MANUFACTURING PROCESS ANALYSIS IN THE MECHANICAL ENGINEERING COMPANY USING TECNOMATIX

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Abstract

Effective operation of business logistics processes is the main aim in the majority of companies acting in various industries where mechanical engineering is no exception. For the correct operation of the production process is necessary to carry out quality analysis for its implementation can be used a wide range of methods and tools. Recently is mostly used a computer simulation method. The article describes the application of the software package Plant Simulation to analyse the production process of real engineering company.

Keyword: Simulation, logistic process, analysis

1. INTRODUCTION

Computer simulation as a scientific tool is being used more frequently when solving problems within manufacturing logistics. It is appropriate especially for situations that can't be solved by classic steps. Simulation as a problem solution tool has several advantages such as time, space and financial saving. The use of computer simulation is suitable in different levels of designing and operation of logistic processes.

Computer simulation method is no longer domain of just a small group of operating workers on higher operating levels. On the contrary, it's possibilities become available to wider group of employees within lower hierarchical levels in logistics department. It gradually penetrates and finds its application in ordinary everyday activities. It supports decision-making and provides exact and strong arguments for workers, who make decisions. There is a possibility to model and simulate particular logistic activities such as warehousing, manipulation or transport thanks to simulation tool effectively.

Application of the above mentioned method could significantly help to plan the particular processes in the course of these activities. It enables to analyse volume possibilities of warehouses, use of storage space, concrete manipulative devices, workload of the workers. It is possible to find narrow spaces within the warehouse functioning with help of simulation experiments. It provides other possibilities in case that company's information system and simulation software are interconnected.

2. COMPUTER SIMULATION WITHIN THE MANUFACTURING LOGISTICS

Manufacturing process (Scheme 1) is sum of the manipulation, technological, operating and controlling activities. Their purpose is to change size, quality, composition and material joining from the technical-economic condition of the manufactured products.

The computer simulation has its non-interchangeable and important place within the manufacturing process. It is applicable to all activities. It enables to analyse volume possibilities of warehouses, use of storage space, concrete manipulative devices, workload of the workers. It is possible to find narrow spaces within the warehouse functioning with help of simulation experiments. It provides other possibilities in case that company's information system and simulation software are interconnected. So the computer simulation method becomes highly efficient tool to increase efficiency of wide scale of activities that are linked to the area of manufacturing logistics and manufacturing systems.

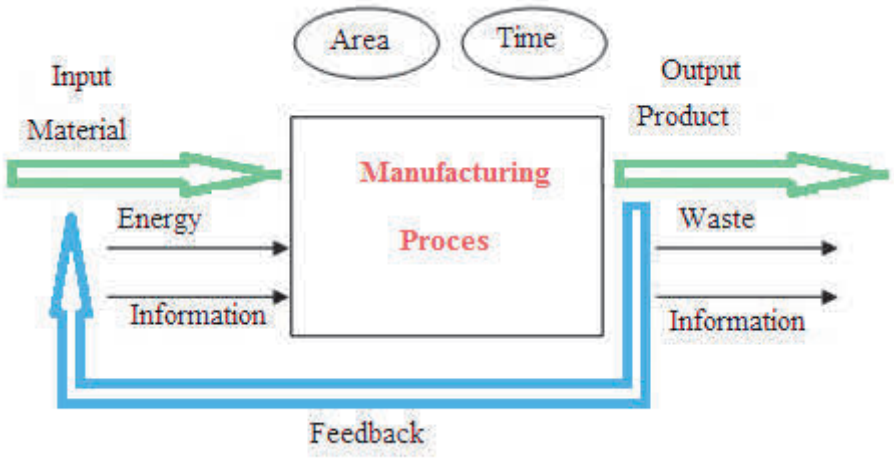

Fig. 1 Manufacturing process 0

As the manufacturing process (Scheme 1) is practiced through manufacturing systems (Scheme 2), which are formed by technological, time, space, object and organisation grouping of material sources and work forces aimed to manufacture particular product, so the computer simulation is applicable in this area. It is conferred to area increasing automation, robotisation, cooperation or material flows designing.

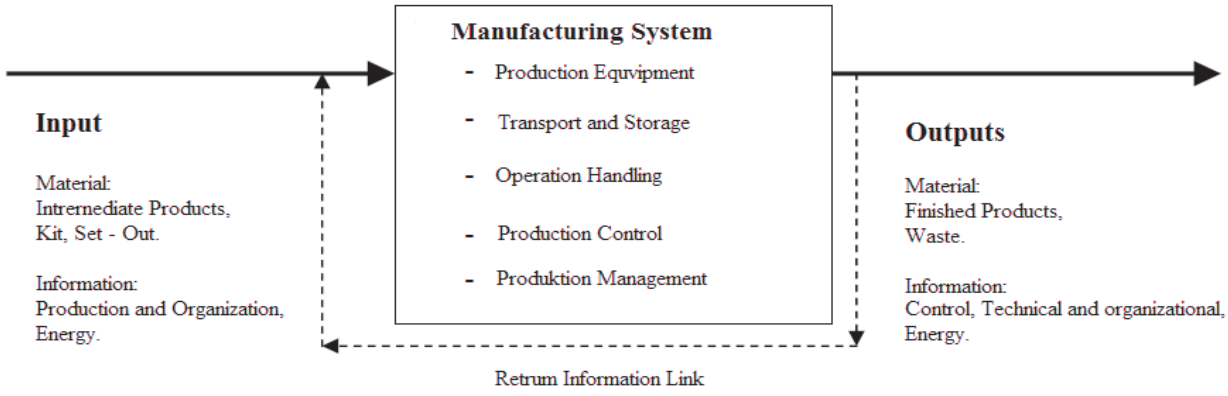

Fig. 2 Manufacturing system 0

3. MATERIAL FLOWS DESIGNING IN MANUFACTURING LOGISTICS

Material flows are joining elements in manufacturing process. From the beginning, from the mining of the raw materials through processing of them, up to their circulation and following consumption. Material flows are performed by handling and transport processes in practice. The speed, fluency and economy of the whole economic state's life depend on efficiency of transport and handling chains [2].

Contents of manipulation with the given material are non-manufacturing operations, which are linked with warehousing, moving and regulation of the materials, semi-products, semi-finished commodities in the circulation and in the manufacture. The character of the transport is to perform movement of transport vehicles on their routes including the transport, thanks to which the goods or transfer of personnel by transport vehicles comes to practice. Circulation and manufacturing processes couldn't work without handling activities with material, because they are their inseparable component [2].

Important factor for whole material handling system must always be optimal manufacturing technology. Just as well, decision-making factor is that manipulation with material must be subordinate to volume, time and space demands of the basic process [2].

4. APPROACH RAMP MANUFACTURING PROCESS SIMULATION

Based on the listed facts, the computer simulation was applied by process assessment of the approach ramp manufacture within manufacturing process analysis in real society (Scheme 3). Its attempt was such a simulation model that would describe the logistic activities within the manufacturing process the most. The created model can, apart from the analysis needs, serve for the future improvement of the manufacturing process, for collection of information about current state and in case of need for the change of the logistic distribution of the whole production. It is possible to solve problems with greater time, financial and material saving thanks to this model.

The programme Plant Simulation was chosen for the simulation model creation and particular experiments and analysis realisation. Within the model were simulated following workplaces: Cutting room, Pressing room, Mounting-welding room, Painting room and Checkout. Apart from the workplaces, the separate means of transport had to be simulated.

Mid-operational transport is practiced trough forklifts, pallet trucks and hanging conveyor. Wooden and metal palettes were used as manipulation units. Values of particular parameters in simulation models were used according to company's technological steps. The model concept was created so, that the result consists of separate smaller sub-models. Individual workplace models were included in the model. They were included based on the real company's ground plan.

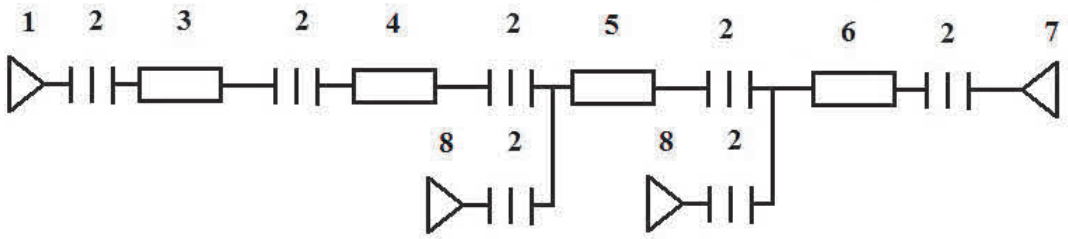

Fig. 3 Block scheme of the approach ramp manufacturing 2 t

1. Input 3 mm a 5 mm sheet metal
2. Pre-operational storehouse
3. Cutting room
4. Pressing room
5. Welding room
6. Painting room
7. Checkout and expedition
8. Mid-operational supplies input

Block scheme of the sub-model (visualised on the **Fig. 4**) discretizes the workplace Pressing room. The workplace serves to produce 'L' profiles for partition, head and longerons, which are formed from 3 mm thick metal sheets of the support and head partition is made from 5 mm in shape of stripes. Semi-products are brought to the workplace in metal palettes with pallet truck. After the manipulation works are finished, semi-products are warehoused into metal palettes and transferred to another workplace by pallet truck.

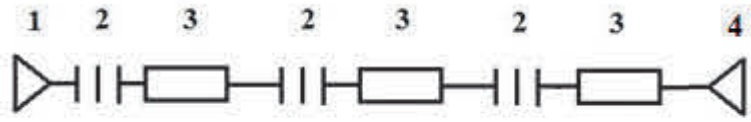

Fig. 4 Block scheme of the workplace Painting room

1. Semi-product input from the previous workplace
2. Mid-operational warehouse
3. Manipulation operation
4. Output of the semi-products

Transformation of the block scheme (**Fig. 4**) with help of tools of the programme Tecnomatix Plant Simulation is presented on the **Fig. 5**. Here is visualised part of the blocks, which is important for simulation of the workplace Pressing room. Between individual blocks representing manipulation activities are found mid-operational warehouse places. After the operation completion follows controlling and then transport to the next workplace.

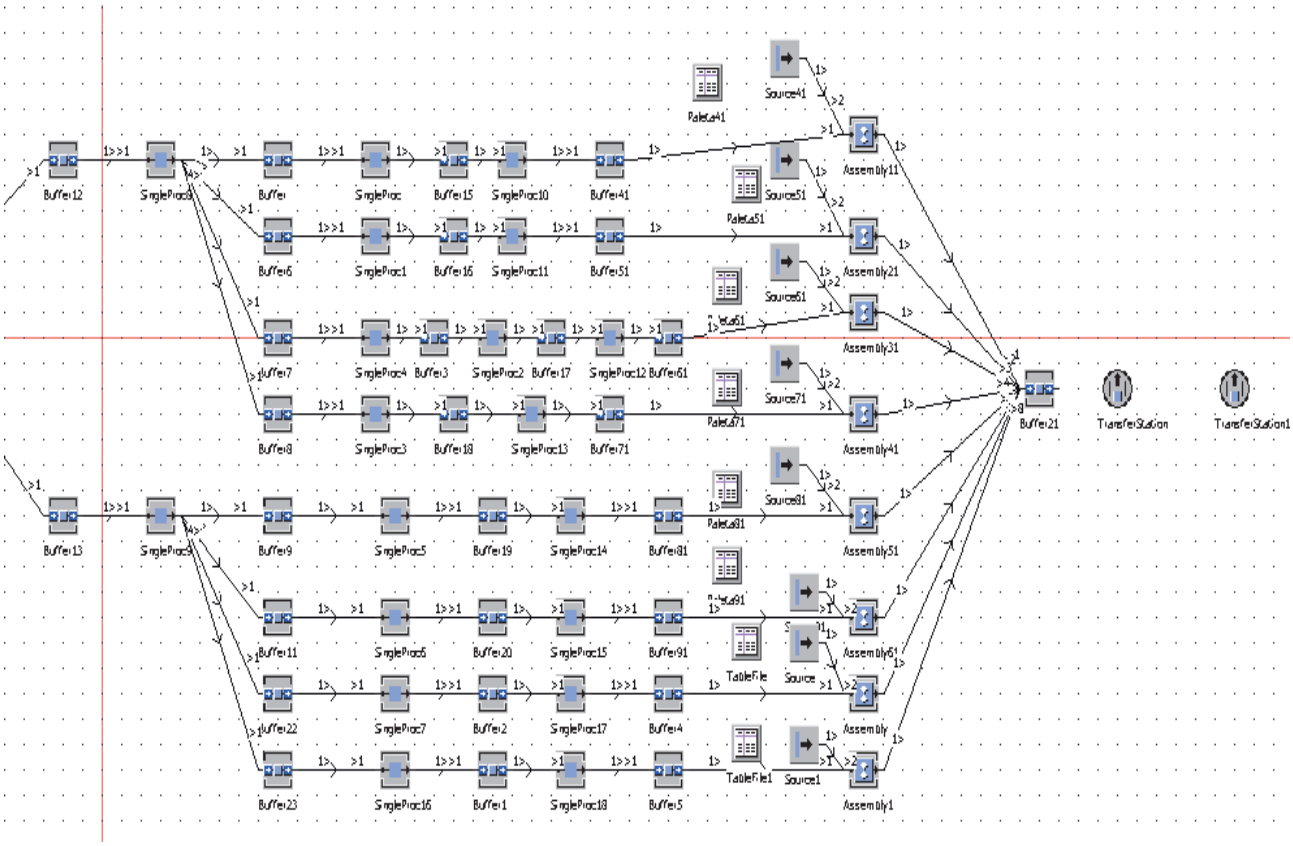

Fig. 5 Pressing room

After the creation of sub-models followed their grouping into hierarchical structure using the simulation programme tools. Hierarchical structure represented separate workplaces and at the end was implemented into one big block Frame. The block Frame includes company's ground plan. Individual workplaces in simulation are interconnected by in-house transport. The final simulation is depicted in the **Fig. 6**.

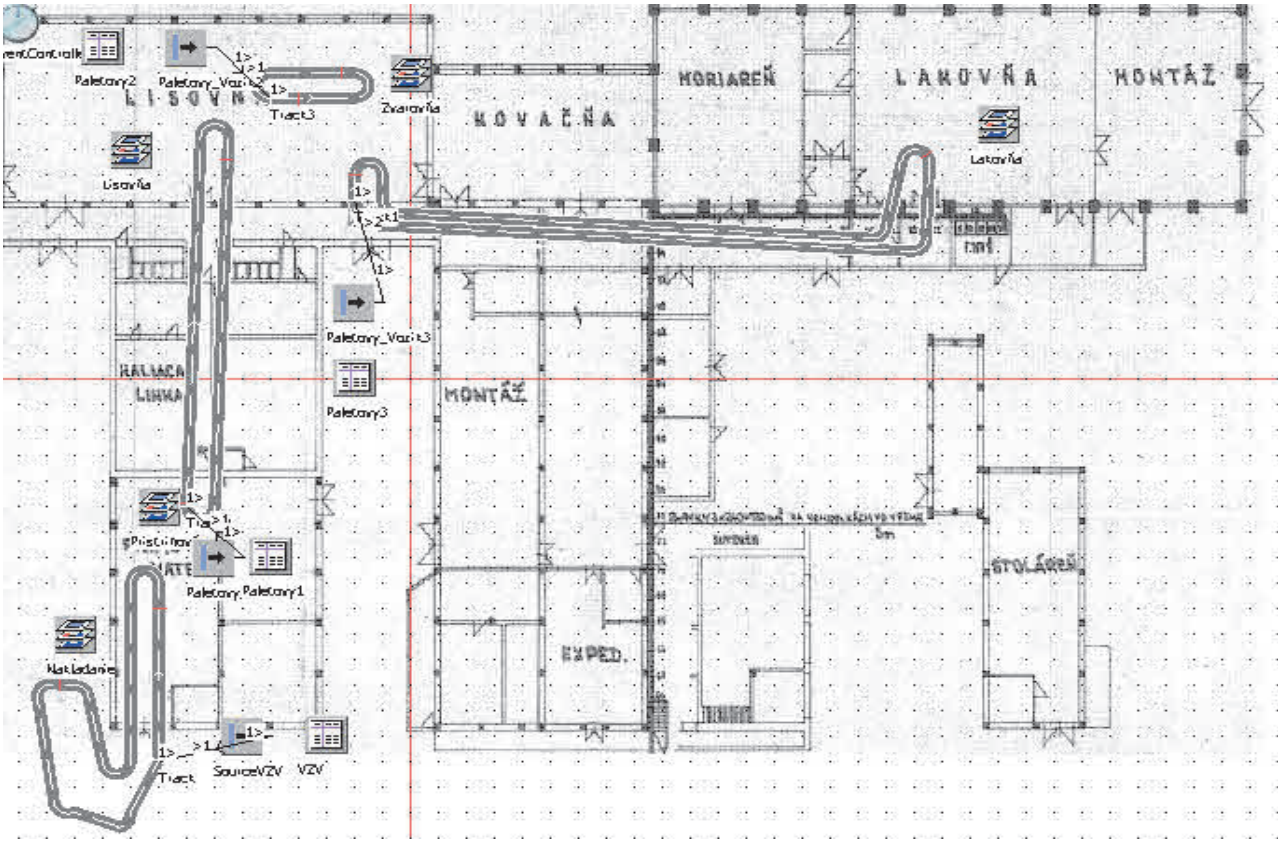

Fig. 6 The complete model

5. ASSESSMENT OF THE SIMULATION RESULTS

Several simulation experiments took a place with help of this simulation process. The aim was to gain information about analysed manufacturing process. For example, **Fig. 7** projects machines load on the workplace Pressing room that serves to process the products from the 3 mm metal plate. It is an activity by which comes to profile bending of the cut metal stripe. The graph displays percentual machine load by bending of particular parts. The most loaded is the machine, which bends partitions because partitions outnumber other parts in approach ramps 2 t. At the same level are loaded bends of the lower try square and bearing square because their proportional representation is the same. The least loaded machine is the one that bends the head square because its number is the smallest.

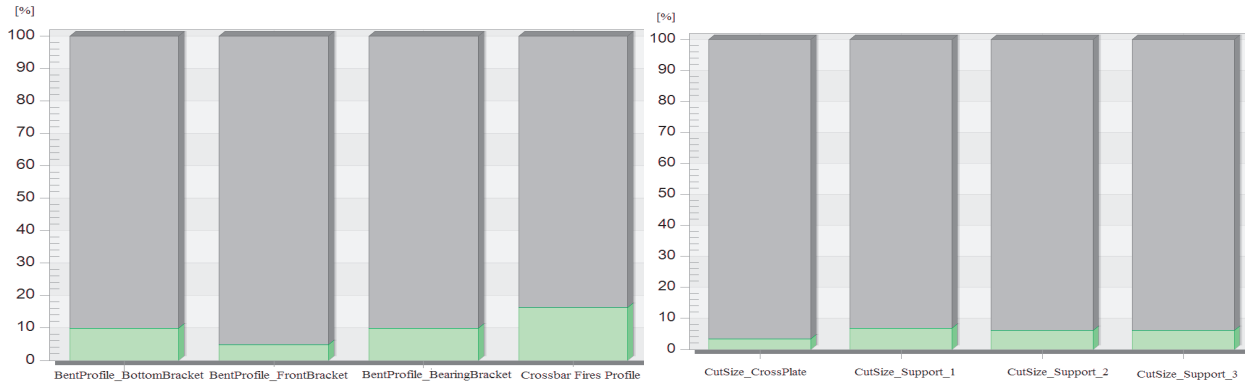

Fig. 7 Statistical load of individual devices by bending of 3 mm and 5 mm products

Machines workload of the machines in the workplace Pressing room that serve to process products from the 5 mm sheet metal is displayed in **Fig. 5**. In the graph is shown the percentual machine load by the bending of individual parts of the activity in which comes to profiles bending of the cut metal stripe. The least loaded is the machine, which cuts size for crosswise sheet metal because the crosswise metal sheet is in quantity 1 piece. The rest of the machines are loaded percentually alike because support 1,2 and 3 are manufactured in the same quantity.

Presentation of the further information is projected in the following column graphs (**Fig. 8**). It is referred to given workplace Welding room, where 4 welding boxes can be found. These boxes serve for assembly of the ramps from the semi-products. In the graph can be seen that workplaces are overloaded. This way the narrow place occurs in manufacturing process as the result of the accumulation of the material in front of the workplace. It happens because 12:47.88 minutes are needed to produce one unit. In front of the workplace have to be mid-operational supplies, otherwise comes to great downtime. The workplace itself would not start its activity from the beginning of the working shift but from the half of it, because of the supply of the material.

In the graph in the **Fig. 8** is represented workplace Painting room and Checkout. Here comes to surface fitting - painting, labelling and packing. From the graph is obvious, that the least percentually loaded is the surface fitting operation as cause of volume of the painting line. After burning in furnace follows labelling, which represents percentually the most loaded operation because it is demanded to put one label on each ramp. Average load is in operation ‘packing‘ where it comes to ramps embedding on the palettes. 80 ramps on each, covering by paper, banding by a metal band.

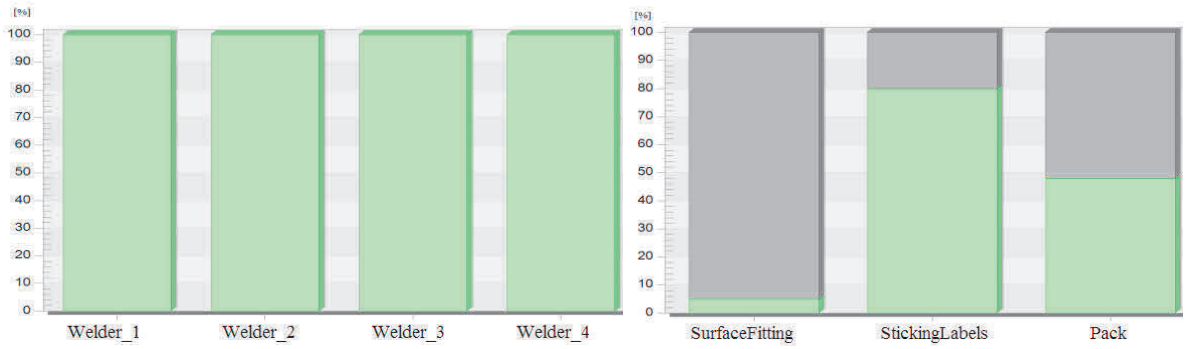

Fig. 8 Statistic load in workplaces Welding room, Painting room, Checkout

6. CONCLUSION

Aim of the analysis of the existing manufacture process provided by company T.E.I.D.E. s.r.o. (Ltd.) was to gain information in order to improve manufacturing process and logistic technological process order. Thanks to the computer simulation method application several simulation experiments were carried out. Acquired information were further processed and assessed. Meanwhile, several narrow places were identified within manufacturing process.

Based on the information, after their processing, some possibilities of manufacturing process improvement were suggested. Concretely:

a) Implementation of afternoon work shift for Cutting and Pressing room. If it is not possible, then raise working time to 12 hours. As the result of material delivery to mid-operational supplies.
b) Increase number of the welding boxes and welders to decrease narrow places. One welding box can produce 50 ramps per working shift.
c) Capacity increase of the painting line or construction of another line. Both would work collaterally.
d) Decrease transport routes to minimum because the transport causes time delay. Optimal would be to have as many workplaces in one place as possible.

At the same time there will be created a simulation model used to satisfy the needs of running and planning of the manufacturing process. The main objective of this will be creation of operative manufacture plans.

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