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LEAN MANUFACTURING – STREAMLINING PROCESSES AND ELIMINATING WASTE APPLIED TO THE ROMANIAN AUTOMOTIVE INDUSTRY

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ABSTRACT

Lean Manufacturing is currently the most important management method for the production companies. The method is used in conjunction with the quality instrument referred to as "6 sigma", derived from the Toyota production system, and was adapted by Womack and Jones, in 1995, for the western companies, referring to the basic capabilities of the companies. Lean Manufacturing means dividing the production system into flexible assembly lines or cells, streamlining and reducing the time for complex operations. Also, implies using workers highly qualified for certain operations, well-made products, a wider range of interchangeable parts. All the above mentioned is achieved through excellent quality, which is a must, reducing costs by improving the production process, international markets and world competition.

These concepts were applied by the author at TRW (Romanian company from automotive domain), with significant results.

KEYWORDS: manufacturing, lean manufacturing, cost, optimization, Romanian automotive industry

1. Introduction

The elements of the activity provided are not static, but Lean methodology offers stability and reduces variation, the essential elements for a continuous improvement. Therefore, the transition from one standard to another, from one product or process to another is done smoothly.

Lean Manufacturing, or production at minimum costs, is a production philosophy defining the reduction of time from customer demand to product delivery, by eliminating waste. The implementation of LEAN principles has become a survival strategy in a production environment in which the COST reduction is a market reality. If the current results of your company do not meet your expectations, you can find solutions to many of your problems, by joining the Lean world. If you want to implement improved long-term production management methods to help you identify the corporate waste and increase the production capacity while reducing the production costs, by reading this module you can get acquainted with several Lean Manufacturing concepts, which, after implementation, will result in:

1) significant reduction in human effort in the production area – enabling reduction of workforce used;

2) reduction in finished products defects by half – huge impact on inventory& stocks;

3) reduction in the production preparation time to one third – enabling more production on the same equipment;

4) reduction to one tenth or less of the unfinished production.

2. Terminology used

According to Taichi Ohno's classification [1], the 7 types of waste in production are:

1. Overproduction: production ahead of the demand of the downstream process/customer. It is the worst form of waste, as it is the direct originator of the other 6 types of waste.

2. Waiting: operators interrupt their work during the breakdown of machinery, equipment or delays in the materials/ drawings/ parts needed for processing.

3. Transportation: moving parts and products that are not actually required, as for instance from the processing line to storage and back to the shop floor –

to the next process, while it would be more efficient to set the next process in the immediate vicinity of the first processing station [2].

4. Over Processing: performing some unnecessary or incorrect operations because of inappropriate tools or by lack of attention.

5. Inventory: holding a larger inventory than the minimum required for the pull production system to operate.

6. Motion: operators move more than it is required – e.g. looking for parts, equipment, documents, repeated movement of tools, etc.

7. Repairing: inspection, reprocessing, scraps.

Efficiency: Meeting exact customer requirements with the minimum amount of resources. Apparent efficiency versus true efficiency: Taichi Ohno distinguishes between the apparent efficiency and the true efficiency by an example with some workers producing 100 units daily. If improvements to the process boost the output to 120 units daily, there is an apparent 20 percent gain in efficiency. But this is true only if demand also increases by 20 percent. If demand remains stable at 100 units, the only way to increase the efficiency of the process is to figure out how to produce the same number of units with less effort and capital.

The following figures show an example of efficiency for a working cell [3], implemented into TRW Automotive Timisoara:

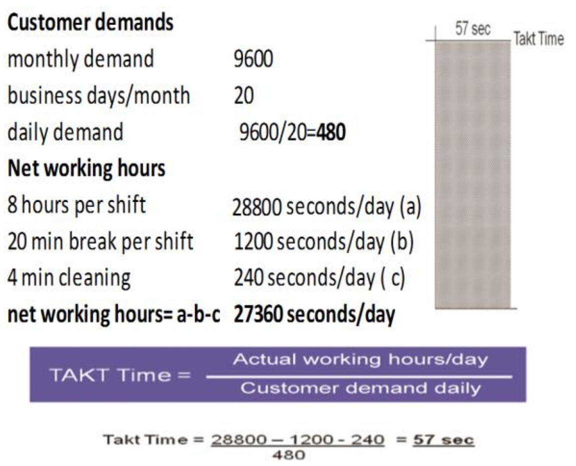

Fig. 1. *Calculating takt time based on customer's requirements* [3]

Starting from the original given customer's demands, given the working days in each region/country, the daily demands can be easily calculated. Furthermore, given the working schedule per shift and considering the regulated breaks and downtimes (cleaning, 5 S...), the needed takt time in order to satisfy customer's demands is calculated above.

Next step is to calculate the planned cycle, which has to be always lower than the takt time, including potential or accepted wastes, as shown in Figure 2 [3].

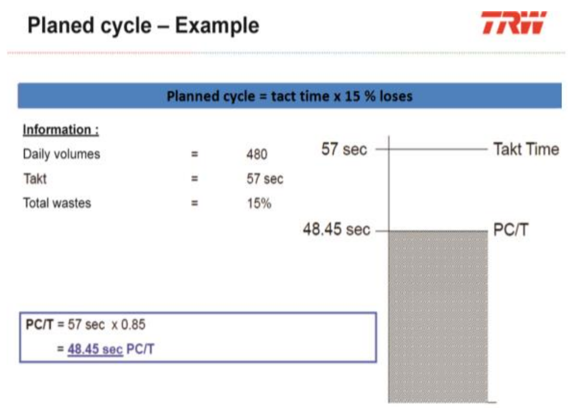

Fig. 2. *Planned cycle definition at TRW Automotive* [7]

The essential step in this exercise is to recognize and eventually eliminate waste contributors. In order to be able to perform this activity, the task or job has to be split in the smallest possible elements (called 'work elements' according to Jeffrey K. Liker and David Meier's [4] definition of Lean. These simple elements sum up the activity per each workbench or each operator, summarizing both 'value- add operations' [4] and 'non-value add' ones as waiting, walking, pulling and so on.

The figure below (Fig. 3) is a typical example of a production system before a Lean evaluation was performed: each operator's tasks are given based on some time measurements, but there are some obvious issues: one operator (operator 3) will constantly delay the overall takt time, while his given time is higher than the needed takt, all other operators have to perform tasks which are not utilizing their available time in a rigorous manner. As a result, the line or cell will constantly run behind the takt, while it will still assume certain inefficiency.

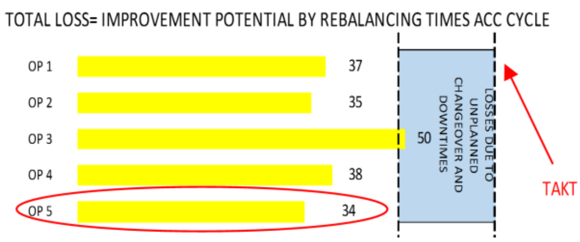

Fig. 3. *Analysis of total wastes at TRW Automotive* [7]

The main elements contributing to the improvement of cell performance/waste elimination are:

1) Ergonomics - the science concerned with the improvement of operator performance in relation to:

- work;
- equipment;
- environment.

Are ergonomics and human factors the same thing?

Essentially yes, they are different terms with the same meaning but one term may be more likely to occur in one country or in one industry than another. They can be used interchangeably but itis pretty cumbersome to read "ergonomics and human factors".

So, what is ergonomics (or human factors)?

"Ergonomics is about designing for people, wherever they interact with products, systems or processes. We don't usually notice good design (unless perhaps, it is exceptional) because it gives us no reason to, but we do notice poor design. The emphasis within ergonomics is to ensure that designs complement the strengths and abilities of people and minimize the effects of their limitations, rather than forcing them to adapt. In achieving this aim, it becomes necessary to understand and design for the variability represented in the population, spanning such attributes as age, size, strength, cognitive ability, prior experience, cultural expectations and goals. Qualified ergonomists are the only recognized professionals to have competency in optimizing performance, safety and comfort" [5].

The 4 principles of saving movement (ergonomics) [6]:

a. Elimination – reduction of the number of movements;

b. Combination – more than 2 movements at a time;

c. Reduction – distance of movement;

d. Smoothness – rhythmic movements.

2) Product flow – ideally in a U-shape, with no 'recurrences' or 'loops'.

3) Configuration and definition of the station should be as simple as possible.

4) Simple delivery of materials to stations.

5) Flexible operators (with various levels of expertise).

By eliminating the 7 waste methods or re-balancing cell (moving the operations from one station to another so that waste should disappear or get minimized), significant results are obtained, as presented in below figure (Fig. 4): while the imposed takt time is kept, with no risks of slowing down the line or not meeting customer's needs, the jobs attributed to different operators were re-organized, in such a way that the value add operations were optimally combined, the non-value add operations were streamlined. As an effect, one of the operators (operator 5) which used to be needed before Lean optimization is now released from the cell. This means a high efficiency of the cell obtained – basically 20% fewer resources for the same output and no need for a higher skill set of the operators.

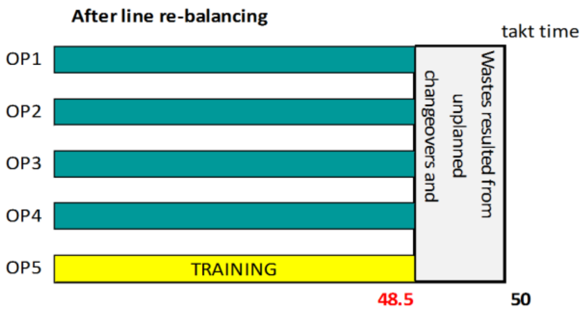

Fig. 4. *Analyzing total wastes after re-balancing at TRW Automotive*

3. Discussion: Production system. Push vs. Pull

One of the major changes driven by Lean methodology is related to the change of mentality regarding the production systems. The business terms push and pull originated in logistics and supply chain management, but are also widely used in marketing. Wal-Mart is an example of a company that uses the push vs. pull strategy (Fig. 5).

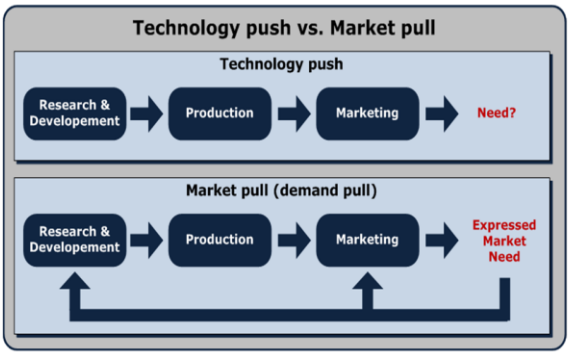

Fig. 5. *Representation of differences between "push" and "pull" systems – technology push vs. market pulling* [6]

A push–pull system in business describes the movement of a product or information between two subjects. On markets, the consumers usually "pull" the goods or information they demand for their needs, while the offerors or suppliers "push" them toward the consumers. In logistics chains or supply chains, the stages are operating normally both in push- and pull-manner. Push production is based on forecast demand and pull production is based on actual or consumed demand. The interface between these stages is called the push–pull boundary or decoupling point, as it can be seen below in Figure 5.

The two major systems (push system, the 'classical one' and the Lean driven pull system are represented in the pictures below (Fig. 6 and Fig. 7):

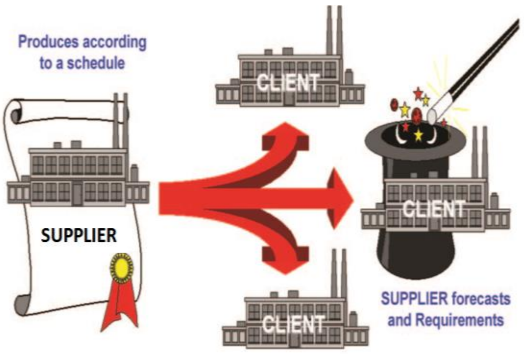

Fig. 6. *Push system characteristics*

The major characteristics of this production system [7]:

- Scheduling production – time, resources, effort needed.
- Difficult control of stocks.
- Problems become invisible – due to the manufacturing batches.
- Increased delivery time.
- Poor quality.
- Complex systems for control.

Pull System means 'pulling' the inventory/demands to the next production step (Fig. 7).

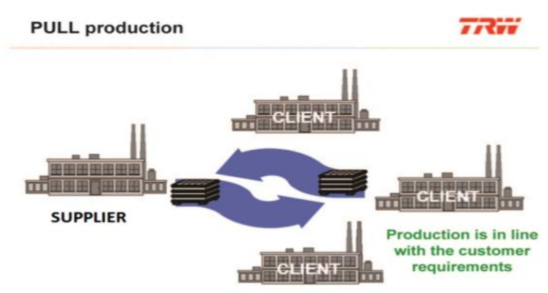

Fig. 7. *Pull system characteristics at TRW Automotive* [6, 15]

The major characteristics of this production system [7, 11]:

- Production is scheduled according to customer's requirements.
- Inventory is controlled and monitored.
- Problems are visible.
- Decreased delivery time.
- Good quality.
- Visual and simple systems for production control.

By implementing the „pull" production system, production becomes more flexible as the members of the work teams "correlate" their progress rate among them, with no need for complex time schedules to standardize work or other laborious analyses to balance work at the workstations. The need for planning and management is reduced as the work teams ensure the continuous flow by self-balancing the workloads – a very simple self-organized form of distributing work, which entails an automatic balancing of the line, at the level of the quickest operator. According to Imai Masaaki, the major benefits of these systems refer to the fact that they:

- are an excellent means of visual control.
- eliminate overproduction.
- indicate priorities.
- simplify production control.
- control the location of materials.
- controls the balancing of operations.
- easily adapt to fluctuation in demands.
- store and move the exact amount of materials required where required.
- avoid stagnation.
- reduce delivery times and wastes.

4. Conclusion

When to use Pull/Push strategy:

a. Push based supply chain strategy, usually suggested for products with small demand uncertainty, as the forecast will provide a good direction on what to produce and keep in inventory, and also for products with high importance of economies of scale in reducing costs [18].

b. Pull based supply chain strategy, usually suggested for products with high demand uncertainty and with low importance of economies of scales, which means, aggregation does not reduce cost, and hence, the firm would be willing to manage the supply chain based on realized demand [18].

These concepts are ready for application in the automotive industry in Romania (TRW - Timisoara) so as to achieve the expected efficiency parameters.

The author, together with a team involved in this process, has carried out a thorough evaluation and analysis of technological processes and manufacturing, and the concepts outlined above are materialized at the level of intercourse.

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