



prometna šola maribor
višja prometna šola

Vocational College of Traffic and Transport Maribor

2. Mednarodna konferenca / **2. International Conference**

INTERNATIONAL CONFERENCE OF LOGISTICS,
ECONOMICS AND
ENVIRONMENTAL ENGINEERING

ICLEEE 2010



Tema 2010: TRAJNOSTNI RAZVOJ LOGISTIKE

Highlight 2010: SUSTAINABLE DEVELOPMENT IN LOGISTICS

ZBORNİK / PROCEEDINGS

Izvedba posveta: 19. 11. 2010

Conference Day: 19. 11. 2010

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2ND INTERNATIONAL CONFERENCE

ICLEEE 10

(INTERNATIONAL CONFERENCE OF LOGISTIC, ECONOMICS AND ENVIRONMENTAL ENGINEERING)

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ISBN:

978-961-6672-08-5

CIP:

Maribor, november 2010

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ANALYSIS OF THE MAIN RAW MATERIAL MOVEMENT AND SUGGESTIONS FOR ITS IMPROVEMENTS IN MANUFACTURING COMPANIES DELFO POLAND S.A.

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Abstract

Article is devoted to the analysis of selected parts of the production process in the company Delfo Poland S.A. based on the classical methods of analysis and ideology of lean management assesses the existing system and proposed changes to improve the economic efficiency of production.

Keywords

main raw material movement, economic efficiency of production

1. INTRODUCTION

The maintenance of a manufacture continuity of a batch process is possible when the materials, parts, machinery, tools and operator teams will be sorted according to their similarity metrics. Today, when technology is supported with modern production techniques such as flow control MRP (Material Requirement Planning), JIT (Just In Time) or by a rapid rearming SMED (Single Minute Exchange of Die), its effects are very interesting. As a result of production reorganization on the group technology can be obtained the reducing of the operating time, the changeovers time and as resulting the lower costs with higher productivity of the production line.

Correctly made analysis of materials movement should include except a modelling stream of raw materials and products also the techniques of a suppliers choice and a basis of orders preparation. This paper presents the use of resource stream mapping in the company Delfo Poland on the example of the selected component of the production (right outer side plating) and after addition to the classic analysis of material flow analysis of benefits has been made.

2. THE IDEOLOGY OF LEAN MANAGEMENT (LM)

The precursor of this ideology is the Toyota Motor Corporation, which after Second World War brought it to manage of the production flows. The main idea is that every process in a resource streams produced only necessary things for the next step of production and at the time, when there is a corresponding requirement. This allows you to weld all stages of production in the united movement, which guarantees the

shortest possible duration of the demand for best quality and minimal cost. The main principle of this philosophy is the continuous elimination of waste, defined as any activity, investment and processes that add no value to the product or service from the perspective of the customer. Tool used to achieve these tasks is the VSM (Value Stream Mapping). This allows to present a current circulation of material in the factory and show a vision of the possible, the future movement, taking into account the proposed solutions. It also allows to indicate the stagnation points of the values flow (eg, the location of the surplus of resources).

Mapping technique enables us to understand the sense of this movement gives an appropriate tone for operational procedures and reveals the action is unfounded or unviable [2, 3].

3. THE SHORT CHARACTERISTIC OF THE COMPANY DELFO POLSKA S.A.

The production of the car is a very complicated process. This process requires the use of complicated technologies, machines, documents, certification, labor and investment capital. Therefore, companies that produce cars usually represent a network of separate, specialized production enterprises.

An example of this type of enterprise is the company DELFO Poland SA, which was founded in 1998. This company specializes in production of stamping, welded components, as well as powder painting and cataphoretic coating for the automotive industry. The main customer for the Polish market is Fiat Auto Poland SA. The sales for foreign markets are addressed, inter alia, for clients such as GM's Opel, Saab, PSA, VW, Volvo Cars. The company is currently implementing World-Class Manufacturing and therefore all actions are aimed at economical and efficient production management [5].

4. ANALYSIS OF THE PROCESS FLOW OF RAW MATERIAL

4.1. The original steel roll for car body covering

Value stream mapping process presented in the company was discussed on the selected part as example. It is the main raw material for the production of outer side panels - car body sheet metal, which need the greatest space for warehousing. Fig. 1 shows signs and symbols in accordance with the literature [4].

- g (sheet thickness) = 0,7 mm.

4.2. Flow diagram of the main raw material - Sankey

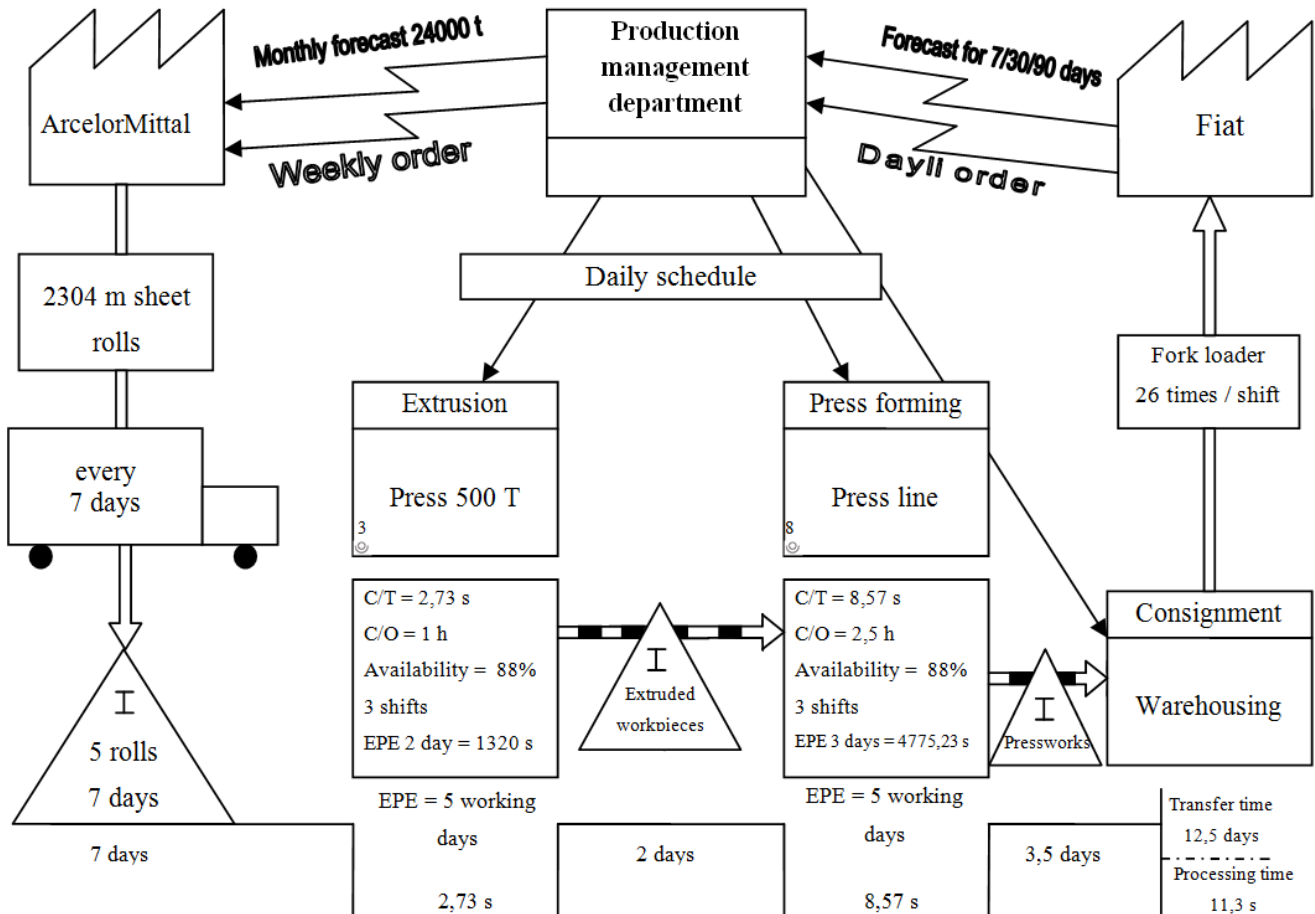


Figure 1: Value stream map for outer side panels

Car body sheet is transported in the form of steel rolls (fig. 2), which differ in size and weight. Weight range (Q) is within the limits of 10 - 27 t. Hole diameter (d) is constant, standardized and equal 500 mm. The outer diameter of the roll (D) is varied depending on the thickness (g) and the length (b) of coiled steel sheet. The diameter of the rolls (D) is in interval 1500-2500 mm. Sheet length after full unrolling its also not a constant and typically equal 1000-2000 m, depending on the type of metal and its thickness. Width of the sheet (l) is within the limits of 1400-1600 mm. The cost range of 20 tons of car body sheet is estimated at around 50 000 €.

The analysis roll (fig. 2) made from galvanized steel with dimensions:

- l (sheet width) = 1590 mm;
- Q (roll mass) = 20 t;
- d (hole diameter) = 500 mm;
- D (outer diameter of roll) = 2500 mm;

diagram

To sum up the various stages of production and related processes have been drawn up Sankey diagram (fig. 3) [1], where in a transparent manner the flow rate of raw material in production processes is shown using the arrow thickness proportional to the amount of material. Based on the chart, you can read that the 20 tons of raw material is obtained extruding 8,4 tonne, which represents 42% of initial weight, and also may indicate that a process generates the largest amount of useless waste of extruding.

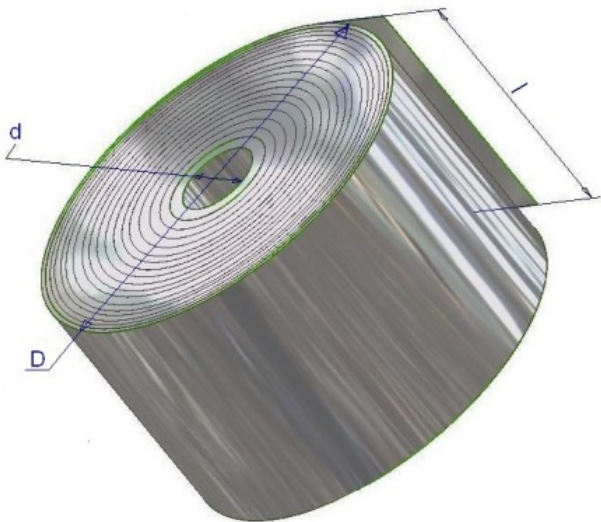


Figure 2: The roll of car body sheet metal with shown main dimensions

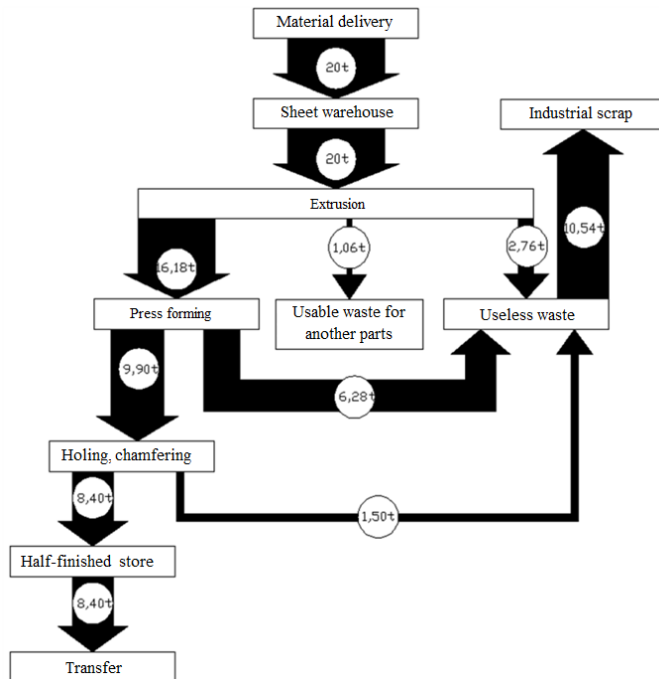


Figure 3: Sankey diagram

4.3. Analysis of the calculation results

The most important calculations is collected in tab. 1, which shows that the press forming process in comparison with the process of extrusion is twice more labor-intensive, it takes more than twice process time and generates almost twice more waste products.

Analysis of the major operations of the process flow indicates the places where can make upgrading to improve economic efficiency. In order to reduce the labour-output ratio of the workforce required for the implementation of press forming process can buy a robot that will bulk finished goods on pallets, thereby replacing the three packers per shift. Analysis of the cost of employment of the staff and

investment in new machine shows that the cost of the investment will pay off after about 13 months.

Tab. 1

Comparison of press forming and extrusion processes

	extrusion	press forming
Labour use / 1 shift [quantity of people]	4	8 (including 3 packers)
Operating time of an industrial line [min]	52,66	111,42
Quantity of production wastes [t]	3,82	7,78

5. ELIMINATION OF SURPLUS STOCKS

In Delfo Poland S.A. most striking seem to be a huge amount of inventory, separate processes making their production (each produces according to own schedule) and a long total time of transition in comparison with a short processing time. The area needed for press forming is comparable with the surface of a medium-sized house and is about five times larger than the area needed for extrusion and represents an area of medium-sized house.

To reduce excessive inventories the re-equipment time should be short and this makes it possible to increase the frequency of re-equipments. Long re-equipment time is specified by requirement to adapt extruding dies and so-called pneumatic grippers. This solves the problem grippers exchange and investment in improving of the dies quality. These activities helped to reduce the backlog of security of certain details by a few percent. May be also consider whether all of the details produced in a factory can be produced on alternate stamping lines. Then, in the case of a more serious loss on one line, after rearming, would be on another and the problem would be solved.

Shortening the production series for outer side panels in half, we can recover over 112 m². This could each year about 56 000 PLN savings (tab. 2). Taking into account the whole list of other manufactured parts we can expect that this surface can be several times greater.

Saving of large surfaces will result in:

- ✓ possibility to waive the hiring of additional warehouse space;
- ✓ possibility of setting up of the stores in the vicinity of the customer;
- ✓ implementation of new manufactures on the recovered surface.

Tab. 2

Analysis of profit after reducing the re-equipments time

	series	surface for extruded parts	surface for pressed parts	result
before	4000	28,53 m ²	195 m ²	saving 111,76 m ²
after	2000	14,26 m ²	97,5 m ²	

A good idea is also a differentiation on basis of the amount of occupied surfaces or overall dimensions. After creating a table on this basis is obtained a simple diagram - how often to re-equip the presses for the purpose of the actions were economical and did not generate surplus stocks (Table 3). The exact criteria establishing (what are the large dimensions or what are the small dimensions) depends on the individual arrangements.

Tab. 3

The scheme of creation of the economic manufacture plan

		overall dimensions		
		large	medium	small
changes	fast re-equipment, short series	body sheets	doors	sills
	fast-activity	floor	bonnets	plugs
	medium	cabriolet tops	reinforcements	pads
	low-activity			

rarely re-equipment, long series

6. PROPOSALS FOR IMPROVEMENTS

The classic analysis of material flow and value stream mapping revealed that some improvements can be made that will significantly affect the economics, organization and safety of the enterprise. The most important are:

- ✓ to avoid the possibility of non-compliance with the programme of delivery of car body sheet metal by a concrete supplier as a result of prolonged damage or natural disaster, there is need to have a list at least of two suppliers of ordered steel, that is not in neighboring locations. Built in this way a contingency plan will provide security for the continuity of production in the analyzed enterprise and the client production. The experience of the Fiat Auto Poland S.A. from May 2010 indicated that the lack of alternative suppliers of specialized parts may stop production for a few days;
- ✓ the quality control should be made mandatory for all rolls of supplied car body sheet metal. Such action will eliminate the possibility of assortment error at receiving of materials for production, shorten the waiting time for the implementation of the reclamations, and prevent the

situation of stoppage of production and incurring costs in this reason;

- ✓ the alternative for the use of forklift trucks can be Ro-Ro sets of trolleys, so that would reduce the number of courses, and thus reduce of vehicles on the roads of enterprise. The forklifts use only for loading and unloading of platforms;
- ✓ because of the often-changing assortment of storage is not possible to create sites dedicated to every part. There is an alternative exit. To facilitate the process of the search of needed parts in the regular warehouses, such as stores of extruded workpieces, and eliminate indicating of rows with chalk using, it is needed a constant description of the rows with using the numbers from 1 to X on the plastic panels, placed high above the details, so that a forklift driver can clearly see what is the row number where he is located now. It is needed to make the scheme of the warehouse on a large panel where to write constant numbers of rows.

7. CONCLUSION

On the basis of analysis of the flow of the main raw material, examination of proposals concerning this flow and management of the whole company it was created a list of actions to be implemented in order to obtain: the better financial results of company and the better organization of production units.

The most important are:

- ✓ at the moment the best way to savings for the enterprise is shorter re-equipments for production of car body sheets at least for half time;
- ✓ economical solution is the purchase of the robot for packing of car body sheets on special pallets - an investment will return after **13 months**. Cons idea is the need to invest a significant financial resources and the dismissal of people;
- ✓ investment for conveyors and Ro-Ro sets of trolleys will significantly improve comfort and safety of workers on the enterprise roads since the factory will use less fork-lift trucks;
- ✓ putting into operation of accurate supply monitoring and prepare a list of alternative suppliers will provide prophylaxis for emergency situations;
- ✓ change in the organization of finished goods warehouse for "panel" management will well impact on the organization of labor and warehouse forklift operators.

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