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Lean manufacturing for productivity improvement in a manufacturing unit an overview

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Abstract
Lean manufacturing today has drawn the attention of the Industrial world due to its advantages over other manufacturing processes to enable their production unit to compete in the present day competitive Globalisation market. The major aim Lean manufacturing is to reduce waste, processing time, space, workforce, other capital & time consuming parameters by analysing different non-value added activities in any manufacturing process. This technology also known as Toyota Production System addresses that production should be customer driven and not supply driven, little or no work-in-progress in between each production stage, identify and remove 7 types of prominent wastages & ultimately increasing the profits of the industry.
The paper describes the key areas which can adopt TPS for purpose of increasing economic benefits of manufacturing unit.

Keywords: Toyota production system (TPS), lean manufacturing tools & techniques

1. Introduction
In the years of restoration following second world war Japanese Industry, Toyota (in particular) had a problem, which was how to [1]. reconstruct a Shattered manufacturing base without recourse to either the huge market or the Economies of scale available to Western (specifically US) companies, and in the face of severe credit restrictions imposed by the occupying forces (leading to reduced sales and very limited resources to invest in the new plant that everyone thought essential to efficient manufacturing). Japanese aimed at getting the best out of limited investment by:

- Building only what is necessary
- Eliminating what does not add to value
- Stop if something goes wrong

This lead to development of Toyota Production System (TPS)/ Lean Manufacturing and idea came to be known as Lean Thinking [2].
This specified five principles:

- Specify value
- Identify the value stream- line up the activities which add value, eliminate which does not add value.
- Create the conditions for value to flow smoothly through the stream.
- Have the customer pull value from stream.
- Pursue perfection – work on improving the responsiveness of the production system to customer demand for value.

While Japanese manufacturers embraced Lean as their biggest hope in recovering effectively from a wartorn economy in the 1950's, today [2] companies embrace Lean Manufacturing for three fundamental reasons. First, the highly competitive, globalized market of today requires that companies lower costs to increase margins and/or decrease prices through the elimination of all non-value added aspects of the enterprise. Second, meeting rapidly changing customer "just-in-time" demands through rapid product mix [3] changes and increases in manufacturing velocity in this manufacturing age is key. Finally, goods must be of high and consistent quality. Lean manufacturing facilitates these three goals.
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 [4].

2. Key principles of lean manufacturing
Key principles behind Lean Manufacturing can be summarized as follows: [1]

1. Value
Every company needs to understand what value the customer places upon their products and services. It is this value that determines how much money the customer is willing to pay for the product and services. This leads to a top-down target costing approach that has been used by Toyota and others for many years. Target costing focuses on what the customer is willing to pay for certain products, features, and services. From this the required cost of these products and services can be determined. It is the company's job to eliminate waste and cost from the business processes so that the customers price can be achieved at great profit to the company.

2. The Value Stream
The value stream is the entire flow of a product's life-cycle from the origin of the raw materials used to make the product through to the customer's cost of using and ultimately disposing of the product. Only by a study and clear understanding of the value stream and its value-add and waste can a company truly understand the waste associated with the manufacture and delivery of a product and/or service. Lean thinking advocates supplier and customer partnership and

radical supply chain management to eliminate waste from the entire value stream.

3. Flow

One very significant key to the elimination of waste is flow. If the value chain stops moving forward for any reason, then waste will be occurring. The trick is to create a value-stream where the product (or its raw materials, components, sub-assemblies) never stop in the production process. Where each aspect of production and delivery is fully synchronized with the other elements. Carefully designed flow across the entire value chain will tend to minimize waste and increase value to the customer.

4. Pull

The way to ensure that nothing is made ahead of time and builds up work-in-process inventory that stops the synchronized flow is to use a pull approach. A traditional western manufacturer will use an MRPII or ERP style of production planning and control whereby production is "pushed" through the factory based upon a forecast and a schedule. A pull approach states that we do not make anything until the customer orders it. To achieve this requires great flexibility and very short cycle times of design, production, and delivery of the products and services. It also requires a mechanism for informing each step in the value chain what is required of them today, based upon meeting the customer's needs.

5. Perfection

A lean manufacturer sets his/her targets for perfection. The idea of total quality management is to systematically and continuously remove the root causes of poor quality from the production processes so that the plant and its products are moving towards perfection. This relentless pursuit of the perfect is key attitude of an organization that is "going for lean".

3. Wastages in an Organization

TPS aims at identification of waste in any manufacturing process. Wastes often hides in plain sight, people become used to living and working around it. TPS [5] defines the waste of following categories:

1. **Overproduction**: Over-production is unnecessarily producing more than demanded or producing it too early before it is needed. This increases the risk of obsolescence, increases the risk of producing the wrong thing and increases the possibility of having to sell those items at a discount or discard them as scrap.
2. **Defects:** In addition to physical defects which directly add to the costs of goods sold, this may include errors in paperwork, provision of incorrect information about the product, late delivery, production to incorrect specifications, use of too much raw materials or generation of unnecessary scrap.
3. **Transportation:** Transportation includes any movement of materials that does not add any value to the product, such as moving materials between workstations. The idea is that transportation of materials between productions stages should aim for the ideal that the output of one process isimmediately used as the input for the next process. Transportation between processing stages results in prolonging production cycle times, the inefficient use of labour and space and can also be a source of minor production stoppages.
4. **Waiting:** Waiting is idle time for workers or machines due to bottlenecks or inefficient production flow on the factory floor. Waiting also includes small delays between processing of units. Waiting results in a significant cost insofar as it increases labour costs and depreciation costs per unit of output.
5. **Over Processing:** Over-processing is unintentionally doing more processing work than the customer requires in terms of product quality or features – such as polishing or applying finishing on some areas of a product that won't be seen by the customer.
6. **Motion:** Motion includes any unnecessary physical motions or walking by workers which diverts them from actual processing work. For example, this might include walking around the factory floor to look for a tool, or even unnecessary or difficult physical movements, due to poorly designed ergonomics, which slow down the workers.
7. **Inventory:** Inventory waste means having unnecessarily high levels of raw materials, works-in-progress and finished products. Extra inventory leads to higher inventory financing costs, higher storage costs and higher defect rates.

4. Advantages of Lean Manufacturing

Table 1

	Traditional Batch Manufacturing	**Lean Manufacturing**
Orientation	Supply driven	Customer driven
Planning	Orders are pushed through factory based on production plan/forecast	Orders are pulled through factory based on customer/downstream demand
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
Hands-off of work-in-progress	Materials after each stage accumulate into work-in-progress storage areas before being retrieved by next production stage	Materials hands-off directly from one production stage to next production stage
Production cycle time	Total production cycle takes significantly longer than actual time spent processing the material	Total production cycle shortens to approach time spent actually processing the materials

5. Lean manufacturing tools and Implementation

The foundation of lean manufacturing includes following tools: [5]

1. **Standard work sequence:** This is the order in which a worker must perform tasks, including motions and processes. This is clearly specified to ensure that all workers perform the tasks in the most similar ways possible so as to minimize variation and therefore defects. Ideally this is so detailed as to clearly describe every single hand movement by a worker. For example, in wood cutting, the standard work sequence would describe every specific cut and operating step from machine setup to materials handling, cutter adjustment, manual movements and processing time. In an assembly process, it would describe the exact sequential step-by step motions by which the item is assembled.
2. **Standard Timing:** Takt time is the frequency with which a single piece is produced. Takt time is used to clearly specify and monitor the rate at which a process should be occurring at various production stages. For lean manufacturers, the Takt time of each production process is actively managed and monitored so that a continuous flow can occur.
3. **Standard in-process inventory:** This is the minimum unit of materials, consisting primarily of units undergoing processing, which are required to keep a cell or process moving at the desired rate. This should be clearly determined since it is necessary to maintain this minimum amount of in-process inventory in order to not cause unnecessary downtime. This is used to calculate the volume and frequency of orders, or Kanban, to upstream suppliers.

Kanban

Kanban means signboard. Kanban provides two major services to lean facility:

1. It serves as communication system
2. It is continuous improvement tool

The essence of kabanas two fold. First, it is direct communications to produce material—in other words, to supplythe customer. It is the pull signal to produce. Once the product is withdrawn by thecustomer, at that moment the kanban tells us exactly what the customer is using, andhence what the customer will need later. This kabanas sent as fast as possible to theproduction line. In essence, the kanban system is doing the "talking" to the production

System, telling it to produce because some product has been removed.

TAKT Time is the maximum time per unit allowed to produce a product in order to meet the demand [6].

Value Stream Mapping (VSM) serves as a straight point to help management, Engineers, suppliers and customers to recognise waste. VSM is a method of visually mapping the products production path including material and information flow.

Total Productive Management (TPM) consists of maintenance program that covers entire equipment life cycle and requires participation by every employee.

The Five S's [5].

1. **Sort:** The first step in a 5S Program is Sort. "Sorting" means to sort through & separate everything in each work area. Keep only what is necessary. Materials, tools, equipment and supplies that are not frequently used should be moved to a separate, common storage area. Items that are not used should be discarded or recycled. Don't keep things around just because they might be used, someday.
2. **Straighten (or "Set in order"):** This is the second step in a 5S program: organize, arrange, and identify everything in a work area, as well as throughout the facility, so that items can be efficiently and effectively retrieved and returned to their proper storage location.
3. **Scrub (or "Shine"):** The third step of the 5S Program entails a thorough cleaning. The first step of 5S involved cleaning up the clutter and sorting out what was needed from those tools, materials, and supplies that are not frequently needed. In the second step everything was straightened up and put away in its proper storage location. The third step entails a thorough cleaning of the area, equipment, and tools.
4. **Stabilize (or "Standardize"):** The fourth step in a 5S program is to make your 5S practices effective and efficient. This is accomplished by simplifying and standardizing. With the first three steps already completed, the effects and benefits of 5S can be seen. Time wasted looking for needed tools has been eliminated. Safety hazards from clutter and debris no longer exist. Early maintenance is keeping equipment online and producing needed products.
5. **Sustain:** The fifth and final "S" in the 5S Program is called sustain. With the first three steps of 5S completed – sort, set in order, and shine – and with the best practices that efficiently and effectively result in those three steps being accomplished having been set in standards, you might think you are done. But, this fifth step is a critically important one, without which 5S will eventually fail.

Fig 1

Conclusion

Lean production method is an effective method to improve production, cost input and ultimately profit by reducing time input to manufacture each product. Although most manufacturing units in the world are still to procure benefits of this new technology there are manufacturing units which have adopted this technology and have improved their production to a great extent and make an impact in this fast growing world of globalisation, competition by not only producing good quality product but also on time guaranteeing customer satisfaction solely by use of this technology.

References

1. Womack JP, Jones DT, Roos, The Machine That Changed the world, Rawson Associates, New York, NY, 1990.
2. Yongsheng Wang, Ershi Qi. Enterprise Planning of Total Life Cycle Lean Thinking.
3. Kartik Ramchandran. A Complete Guide for Lean Manufacturing.
4. Hudli Mohd. Rameez, Areas of Lean Manufacturing for Productivity Improvement in a Manufacturing Unit.
5. Taichi Ohno, Toyota Production System, Productivity Press. 1988; 6(58):126.
6. Aza Badurdeen, Lean Manufacturing Basics, 2007.