RESEARCH IN LOGISTICS & PRODUCTION

CURRENT STATE MAP AND REORGANIZATION OF PRODUCTION FOR EXAMPLE REAL FACTORY

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Abstract The paper presents an example of building the Current State Map and a proposal for the reorganization of production process in a INVENTOR factory. The tool that has enabled realization the improvement of the production process was Value Stream Mapping. Collected a lot of information about the production process. The basis of the reorganization is to analyze the current situation of production and the conclusions of this analysis. Also the paper presents a comparative analysis of selected process parameters before and after the reorganization.

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1. INTRODUCTION

In manufacturing plants behaving traditional approach to production management notes some habits. Behavior, habits, perform the duties of the employees, often from long years remain largely unchanged. Modern methods of efficient production management Lean Manufacturing clearly show, that not always the maximum use of production capacity is justified financially. Currently in production management are so-called trends "weight loss" production processes. Used for this purpose Lean Manufacturing tools, that allow more efficient use of resources production plants. Flow of value in the production process is shown on the Value Stream Mapping (VSM). It is a very good visualization tool that allows rapid identification of "weak points" of the process.

2. FLOW PRODUCTION AND LEAN MANAGEMENT

Manufacturing company can be represented as a system which receives some input supply and information, next on this system products are manufactured (Brzeziński, 2002). In the traditional approach to production management often encounters the so-called “push production system”. Realization of each operations in this system is initiated by providing materials / semi-finished products.

Lean Management – philosophy, which aims to improve and "slim down" production. “Slim-down” it is: reduction of materials and semi-finished products, produce necessary quantities of products, reduction stocks of finished products to the minimum. The essence of Lean Management is also possible use of small amounts object of works (minimum: human labor, machinery and equipment, surface of production hall). Lean Management refers to both manufacturing companies and non-manufacturing companies. Strictly, manufacturing companies applies to the term – Lean Manufacturing. James P. Womack and D. T. Jones. define Lean Manufacturing as “Producing only what is needed, producing only when it is needed, using minimal resources” (Womack, 2001). John Shook, in turn, on Lean Manufacturing writes: “Manufacturing philosophy, which eliminates the loss, up to shorten the transition time between customer order and delivery " Lean Manufacturing is a philosophy with a series of rules of never-ending improvement of production and pursuit of excellence. Examples of bad management in the manufacturing process can be:

- overproduction,
- unnecessary movement in the workplaces,
- unnecessary waiting,
- unnecessary transport of components, parts and semi-finished products,
- excessive stocks of raw materials, semi-finished and finished products,
- defects of: products, documentation, supplies, information.

2.1. Value Stream Mapping

One of the basic tools of Lean Manufacturing is Value Stream Mapping (VSM). VSM is to collect actual data about flow elements in the production process. These elements are:

- operation time, changeover time,
- size of transport batch, order of operations, number of workstations,
- number of the operators, etc.

Also VSM is to collect actual data about flow process information:

- manner of placing orders with suppliers of material,
- manner to collect orders from the customer,
- production orders.

Information collected and adopted marking system to drawing so-called "Current Satate Map". This drawing is the current state of the manufacturing process. Current State Map and a series of calculations which based on the collected data allows to draw a Future State Map.

2.2. Tools supporting VSM

Value stream mapping assumes the use of tools to support, improve values for indicators for selected stages of the process. For examples are:

- 5S – systematic method of learning, discipline, standardization and the pursuit of excellence. Is to maintain the 5 principles: Selection, Taxonomy, Cleaning, Standards and Self-discipline,
- TPM – Total Productive Maintenance - aim is to ensure maximum availability of critical equipment by minimizing the occurrence of failures and faults,
- *TQM* - Total Quality Management,
- MTM – Methods time measurement - analysis of elementary movements aimed at shortening the cycle time (the duration of a single operation),
- SMED – Single Minutes Exchange of Die - reducing machine changeover time; goal is to perform during changeovers only absolutely necessary works.

3. MANUFACTURING PROCESS – INVENTOR FACTORY

INVENTOR factory specializes in the manufacture of agricultural and forestry machinery. Analyzed the production process feeder, which is a part of shredder of tree branches. INVENTOR factory produces two types shredders: with manual and hydraulic feeder biomass. Manual feeder construction is very simple. It is a steel construction, which is composed of only a few parts. The major part of this structure is a conical roll. Construction of hydraulic feeder is more complicated, which con-

sists of more than 20 parts and additionally is installed hydraulic equipment (Fig. 1).

Fig. 1 Hydraulic feeder

Analysis of the production process of feeder includes part of the process from input materials to be welded together feeder. The flow of materials and semi-finished products for further workstations is shown in the figure (**Fig. 2**).

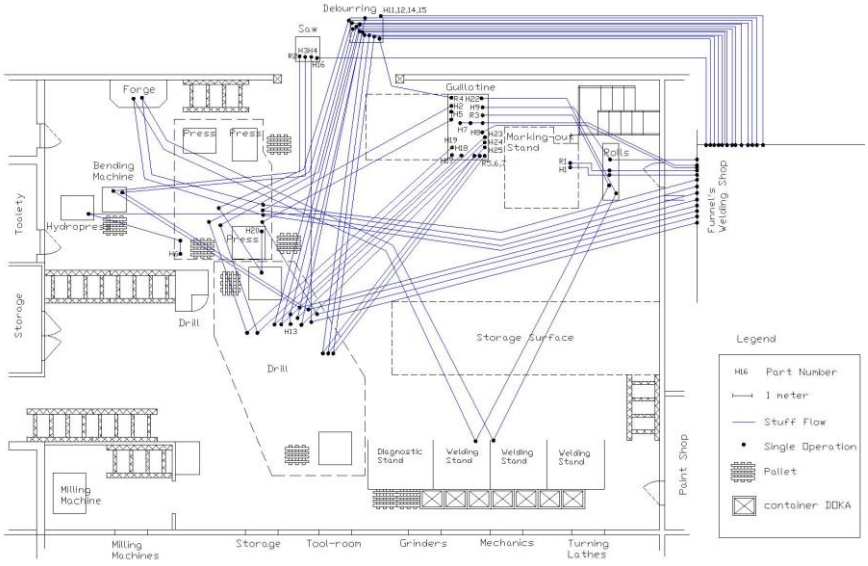

Fig. 2 Flow diagram of materials and semi-finished products in the INVENTOR factory

3. CURRENT STATE MAP

In order to sketch Current State Map must collect all information describing the production process. Collect all necessary data allows to perform a series of calculations and allows determination of the main indicators of the production process. These indicators were : OEE – Overall Equipment Effectiveness, OPC – Overall Production Capacity, C/Tp – product cycle, I-Inventory (stocks), EPE-every part every, Timeline transition of materials through the production process, etc. Indicators describing the production process was applied to the Current State Map, which was made by using the software MS Visio 2010.

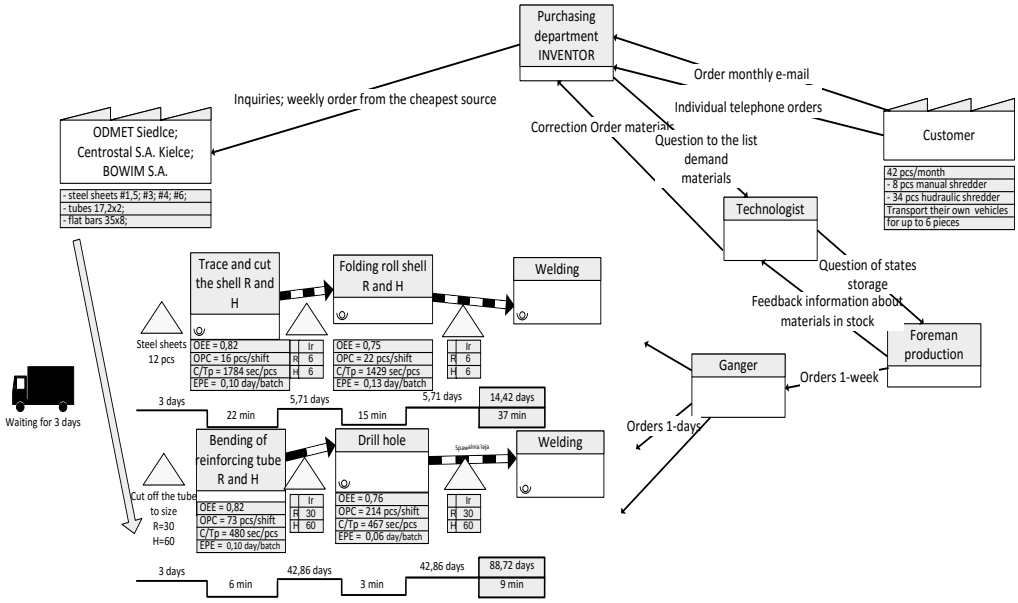

Fig. 3 Part of Current State Map

3.1. Analysis of the current state

The first step in the analysis was to compare the product cycle with customer tact on the various stages production process. In steps which the product cycle has a value close or higher than the customer tact, there is a risk of overtime. The graph (**Błąd! Nie można odnaleźć źródła odwołania.**) shows a comparison of the two values.

A lot of steps in the production process have a unfavorable values of indicators. Very large inventories of raw materials, intermediate stocks and stocks of finished products are the reason for a very long flow of materials through the process pro-

duction. Hoarding also causes a greater need for warehouse space. In the production process it is desirable to reduce the amounts of stocks. Some steps of the production process have a significantly lower OEE than the average. The use of tools TPM, TQM, can improve the efficiency of the process.

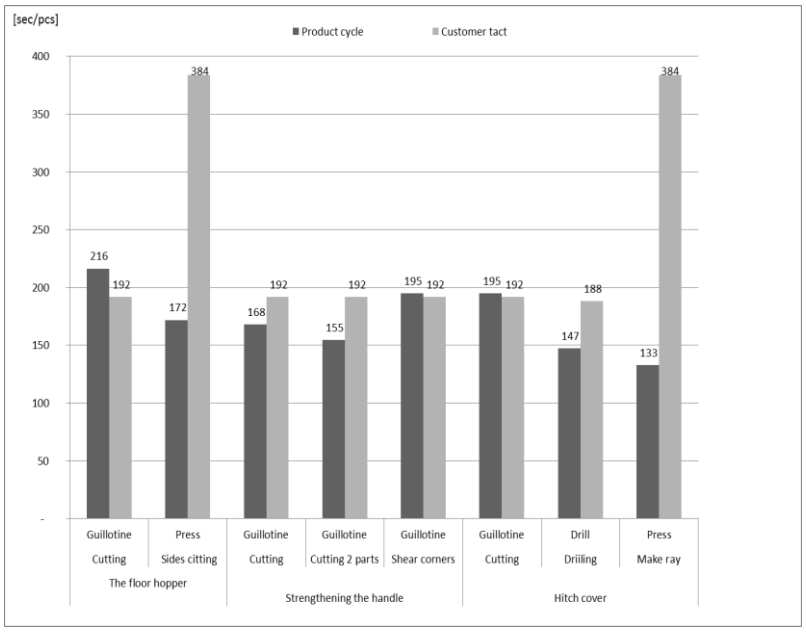

Fig. 4 Comparison product cycle and customer tact

4. REORGANIZATION OF PRODUCTION PROCESS

Reorganization of the production began to change the way that of stock accumulation. Factory sells the finished products in their own facility, the total elimination of stocks of finished products is unfavorable. Applied so supermarkets products and semi-finished products for each stage of the production process.

Another change is a change the production control. Proposed control by Kanban cards. The initiator of the production orders will not be the previous operation (push system). According to the assumptions, the production will be enforced by customer's order. Order to perform the operation will come from the next workstation (pull system).

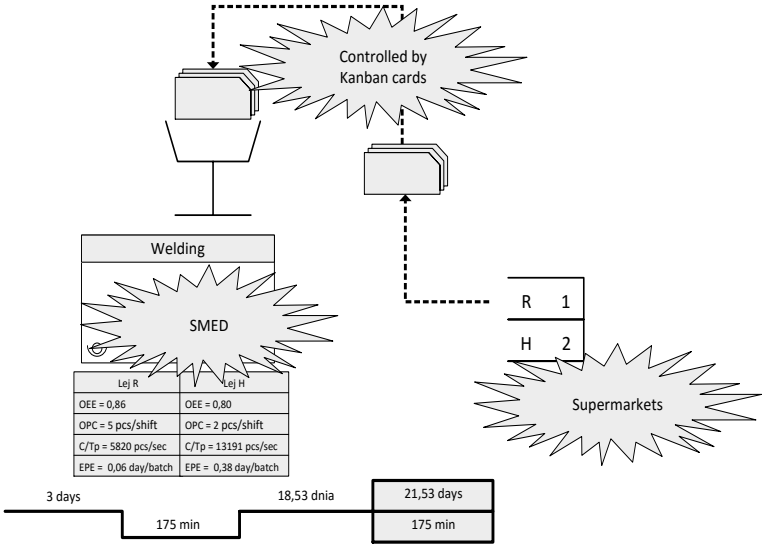

Fig. 5 Proposals for changes at the Current State Map

Because the machine availability is low, there is a risk of overtime (**Fig. 6**). Used for this purpose two tools: SMED and MTM. Similarly was done a few other production process steps.

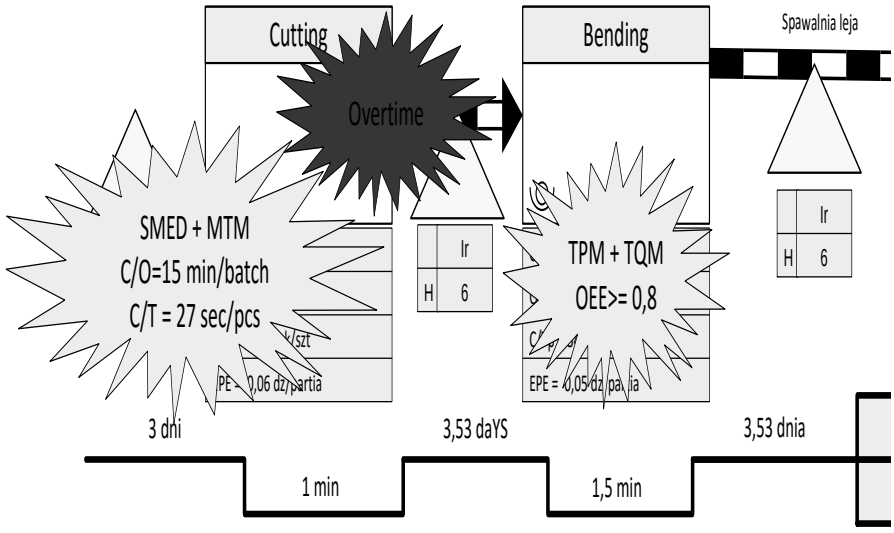

Fig. 6 Proposals for changes at the Current Map State

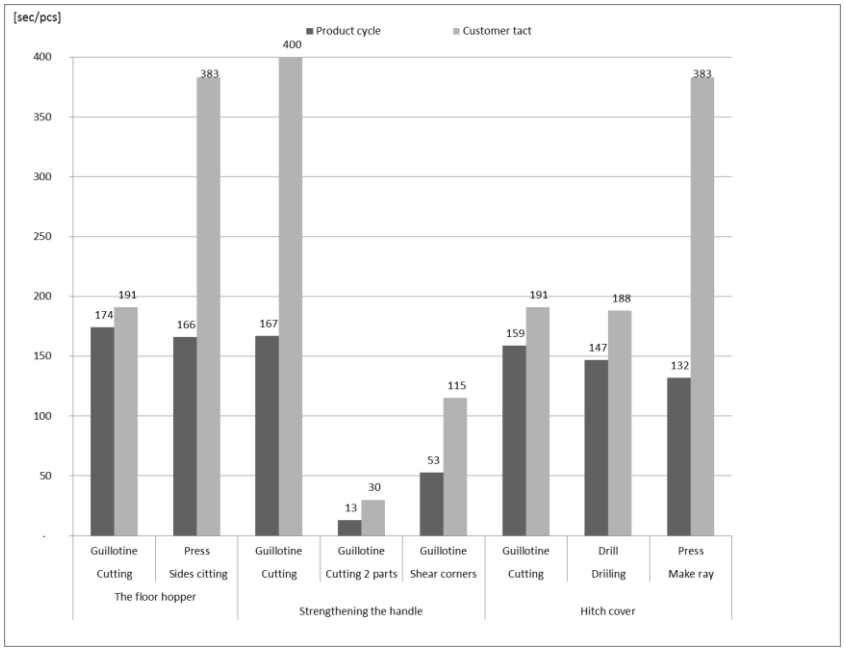

Fig. 7 Comparison product cycle and customer tact after reorganization

The following is a comparison of the product cycle again with tact customer. It was observed a significant improvement, at any stages of the production process there is no risk of overtime. The use of continuous flow and tools supporting effectively reduce product cycle below customer tact.

4. CONCLUSIONS

Value Stream Mapping:

- is a very good tool for a comprehensive approach to improve the efficiency of the production process,
- quickly allows you to see areas that adversely affect the production process,
- shows what and where in the production process must be improved to increase the efficiency.

Some of Lean Manufacturing tools sometimes appear to be insufficient to achieve the assumed values . There is a need to further improve the process step. Prepared calculations and drawn maps of states of the production process can be very beneficial for the INVENTOR factory. Implementation all part of the proposed changes should bring beneficial effects.

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BIOGRAPHICAL NOTES

Łukasz Gola is currently a researcher and teacher on Institute of Production Engineering and Automation at Cracow University of Technology. Her research interests include machining process plans, assembly process plan, CAPP systems, production scheduling and process optimization, methods of working time measuring and standardization of work time.

Wojciech Szewczyk is currently an alumnus of Cracow University of Technology, studied there at Institute of Production Engineering and Automation. He graduated with master degree. He is workig in the production plant INVENTOR as a technologist constructor in R&D department. In his work on improving the current products of INVENTOR production plant and on constructing new products.