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Lean Wastes: A Study of Classification from Different Categories and Industry Perspectives

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I. 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.

Lean Concepts

Lean is a way of achieving more with less resources, creating an organization that responds to greater flexibility with shorter lead time and where the focus is on the customer, both external and internal.

The principles and the opportunities are applicable irrespectively of industry or type of activity. It is all about “learning to see” and elimination of all various types of waste that is built into our systems, and to look at what is value creation for the customer.
In principal, all organizations have major underutilized potentials. Now we have got to make use of it, and to stop the trend whereby all too many slip behind as it concerns long-term profitability and competitiveness. The key for success is to start a process whereby the knowledge and ideas of all employees is fully utilized, and driven by a Lean philosophy. Positive result will be achieved immediately.

The Lean concept is a business strategy and should be practiced throughout the whole organization. It is practiced in widely different businesses such as manufacturing industry, healthcare and the service sector. The results are speaking for themselves. As from the first step, which may only cover a small part, and every step there after. To fully exploit the competitive advantages of the Lean concept, all parts (both main and supporting processes) of the organization need to be included, as well as suppliers and customers from raw material to end user (Total value chain).

II. OBJECTIVES OF LEAN WASTE MANAGEMENT

1. To explain how the basic elements of Lean Eliminate waste create flow and continuously improve operations
2. To assess the benefits of lean, as well as the difficulties in implementing lean systems
3. To analyse how the complementary concepts of lean and six sigma work together for process improvement
4. To construct and intrepret a value stream map
5. To create strategies for implementing lean in service industries
6. To use lean concepts and techniques to enhance environmental initiatives.

Fig. 1 Lean waste management

Lean Value Chain

After the initial steps are taken by an organization in the implementation of the Lean philosophy into its own internal processes, it usually starts becoming apparent that there is an outside world, which is not quite aligned to your own activities. This is the time to address the outside world, suppliers and customers, and see how they can become part of the value chain approach and how they can be aligned in the same way the internal processes are aligned.

III.WASTES IN MANUFACTURING

The seven wastes consist of:

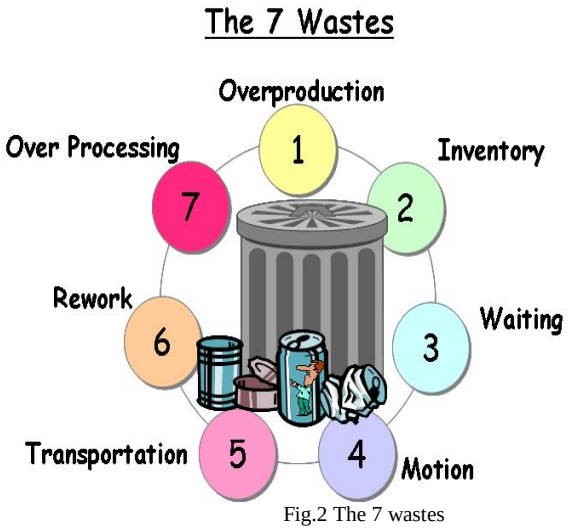

Fig.2 The 7 wastes

1. Overproduction

Simply put, overproduction is to manufacture an item before it is actually required. Overproduction is highly costly to a manufacturing plant because it prohibits the smooth flow of materials and actually degrades quality and productivity. The Toyota Production System is also referred to as “Just in Time” (JIT) because every item is made just as it is needed. Overproduction manufacturing is referred to as “Just in Case.” This creates excessive lead times, results in high storage costs, and makes it difficult to detect defects. 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.

2. Waiting

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. Goldratt (Theory of Constraints) has stated many times that one hour lost in a bottleneck process is one hour lost to the entire factory’s output, which can never be recovered. Linking processes together so that one feeds directly into the next can dramatically reduce waiting.

3. Transporting

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.

4. Inappropriate Processing

Often termed as “using a sledgehammer to crack a nut,” 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. Toyota is famous for their use of low-cost automation, combined with immaculately maintained, often older machines. Investing in smaller, more flexible equipment where possible; creating manufacturing cells; and combining steps will greatly reduce the waste of inappropriate processing.

5. Unnecessary Inventory

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. By achieving a seamless flow between work centers, many manufacturers have been able to improve customer service and slash inventories and their associated costs.

6. Unnecessary / Excess Motion

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.

7. Defects

Having a direct impact to the bottom line, quality defects resulting in rework or scrap are a tremendous cost to organizations. Associated costs include quarantining inventory, re-inspecting, rescheduling, and capacity loss. In many organizations the total cost of defects is often a significant percentage of total manufacturing cost. Through employee involvement and Continuous Process Improvement (CPI), there is a huge opportunity to reduce defects at many facilities.

In the latest edition of the Lean Manufacturing classic Lean Thinking, Underutilization of Employees has been added as an eighth waste to Ohno's original seven wastes. Organizations employ their staff for their nimble fingers and strong muscles but forget they come to work everyday with a free brain. It is only by capitalizing on employees' creativity that organizations can eliminate the other seven wastes and continuously improve their performance.

Many changes over recent years have driven organizations to become world class organizations or Lean Enterprises. The first step in achieving that goal is to identify and attack the seven wastes. As Toyota and other world-class organizations have come to realize, customers will pay for value added work, but never for waste.

IV.WASTES IN PRODUCT DEVELOPMENT

The first step in eliminating waste from New Product Development (NPD), and thus improving the process, is to learn to identify the eight wastes. By closely examining the entire NPD process from a Lean perspective, the opportunities to drive out waste and increase value will become obvious.

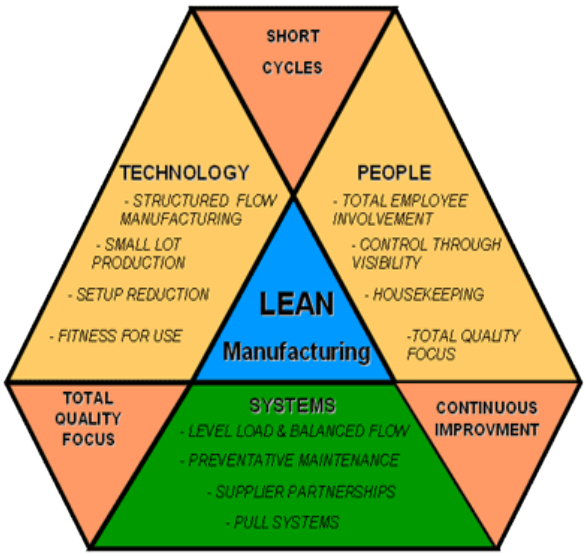

Fig.3 Waste in Product Development

Defects

Defects are the result of executed processes that did not produce value.

- Improper information on drawing
- Missing views on drawing
- Incomplete information
- Product flaws resulting in missing customer expectations
- Reworking product or processes

Overproduction

Waste from producing product that is not currently needed or product that is not needed at all.

- Unnecessary documentation
- Cost overruns due to excessive project time charging

- Overlap of strategic and non-strategic projects competing for limited resources

Waiting

No value is added while people wait for product to process or product waits for people or machines.

- Unbalanced workflow within the team
- Time spent getting approvals
- Dependant on the number of hand offs and task dependencies

Non-utilized resources/talent

The waste of underutilized intelligence and intellect commonly referred to as behavioral waste.

- Underutilizing people's knowledge and creativity
- Uneven work flow resulting with some team members overburdened while other underutilized

Transportation

While the product is moving, no value is added to it.

- Carrying, mailing, or even e-mailing documents stops the process
- In an electronic system look at the number of hand offs where we pass something to someone else

Inventory

Inventory is the collection of unprocessed documents, data objects, and transactions queued-up between people and processes.

- Drawings and specification – we invest time to make them, update them, and manage them
- Collections of unprocessed information and data

Motion

Excess movement by people or equipment only consumes time and resources without producing value.

- Efficiency of software – number of mouse clicks, number of routines, number of transactions
- Frequently searching for drawings and other information on remote shared services like servers or printers

Excess Processing

Doing more than what is necessary to generate satisfactory value as defined by the customer.

- Using software that has a function beyond what is needed
- Product designs or processes that are too complex
- Unnecessary steps in design process
- Excessive number of iterations
- Over-designed or over-engineered product

The 7 Deadly Wastes

as defined by Taiicho Ohno (Toyota executive, 1912-1990)

1. Defects
2. Overproduction of things not demanded by actual customers
3. Inventories awaiting further processing or consumption
4. Unnecessary over-processing (for example, relying on inspections rather than designing the process to eliminate problems)
5. Unnecessary motion of employees
6. Unnecessary transport and handling of goods
7. Waiting for an upstream process to deliver, or for a machine to finish processing, or for a supporting function to be completed, or for an interrupted worker to get back to work...

And a few more types of waste...

8. Confusion — missing or misinformation. Confusing goals & metrics.
9. Unsafe or unergonomic work conditions
10. Underutilized human potential — skills, talents, and creativity

V.WASTES IN SERVICES

The original seven wastes (muda) were defined by Taiichi Ohno, the father of the Toyota Production System. These wastes have been often redefined to better fit new organisations, industries, or external pressures.

One redefinition of these wastes for service operations by Bicheno and Holweg (2009) is as follows:

1. Delay on the part of customers waiting for service, for delivery, in queues, for response, not arriving as promised. The customer's time may seem free to the provider, but when she takes custom elsewhere the pain begins.
2. Duplication. Having to re-enter data, repeat details on forms, copy information across, answer queries from several sources within the same organisation.
3. Unnecessary Movement. Queuing several times, lack of one-stop, poor ergonomics in the service encounter.
4. Unclear communication, and the wastes of seeking clarification, confusion over product or service use, wasting time finding a location that may result in misuse or duplication.
5. Incorrect inventory. Being out-of-stock, unable to get exactly what was required, substitute products or services.
6. An opportunity lost to retain or win customers, a failure to establish rapport, ignoring customers, unfriendliness, and rudeness.
7. Errors in the service transaction, product defects in the product-service bundle, lost or damaged goods.
8. Service quality errors, lack of quality in service processes.

VI.WASTES IN INTERNAL OPEARTIONS

Fig.4 Wastes in internal operations

Most purchases are made based on what was purchased in the past, these 'repeat' purchases in terms of their source, costs and environmental impact.

a. Materials Use – Distance travelled and whether they are made from renewable
b. Packaging – Cost of Packaging
c. Water - Machinery set to optimise use, completely fill washing machines before using, ensure temperature settings accurate, routinely check all water sources for leaks and fix immediately.
d. Energy - Energy efficiency but also have a policy in place for replacement and new equipment to ensure long term benefits of purchasing low energy use products.

VII.WASTES IN CONSTRUCTION

Construction waste consists of unwanted material produced directly or incidentally by the construction or industries. This includes building materials such as insulation, nails, electrical wiring, and rebar, as well as waste originating from site preparation such as dredging materials, tree stumps, and rubble. Construction waste may contain lead, asbestos, or other hazardous substances.

Much building waste is made up of materials such as bricks, concrete and wood damaged or unused for various reasons during construction. Observational research has shown that this can be as high as 10 to 15% of the materials that go into a building, a much higher percentage than the 2.5-5% usually assumed by quantity surveyors and the construction industry. Since considerable variability exists between construction sites, there is much opportunity for reducing this waste.

Certain components of construction waste such as plasterboard are hazardous once land filled. Plasterboard is broken down in landfill conditions releasing hydrogen sulfide, a toxic gas.

There is the potential to recycle many elements of construction waste. Often roll-off containers are used to transport the waste. Rubble can be crushed and reused in construction projects. Waste wood can also be recovered and recycled.

VIII.CONCLUSION

Lean management is an approach to running an organization that supports the concept of continuous improvement, a long-term approach to work that systematically seeks to achieve small, incremental changes in processes in order to improve efficiency and quality.

Lean management seeks to eliminate any waste of time, effort or money by identifying each step in a business process and then revising or cutting out steps that do not create value. The philosophy has its roots in manufacturing. A select group of service organizations is achieving sustained improvement through the four disciplines of the Lean Management System, an integrated management approach that fosters daily progress, meaningful purpose, and lasting value.

This study reveals that waste activities and the classification in non-manufacturing are not same as manufacturing waste activities. There are some waste activities which are similar in nature but there are other non-vale added activities, which are different from manufacturing wastes. In this study possibilities for waste prevention have been treated. No attention has been given to the development of clean processing methods as these entail specific fundamental technical and economical knowledge.

For a reduction of environmental problems that occur because of discharge of waste, improved housekeeping practices and management practices are of more importance. Good house-keeping practices are not easy to describe, but it is clear that, as the amount of water used is major factor in all industries (if more water is used, total wastewater production per unit of product processed may

increase manifold) proper water management is one of the first aspects deserving attention. A reduction of water consumption without decreasing hygienic standards, is often possible. This reduction may be reached by good-house keeping practices, but also by the introduction of new techniques.

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