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THE VALUE CREATING APPROACH IN THE ESTONIAN ENGINEERING INDUSTRY

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Abstract: *Lean manufacturing is a concept that has been used extensively to improve the results of manufacturing enterprises. Today there is an abundance of literature on many techniques and methods, yet there is very little information on integrating techniques and its impact on various industries. This article describes a research based on a case study and offers solutions for reducing Production Lead Time and Production Space by integrating various techniques. The effectiveness of this method was evaluated in the form of measurement results for the project's critical success factors and key indicators.*

Key words: Production Lead Time, Production Layout, Value-Stream Mapping, CSF, Lean.

1. INTRODUCTION TO VALUE-STREAM MAPPING APPROACH

Short delivery terms have become one of the biggest challenges for manufacturers in today's economy. At the same time, constant price pressure is reason to think about lowering costs. The article describes a case study used to examine mapping of a value stream and the economic effect from relocating equipment on this basis.
A method for mapping Material and Information Flow was developed in the framework of the Lean concept. This is called Value Stream Mapping, and the principles have been in use in the Toyota Production System since the beginning: "Toyota people learn about three flows in manufacturing: the flows of material, information, and people/process [1]. " This article deals above all with the effect of flow of material on Production Lead Time, on the basis of which the Layout of equipment has been optimized. The purpose of the research is an economic effect arising from the above.

2. PROJECT METHOD - INTRODUCTION TO STRAM

Stram is a Swedish manufacturer that is part of the Trading House Scandinavia group. Stram operates in the metal furniture sector and has been based in Estonia since 2009. In connection with the manufacturing unit being moved to Estonia, the following methods were implemented in the project.

2.1 Production Lead Time

To determine Production Lead Time, value stream mapping was used.
The following is essential in Value-Stream Mapping:

- Determining Product Family
- Mapping Material and Information Flow

It is important to determine product families as it is not necessary to have a value stream map for each product. It is important to determine which similar processes the products undergo. For this purpose a matrix of the products and of the steps and equipment in the process of producing the product was compiled (Table 1.)

Product Family	Production Steps				
Products	1	2	3	4	5
A	x	x		X	
B	x	x	x	X	
C		x		X	x
D		x		x	x

Table 1. Matrix of Product Family

To map the Material and Information Flow, first the process steps and equipment were entered on to the map, along with customer demand, Production Control and, tentatively, supplier(s). Thereafter arrows were added to indicate the direction of the movement of information and materials. After the basic schematic was compiled, the actual measurements took place. The following was determined and marked on the map:

- Cycle Time (C/T) separately for each step of the process
- Work in Process or WIP – the quantities of material between steps in the process – converted to Lead Time based on customer demand.

The totals for the data obtained (Production Lead Time and Process Time) were shown separately. This resulted in the Current-State Map seen in Figure 1.).

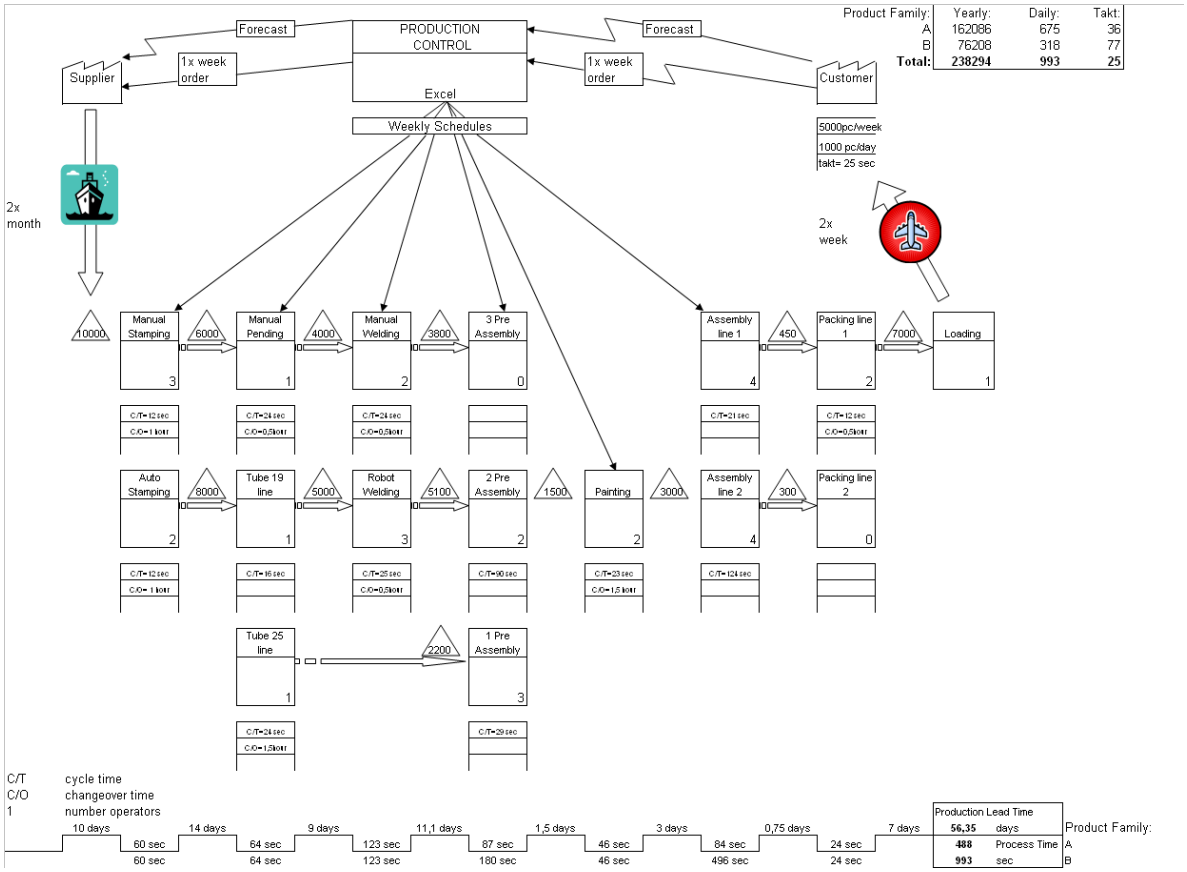

Fig. 1. Current-State Map

2.2 Production Layout

The sequence of steps in the manufacturing process can clearly be seen in the Value-Stream Mapping process. In manufacturing it is important to understand the principles of Functional Layout – how the functional equipment are situated – and Cellular Layout [2]. When we look at the existing Current-State Layout in Fig. 3, we see how materials move functionally between

processes. To some extent the processes are interlinked and cellular groups have been formed. Thus it is only important to make the material flows between cellular groups more fluid. Depending on the different durations of Cycle Time (Fig. 1) various methods should be used to synchronize manufacturing. In light of the need to quickly set up manufacturing operations in a new location, it was possible to change the material flow from Push method to the Pull method [3]. Thus buffers have been calculated to ensure the existence of sufficient material; the buffers are fed accordingly on the basis of the "Kanban" method [1]. The Future-State Map (Fig. 2) shows the activities that require improvement and possibilities already in the first stage.

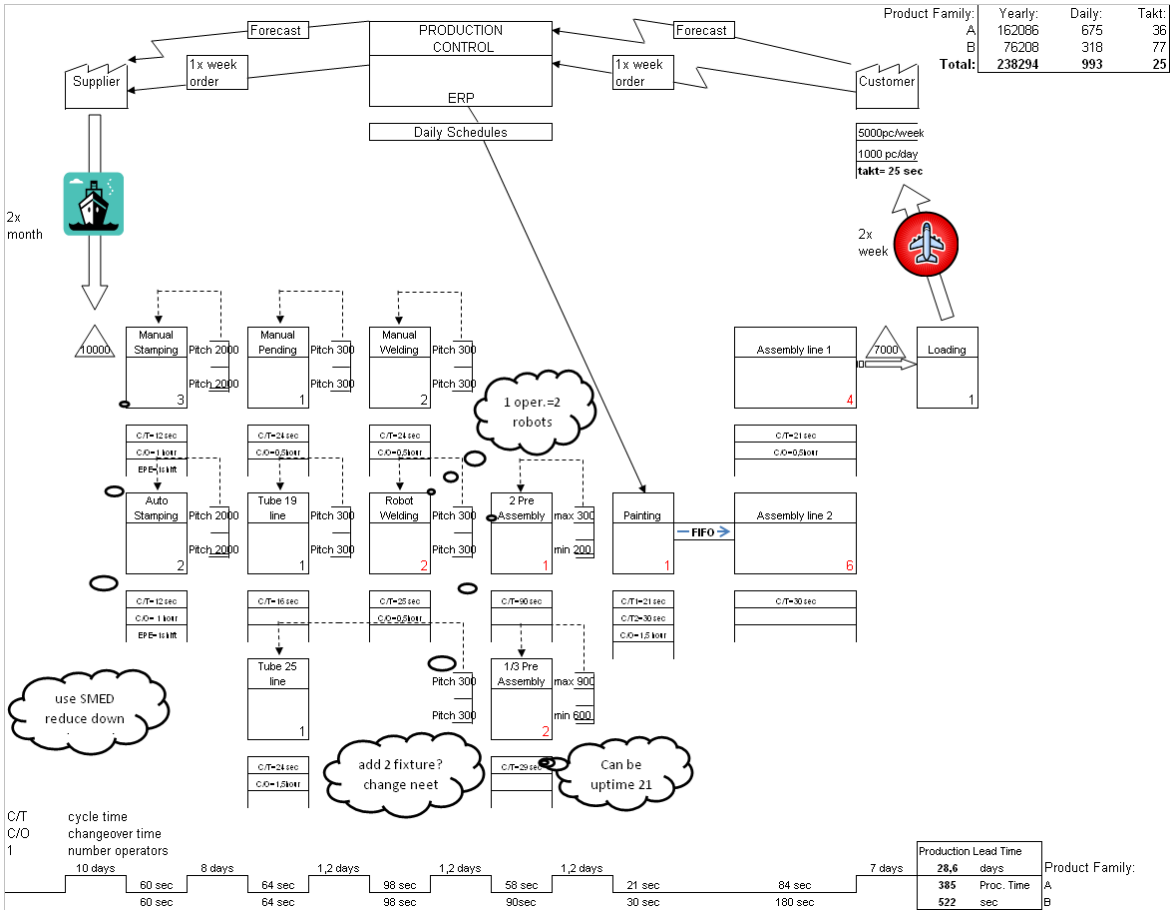

Fig. 2. Future-State Map

3. INTEGRATED RESULTS - VALUE-STREAM MAPPING AND REENGINEERING PRODUCTION LAYOUT AT STRAM

Preparations for moving manufacturing operations began in May 2009. During two months, the existing operations were mapped and a future-state map, layout and project plan were also completed. Manufacturing at the new plant began on 24 September 2009. The project was completed in October 2009 and culminated with the Future-State Map for the value stream.

These are the following:

- reducing the share of Materials (WIP) between process steps
- Replacing Push with Pull system
- Improvements for synchronizing Cycle Time

A new layout was designed in light of the given activities (Fig. 3, Future-State Layout)

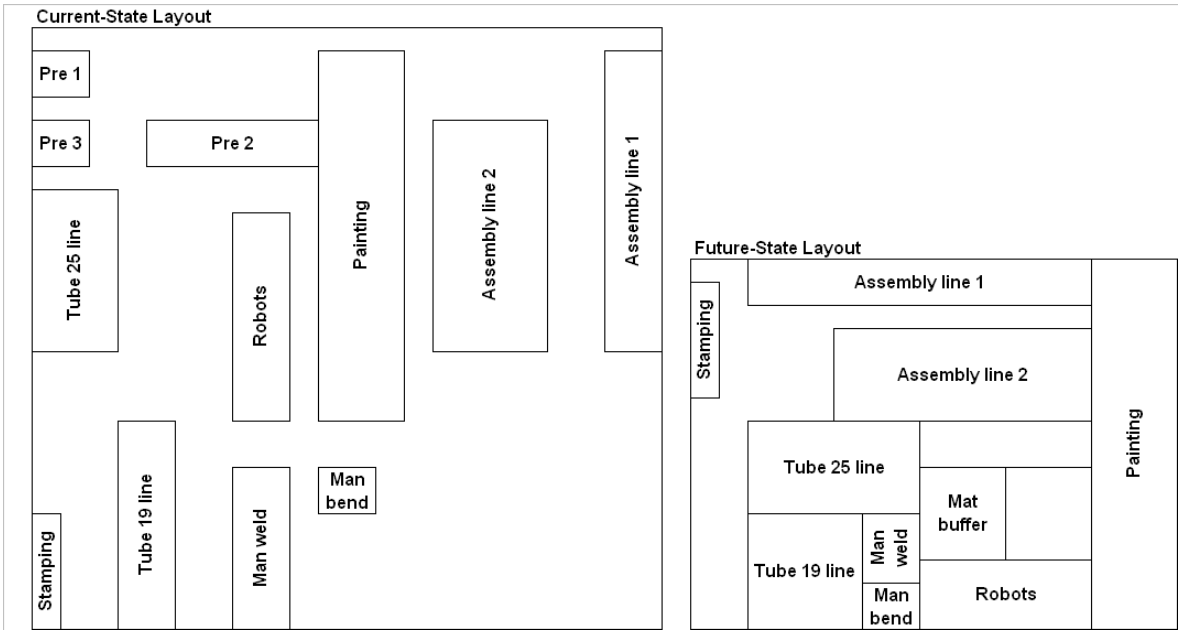

Fig. 3. Layout

Table 2 shows two targeted and measured Critical Success Factors or CSFs set as objectives and measured in the strategic planning process [4] along with the corresponding Key Performance Indicators or KPIs [5].

Figures		**Results**			
CSF	**KPI**	Current L/T [day]	Future L/T [day]	**Current Turns**	**Future Turns**
Production Lead Time	Total Inventory Turns	56	29	5	9
	Total Inventory Turns WIP	39	12	7	21
Improved Space		Current space	Future Space	**Saved [m²;m³]**	**ISP [%]**
	Saved area [m²]	11000	7500	3500	32%
	Saved area WIP [m²]	5720	2720	3000	52%
	Saved space [m³]	99000	48750	50250	51%
	Saved space WIP [m³]	51480	17680	33800	66%

Table 2. Result of measures.

The results in the table were calculated as follows:

- Total Inventory Turns (TIT)

$$TIT = \frac{225}{L/T} \quad (1),$$

where 225 is the number of working days per year and L/T is the Lead Time.

- Improved Space Performance (ISP)

$$ISP = \frac{SS}{CS} \quad (2),$$

where SS is Saved Space and CS is Current Space.

The strategic success factors in the given project are Production Lead Time and Improved Space. The selected key indicators Total Inventory Turns (1) and Improved Space Performance (2) best characterize the company's future potential Critical Success Factors as a result of the project. For instance, delivery terms (see introduction), which has become 27 days shorter in manufacturing. As a result, it will be possible to better plan inventories and presumably the project will lead to optimization of warehouse inventories, which amount to 17 days at the moment. From the standpoint of lowering costs, the advantage of reduced use of space lies in two aspects:

- Sales revenue per square metre will increase
- Overhead costs (heating, lighting, ventilation etc) will be reduced

4. DISCUSSION - EVALUATION, CONCLUSIONS

The Value-Stream Mapping approach described in this article and the economic effect from relocating equipment on this basis was greater than expected upon integrating these techniques. Considering the mapping of the value stream, we can consider as an economic effect only the growth in Inventory Turn. Other possible solutions may not see use (such as reduction in overhead costs).

Thus we can confirm that the benefits of integrating different techniques constitute the possibility to do the following:

- Increase the company's revenue (1) + (2)
- Reduce product delivery term (1)
- Reduce costs (2)

The capacity of this economic effect is characterized by tripled Inventory Turn, which is related to aspects regarding use of the VSM tool. This is complemented by an effect due to reduced Production Space, which was made possible due to the 66% reduction in the volume of production space.

In conclusion, it can be stated that the revenue obtained from integration of various techniques may be many times greater than if only a single tool is used. Approaching the matter inductively, we can thus say that the advantage of a manufacturing system as a set of integrated techniques has also been demonstrated.

5. ACKNOWLEDGEMENTS

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