ELIMINATING WASTE IN COMPANIES

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ABSTRACT

The global economic recession has caused a reduced volume of orders, market saturation and low price competition pressure, so it is the right time for reorganization and optimization of companies and not for dismissal of employees.

By dismissing employees the company loses good staff, employees accustomed to the work in their company, the moral of workers decreases and the reputation of the company diminishes.

For these reasons, the companies must exploit this global crisis and during this time, with fewer orders, shift as much energy as possible to improve the organization of the company. This primarily means evaluation of processes and problems that have occurred during production and could not be removed before due to the lack of time, or employees were not able to remove them because they did not have enough knowledge.

Recession is the time to fix enterprise's internal problems and eliminate waste. In most companies, the share of activities that truly create new value is less than 10%. All other activities that do not create value can be attributed to waste. Eliminating waste is the first step towards automation and introduction of Kaizen system (continuous improvement).

The article will summarize the wastes as a stimulation and consideration for companies that want to address and eliminate waste.

Key words: Waste, Continuous improvement, Lean manufacturing

1. Introduction

Currently, almost no production company (being under strong competition pressure) can be successful without using the lean production methods. Lean production (or TPS system according to its author Taiichi Ohno) is a base for a successful, competitive and modern material flow. Simple process flows with simply recognizable and quick improvement goals lead to quick rise of economy.

Because of new possibilities available on the Internet, even smaller companies can now compete with their products on the global market. Companies with a good starting position do not have any advantage on the global market; companies that can response quickly to market demands and can optimize highly flexible processes have gained advantage over them.

Lean production (i.e. TPS system) consists of several methods and procedures that allow for an effective and modern material (or product) flow [1].

The most important methods and procedures that ensure lean production are:
Discovery and elimination of waste: Ignoring any waste in the production process encourages negative development. Only systematic discovery and elimination of waste in production processes improves processes and ensures positive development.

5W method: When analyzing background of a problem, the question WHY is being asked FIVE times. Has the problem arisen because of: machine, worker, material, measurement or method? 5W method very quickly leads to discovery of the main reason and to a solution of the problem.

Poka Yoke method: error-preventing strategy. The basic idea of this method is to design a process in such a way that it is impossible for errors to occur; and if they do occur, they are eliminated quickly. Error-preventing devices in a process are designed in such a way that errors cannot be made. Devices can operate by detection and by using audible or light warnings.

Andon: Andon is a semaphore above the production line. It shows the production process line status. Colors of the semaphore lights are the same as traffic lights used on streets. If a worker detects a small anomaly on the production process line, he lights the YELLOW LIGHT on the semaphore and thus asks for help. If the worker detects a larger anomaly, he lights the RED LIGHT and thus stops the production process on this particular line. GREEN LIGHT on the semaphore indicates that the production process on the line flows normally, without difficulties. Andon allows the workers to assume responsibility for execution of production processes of the line.
Multi-machine manipulation: A worker does not operate only one machine – he operates several machines. This is possible if machine cycles allow this. Waiting time losses are reduced or eliminated in multi-machine manipulation.

Kaizen: This is a method of continuous improvement; in the beginning it was used for continuous improvement of production processes. Today Kaizen is used for continuous improvement of any working process.

From protection of employees and protection of an individual to a reduction of the number of employees: Company employees are a sort of a "family" so it is important to protect each individual against the economy measures. By flexibilization of qualifications in a company it is possible to achieve universal use of employees, establish prerequisites for teamwork, and achieve higher efficiency.
**Just in time:** JIT means supply of material at the right time, of the right quality, in the right quantity and on the right location. In this way the production flows are optimized holistically, it is not just their functions that are optimized.

**Kanban:** The term "Kanban" means a label or a card on a box; it is used as a means of control. There are several types of Kanban cards: concept order, delivery, supply, signal, express and urgent Kanban card. The concept of the Kanban system is shown in Figure 9.
The principle of SUPERMARKET and SUPPLIER KANBAN: In supermarkets the processes are carried out using the PULL principle: when the stock of a particular material has been used up to a certain limit, new material is ordered at the supplier with the KANBAN SUPPLIER card.

A simple example of the supermarket system is a vendor for drink and food.

Fig. 10: An example of the supermarket system

Production Leveling (Hei-junka): Leveling of labor is carried out. The goal is to make a transition to a production on the principle of a conveyor belt and thus avoid large waste. It is also possible to achieve continuous material flow and therefore JIT-oriented processes by adding buffers.

Fig. 11: Production-leveling philosophy

Toyota company developed a 6-step production-automation procedure (Figure 12).

Fig. 12: Automation procedure steps [2]
We can see that the first step of the production-automation procedure is ELIMINATION OF WASTE, so in the follow-up we will deal with the problems of finding and eliminating production waste.

2. Waste in manufacturing

All activities in manufacturing processes that do not add any value to the products are waste. It is necessary to find all sorts of waste in manufacturing processes and suggest the ways of their elimination. SEVEN TYPES OF WASTE were found in Toyota [2]:

1. waste of OVERPRODUCTION
2. waste of WAITING
3. waste of TRANSPORT
4. waste of INAPPROPRIATE PROCESSING
5. waste of UNNECESSARY INVENTORY
6. waste of UNNECESSARY MOTION
7. waste of MANUFACTURING DEFECTS.

2.1. Waste of OVERPRODUCTION

Overproduction occurs if more products are manufactured than it was planned by the production plan, or if products are manufactured faster that it was planned. Consequences are piles of too early deposited products in intermediate warehouses.

In order to prevent that a worker on a machine in a production line would not be without work, he starts processing the next operational order immediately after having finished the previous one. This new product was planned to be manufactured later, so the worker creates overproduction, which requires intermediate warehouses.

The company should have a good overview of overproduction, so it has to organize the work in such a way the overproduction is clearly visible (Figure 13).

![Fig. 13: Less than 10% of activities are used for creation of added value](image)

Overproduction can be eliminated by informing and convincing the workers that they have to stop working the moment when the daily production plan has been achieved. It is better that workers do not work than that they do something that they do not need.
2.2. Waste of WAITING

Waiting times can be visible or hidden. A clearly visible form of waiting time can be seen in a case of a worker who operates a single machine that has an automatic feed and stop device (Figure 15).

Hidden forms of waiting arise due to difficulties in execution of production process, such as waiting because of a machine defect, shortage of material, damaged material, machine set-up, change of tools and devices, or unauthorized leave of a worker.

By eliminating waste of waiting, other waiting-related waste is often also eliminated.

2.3. Waste of TRANSPORT

Waste of transport is a consequence of excessively long, intersecting transport paths, temporary storage, load and unload, transport of pallets hither and thither.

Waste of transport is also caused by too detailed process breakdown and exaggerated division of work, due to imprecisely defined intermediate warehouses and due to production in large series.

Waste of transport can be eliminated by optimizing transport paths, by defining exact locations and numbers of intermediate warehouses and by a transition from large-series to small-series or even individual production.
2.4. Waste of INAPPROPRIATE PROCESSING

Waste of inappropriate processing is a consequence of a poorly planned production process of the product. The product does not satisfy requirements and has to be reworked; sometimes it is even useless. The reasons for waste of inappropriate processing can be found by using the fishbone diagram. Waste of inappropriate processing can be eliminated by a thorough analysis and continuous improvement of manufacturing process.

2.5 Waste of UNNECESSARY INVENTORY

Waste of unnecessary inventory is similar to the waste of overproduction. Just like overproduction, supply of too large quantities leads to the waste of unnecessary inventory. Costs upon exit from the warehouse consist of costs for purchasing material and products, order-launch costs and inventory costs. High costs are therefore related to storage and they can amount up to 20% of the product sales value (Figure 18). Waste of unnecessary inventory can be minimized by defining optimal, maximum and minimum inventory, as well as exact time when the ordered quantity should arrive at the warehouse.
2.6. Waste of UNNECESSARY MOTION

Waste of unnecessary motion is clearly visible when holding and depositing products. Workers sit by the conveyor belts and put together parts in order to make the final product. The main element of the assembly line is a conveyor belt, so the waste consists of reaching and depositing. The main reason for waste of unnecessary motion is the sitting work of workers, which reduces workers' moving area and eliminates mutual help of workers. Waste also occurs because of one-hand work: a worker holds the part with his left hand and he uses just one hand for manufacturing activities (Figure 19).

2.7. Waste of MANUFACTURING DEFECTS

Waste of manufacturing defects appears on locations where semi-manufactured products accumulate and therefore intermediate storage is required (Figure 20). It is possible to eliminate waste of manufacturing defects by training workers to control the workplace, product and circumstances: The worker who manufactures a particular part should have the possibility of supervision how this particular part was manufactured at his predecessor. The worker who has just finished a particular part should check it immediately.
The worker who has finished a particular part should also build it in in his workplace.

![Diagram of production process]

**Fig. 20: Waste No. 7: Manufacturing defects**

3. Conclusions and findings

"Waste" is any activity that does not add value; there are more than seven ones that are listed above. By knowing where possible waste occurs, every company should find for itself where the waste arises and then eliminate it. This is the first step towards a full automation of manufacturing processes.

On the basis of these simple procedures the productivity of the employees (and the company) will rise. At the same time the number of defects will reduce. If everything is done properly, the moral of employees will rise, because they will be able to significantly contribute to easier and tidier work.

Designers of new products, production process planners and toolmakers have an important role in the company. Also important is a dialog between them, which ensures execution of harmonized processes of new product development, i.e.: processes without waste. Elimination of waste in the company is the first step towards the automated production.

5. References