Achieve to agility manufacturing by use of seven wastes through Lean manufacturing

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ABSTRACT

Hop and Spearman (2000) introduce statement on the waste-free state that was given as early as 1983. The seven wastes are at the root of all unprofitable activity within organizations. Waste elimination is one of the most effective ways to increase profitability in manufacturing and distribution businesses. To eliminate waste, it is important to understand exactly what waste is and where it exists. While products differ in each factory, the typical wastes found in manufacturing environments are quite similar. After years of work to eliminate waste, Toyota, the Japanese automobile manufacturer, identified the following seven wastes as the most prominent ones. The purpose of implementing lean manufacturing is to become leaner. Ultimately, the goal of a leanness manufacturing system is to become totally “waste-free.” Also we can use these in agility manufacturing, where lean and agility mix together and corporate new concept that call Legality.

Keywords: seven wastes, Lean manufacture, Agility manufacture;

Introduction

Waste elimination is one of the most effective ways to increase the profitability of any business. Processes either add value or waste to the production of a good or service. The seven wastes originated in Japan, where waste is known as “muda.” "The seven wastes” is a tool to further categorize “muda” and was originally developed by Toyota’s Chief Engineer Taiichi Ohno as the core of the Toyota Production System, also known as Lean Manufacturing. To eliminate waste, it is important to understand exactly what waste is and where it exists. While products significantly differ between factories, the typical wastes found in manufacturing environments are quite similar. For each waste, there is a strategy to reduce or eliminate its effect on a company, thereby improving overall performance and quality.

The main part:

The seven types of waste are:
1. Waste from overproduction
2. Waste from waiting times
3. Waste from transportation and handling
4. Waste related to useless and excess inventories
5. Waste in production process
6. Useless motions
7. Waste from scrap and defects

Waste from overproduction

It may sound surprising, but many companies are producing more than necessary because they lose parts, products and material! Without order, care and discipline in storage, inventories will fill all available space. Temporary storing a batch in a non-defined / dedicated area is risky, as someone could move the batch without care nor notice. In such a case, it is likely to lose its track, all ending in a waste of raw material, energy and man power.

It may lead to a double waste if the lost batch requires to produce a new one be delivered!

Eliminating the wasted space and valuable surface by excess inventories and overproduction is another potential improvement.

The simple solution to overproduction is turning off the tap; this requires a lot of courage because the problems that overproduction is hiding will be revealed. The concept is to schedule and produce only what can be immediately sold/shipped and improve machine changeover/set-up capability.

Case Study: Overproduction:

Our client was a mid-Atlantic sand and gravel company with a need to optimize the flow of raw materials between their mines and their processing...
facilities. Analysis revealed that transport trucks were being scheduled inefficiently with little coordination between the production of the mine and the demand of the processing facility. The mines would swing between extremes of overproduction and waiting simply to fill the available trucks, often producing excess materials which wasted labour, fuel and other resources by requiring redundant handling steps.

We designed and helped our client implement an improved scheduling process to coordinate mine production, truck transport and processing. Our client recognized significant savings of labour, storage and fuel resources while realizing a more orderly, predictable and flexible flow of materials and products.

Waste from waiting times:

Waiting is a consequence of poor synchronization between process stages or bad preparation. Waiting for parts, material, tools, instructions, etc… can be caused by a lack of rules about storage places, when people have to search everywhere. Also whenever goods are not moving or being processed, the waste of waiting occurs. Typically more than 99% of a product’s life in traditional batch-and-queue manufacture will be spent waiting to be processed. Much of a product’s lead time is tied up in waiting for the next operation; this is usually because material flow is poor, production runs are too long, and distances between work centers are too great.

A relationship exists between the time a part spends in the manufacturing system and the total number of parts in the system. This relationship, known as Little’s Law (Little, 1961), can be expressed as follows:

\[ L = \lambda \times W \] (1)

Where the variables and their units are the following:

- \( L \): Average quantity of parts in the system (i.e. total inventory) [parts]
- \( \lambda \): Average rate parts enter and leave the system [parts / time]
- \( W \): Average time spent in system (i.e. throughput time) [time]

This relationship assumes that the manufacturing system is operating at a steady state, so that the rate parts enter the system is, on average, equal to the rate at which parts leave the system. If these rates are not equal, parts will either accumulate in the system (arrival rate > departure rate) or the number of parts in the system will go to zero (arrival rate < departure rate). Little’s Law has been used to develop quantitative relationships between inventory and throughput time for the delays mentioned in this decomposition branch.

Case Study: Waiting:

Our client was a Big 3 automobile manufacturer which sought to improve assembly line flow in one of its Midwest plants. Its work cell for making connecting rods suffered frequent delays caused by adjustments and maintenance operations on its tooling and machinery. Our analysis revealed that the buffer queue was inadequate causing small production variations in one manufacturing step to cascade down to delays for subsequent operations.

Our solution was to design a FILO (first in, last out) style queuing tower to buffer small variations in the production flow, thus minimizing wait time for subsequent operations. In designing the queuing tower we ran simulations to determine the optimal size and capacity to ensure a smooth workflow. Thus, each worker had the right piece at the right time to keep productivity efficient and well managed.

Waste from transportation and handling:

Transporting product between processes is a cost incursion which adds no value to the product. Excessive movement and handling cause damage and are an opportunity for quality to deteriorate. Material handlers must be used to transport the materials, resulting in another organizational cost that adds no customer value. Transportation can be difficult to reduce due to the perceived costs of moving equipment and processes closer together. Furthermore, it is often hard to determine which processes should be next to each other. Mapping product flows can make this easier to visualize.

The necessity to move and transport can be caused by the previously mentioned wastes. All transportations may not be eliminated, but they have to be kept to the very minimum.

Case Study: Transportation:

Our client was a south eastern manufacturer of injection moulded parts for the automobile industry. After acquiring a competitor our client found itself with expanded production capacity, but that it was wasting resources by transporting parts back and forth between the two plants for successive finishing operations. In addition to the costs of fuel and truck maintenance, each transfer required time and labor to package, inventory and receive parts. This excessive focus on internal logistics had the potential to distract the client from improving the service and quality it could deliver to its customers, and thus endangered its competitive advantage.

We worked closely with our client to design and implement a plan for combining the two plants into one. By applying principles of efficient work cell design we helped our client improve productivity, reduce costs, eliminate most of the work in progress inventory, and accelerate the manufacturing process.
to produce a better product in less time at a lower cost. By eliminating the unnecessary transport of parts between two plants our client saved one to two weeks in producing each batch of parts.

Waste related to useless and excess inventories:

Waste of inventories is material between operations as a result of large lot production or processes with long cycle times. It includes excess stock in the form of raw materials, work-in-progress, and finished goods. This is often caused by poor layout.

Work in Progress (WIP) is a direct result of overproduction and waiting. Excess inventory tends to hide problems on the plant floor, which must be identified and resolved in order to improve operating performance. Excess inventory increases lead times, consumes productive floor space, delays the identification of problems, and inhibits communication.

"Useless"! The name itself gives the solution.

In the 5S way, anything that is useless is to be eliminated. In case of inventories, the gain is the value of the goods stored and the regained spaces, which must be dedicated preferably to value creating activities.

Paper documents and their numerous copies, catalogues and calendars of previous years, files and data, dry and worn out pens and pencils... all excess inventories!

Case Study: Inventory:

Our client was a north eastern manufacturer of industrial valves such as might be used in chemical plants or swimming pools. Its basic problem was that it had no mechanism for planning production because it had no mechanism for predicting sales accurately. This lack of responsiveness to market conditions meant that it could use neither its manufacturing nor its financial resources to their fullest extent.

Our solution was to develop a sales forecasting economic model for the client’s specific market segments. This statistical software model uses leading economic indicators to predict future sales. It takes into account the patterns of discretionary buying among other businesses and consumers and helps our client determine what to produce, when to produce, and how best to bring their products to market. By relating market conditions to inventory levels our client is better able to manage their cash flow and improve their profitability.

Waste in production process:

This is the single most difficult type of waste to identify and eliminate. Reducing such waste often involves eliminating unnecessary work elements [including inspection through implementation of automation in such a way to promote flow.]

Many organizations use expensive high precision equipment where simpler tools would be sufficient. This often results in poor plant layout because preceding or subsequent operations are located far apart. In addition they encourage high asset utilization (over-production with minimal changeovers) in order to recover the high cost of this equipment.

This type of waste is also common in administration processes and office work. Old rules still remain even if the causes of their creation disappeared a while ago. As long as nobody will update the set of rules, everyone will carry on, sticking to the olds with application and discipline (!!).

Case Study: Process:

Our client was a Midwest manufacturer of stepper motors (used for computer controlled operation such as for printers or plotters). Though the manufacturer had a good basic design concept, their product required excessive time and skill in assembly due to its complexity.

We applied our skill and experience in design for manufacture and assembly (DFMA) to the challenge of making our client’s product better while reducing the time and expense needed to make it. By eliminating parts not adding value to the end user and reducing the machining operations we helped our client streamline manufacture, reducing twelve assembly steps to two. The redesigned motor thus cost significantly less plus it was more durable and reliable.

Useless motions:

This waste is related to ergonomics and is seen in all instances of bending, stretching, walking, lifting, and reaching. These are also health and safety issues, which in today’s litigious society are becoming more of a problem for organizations. Jobs with excessive motion should be analyzed and redesigned for improvement with the involvement of plant personnel. Instead of automating wasted motion, the operation itself should be improved.

Case Study: Motion:

Our client was a Mid-Atlantic manufacturer of hand tools which wanted to improve the efficiency of its production line. We worked closely with management and workers to identify which operations contributed to the value and quality of their product, and which operations were wasted motion of little value.
Our solution was to design work cells and a manufacturing line flow so that parts were presented to each worker in an oriented fashion; that is, each part would be presented to the worker in the right direction, with the right placement at the right time. We eliminated unnecessary operations of turning parts over, placing them in or out of bins unnecessarily, etc., and thus helped introduce an improved rhythm and flow to the manufacturing process.

In addition to reducing worker fatigue and frustration, this solution greatly improved the fortunes of our client company by improving its cost-effectiveness, and thus its cost-competitiveness.

Waste from scrap and defects:

Waste defect is a way of thinking and doing that reinforces the notion that defects are not acceptable, and that everyone should "do things right the first time". The idea here is that with a philosophy of zero defects, you can increase profits both by eliminating the cost of failure and increasing revenues through increased customer satisfaction.

Number of defects and quality problems can be directly linked to the work place state:

Assembly mistakes (parts mismatch) due to jammed work table with parts from different models/series
Forgotten parts in assembly, the parts could not be seen in the mess on the table
Scratches on parts by scarps form the work table (burr, dirt, parts...)
Spoiled parts, useless because dirty, scratched...
Assembly mistake by not following the right sequence

Case Study: Product Defects:

Our client was a Canadian manufacturer of sensors for anti-lock brakes. The failure rate of their product was small, but in this industry any failure rate is a matter of critical importance.

We did an analysis of the part design and manufacturing process to identify elements which could be improved. We helped our client redesign the part to make it more robust by minimizing the significance of manufacturing variations. This increased robustness meant greater reliability for the end user, with less waste for the manufacturer.

While our focus was first and foremost on improving the quality of the product, our improvements also resulted in an improved and more cost-effective manufacturing process.

Agility manufacture

The figure 1: Sharp model

The figure 2: Gunasekaran model

One of ways to the JIT and LEAN manufacture is seven wastes. So, we can reach agility manufacture from seven wastes.
Conclusion:

You can't focus effectively on seven areas at once, and you need to know where to start and what to do next. The first step to eliminating the seven deadly wastes is to identify each one within the operation. After that, measures can be taken to correct the situation and eliminate the problems. Such action may require simple, inexpensive solutions to a single work station or may involve changes as massive as a new layout of the factory floor with more efficient machinery. The appropriate solutions require careful study of the operation, clearly defined objectives, and thorough investigation of the benefits to be gained by each change.

Seven wastes had applied in JIT and Lean production. Nowadays, we can use these in agility manufacturing, where lean and agility mix together and corporate a new concept that call Leagility. Also you can see in Sharp model that if you want to reach to Agility manufacture at first you must have done the Lean production. So, you can reach to Lean production by help of seven wastes.

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