork
- ❖ Communication
- ❖ Efficient use of resources and elimination of waste.
- ❖ Continuous Improvement

A systematic & comprehensive implementation of Lean Manufacturing typically results in a substantial reduction in inventory, capital employed and cost of quality. The other benefits that come with conversion to lean from mass manufacturing are decrease in lead time, better on-time delivery & improvement in quality. These factors lead to an increase in market share & increase in revenues.

5.1 THE CHALLENGES

The Lean philosophy seems like a set of simple principles, its implementation is easier said than done. In order to survive in the competitive environment where the competition is forcing “better, faster, cheaper” products & processes, the managers have to break the mold and abandon the prevailing manufacturing paradigms to constantly trim the costs to offset the reducing prices & learn to play the game with the new rules. Some of the new rules of the manufacturing are:

- ❖ Scrap and rework in PPM (parts per million) and not in percentages. Measurements in percentages leave too much room for waste. The high scrap & rework causes instability & risk to product flow & therefore causes (non-value-added) inspection work. Added to that is the risk of sending bad parts to the customer due to

inspection mistake or mix-ups. Customers in auto industries are expecting measurement & reporting scrap & rework in PPM.

- ❖ Lead-time between order & delivery in hours & not in weeks. Lead-times of weeks are the things of the past. Good companies located close to the customer's plant receive a rough order stating product volume and mix one week in advance. Specific requirements (including delivery sequence) are specified less than an hour before delivery. If the customer is more than an hour's drive away, best-practice order lead-times are never longer than a day, and the delivery time-slot is half an hour.
- ❖ Changeover times (from one part to another) in minutes & not shifts & every part made every day and not every week or month. Our old thought process accepts changeover as a fact of life & no effort is put to reduce it and logically the plants ran large batches so as to do fewer changeovers. Lean thinking forces us to reduce changeover times to minutes. Large batches imply high inventory carrying cost. They also lead to long lead times and low flexibility. Every-product-every-day production is becoming a norm for leading edge competitors. A world-class car plant has achieved a changeover time of 5 minutes for its 200-ton presses, and is therefore able to produce 80% of its stamping part numbers every day.
- ❖ Time between breakdowns of equipment of weeks & months rather than days. TPM culture builds a discipline and system that drastically improves the machine reliability and up-time. No longer machines have to breakdown to be fixed. Preventive & predictive thinking ensures zero breakdowns, zero rejects & zero accidents. This "Zero" is the new paradigm in machine maintenance.
- ❖ Time spent on "Continuous Improvement" rather than "Fire Fighting". Firefighting wastes time and prevents improvements & break through thinking. Good companies build a solid "Daily Work Management" culture based on Deming's PDCA philosophy, which moves the management focus from firefighting to improvements.

❖ 5.2 GET KNOWLEDGE

An external consultant, Sensei or an experienced employee can provide the required knowledge. The knowledge is required not only in the concepts & the implementation process, but also in the tools & techniques required to successfully eliminate waste & break bottlenecks.

❖ 5.3 SEIZE OR CREATE A CRISIS

Because the lean transformation is a hard and stannous process, it occurs in a crisis situation. Higher management has to communicate the urgency of implementing the changes and show its own commitment by leading by example.

❖ 5.4 IDENTIFY VALUE STREAM (VS), APPOINT A VS MANAGER & CONDUCT VS MAPPING

The first step for any organization is to identify a Value Stream through which the product passes, as it moves from raw material to finished product, from order to delivery and initially from concept to production launch. Appoint a "Value Stream Manager", who is responsible for the complete value stream, cutting across the organizational boundaries. After identification, the mapping of the value stream is done in order to expose the waste in the value stream.

❖ 5.5 ELIMINATE WASTE & CREATE FLOW

The key point is to start with activities the customer will immediately benefit from, not with initiatives that are technically intriguing or exhilarating for managers. Once the major chunks of waste are eliminated, flow needs to be established. The value adding steps need to be arranged in a sequence such that the material flows in a continuous flow in the direction of the customer, without any stoppage or back flows.

- ❖ To achieve flow for an extended period of time, all the equipment and labor in the process must be available and capable of performing at all times, through preventive maintenance & training of employees to perform a wide variety of jobs in their work areas.

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5.10 DEVELOP PULL

While implementing continuous flow production is an important step that can be a major driver of consistent productivity and margin improvement, if the company is not producing what the customer wants than it is still waste. This is where the concept of pulling demand from the customer, rather than pushing product and then having to discount it, comes into play.

In a production plant, each process can be considered as a customer to the previous process. Various methods such as *Kanban* (Japanese word for signal) are used to communicate to the previous process the exact requirement of this process. The *kanban* carries information regarding the part number, quantity, location, delivery frequency, etc. The *kanban* travels with the actual parts and this system is a simple, seemingly foolproof way to make sure the right parts are made at the right time in the right amount.

5.11 PURSUE PERFECTION

The “journey to lean” is endless. The leaner a system becomes, the more and more waste is exposed & inefficiencies brought forth.

The intolerance to equipment breakdowns & quality problems increases. A continuous improvement culture in the company consistently removes this waste to become better & better.

5.12 EXPAND THE SCOPE

Once success has been demonstrated in a small area, the scope of the implementation should be expanded to include other functions & go beyond the plant boundaries, to reach suppliers & customers.

6.0 CONCLUSION

In the developing countries such as India, Iran, Brazil etc. we still have industry based on old craft or mass manufacturing systems which over time has proven to be highly inflexible, capital intensive and inefficient from cost and cash flow standpoint. Globalization and opening up of economies in these countries, on the other hand, are putting enormous pressure on the management of these industries, to find ways to improve efficiency, quality & reliability & all this while cutting cost and improving return on investment. Under the existing practices & paradigms survival is threatened.

Lean Manufacturing philosophy has emerged over the last decade as a very powerful way of improving our systems and competitiveness. Industries in developing world can adopt these principles and use the strength of flexibility to make an impact in the manufacturing world.

The improved performance achieved by transformation are,

- Achievement of world class levels of product quality.
- Much improved productivity given the scale of operations.
- Supply of products with a good price/value relationship.
- Significant local innovation.
- Growing exports.

7.0 REFERENCES

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