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Potential of Using Burning Equipment in the Engineering Company and Metallurgy

Vladimíra Schindlerová, Michal Bučko, Ivana Šajdlerová
Faculty of Mechanical Engineering, VSB – Technical University of Ostrava, 17. listopadu 2172/15, Ostrava-Poruba, 708 00. Czech Republic. E-mail: vladimira.schindlerova@vsb.cz, michal.bucko@vsb.cz, ivana.sajdlerova@vsb.cz

Currently, companies have been trying to make the use of their technology, manufacturing capabilities and experienced workforce to respond flexibly to market demands. Collecting and processing of all relevant data in the company is one of the key points to which increased attention should be paid so as to maximize the efficient use of own resources and consequently ensure a continuous reduction of production costs. The article deals with the use of burning machines in engineering company. The product range involves the production of burnouts from standard and special materials as well as welded steel parts of structures. The company has long struggled to optimize the material and information flow between particular production operations. This paper was focused on information flow logistics, which proved to be the biggest weakness of the central material preparation department during the bottleneck analysis. The scientific contribution of the resolved issue can be seen mainly in the possibility of interconnecting process analysis and optimization of material and information flows.

Keywords: Optimization, Information system, Burning machine, Production process, Process analysis

1 Introduction

Efforts to optimize material flow have become a very important issue for manufacturing companies which want to succeed in today's strong competitive environment. Companies have constantly pursued to increase the efficiency of their production process so as to produce as many products as possible at the lowest price, but not at the expense of quality. This goal can be achieved wirh effectively managing material flows from material entry into the company to final distribution to the customer. In order for an enterprise to be able to analyze material flows, it is essential to know the methods and procedures which are important for carrying out the analysis and for selecting the needs of the enterprise. [1, 2] The logistics chain represents the tangible and information connection of customers with manufacturers and is based on the demand of the end consumer, i.e. it is a connection of suitable main and secondary company activities. [3, 4]

Information systems which are an inseparable part of IT systems in company are necessary for their management. Different types of systems and databases are often used for each process and communication between them is very difficult. Therefore, companies search for a unified system which would connect not only external but also internal sources of information and enable comprehensive management of all company processes. [5, 6]

2 Tools suitable for improving company processes

Company processes (main, managing, resource management, supportive) integrated into the enterprise system are essential to organizations. The purpose of the process approach, i.e. application of the process system within the company, their identification, interaction and their management is to effectively manage the processes taking place in the organization. [7, 8, 9] Process analysis is an analysis of the workflow within an organization which helps to understand, improve and manage individual processes. This analysis does not help to identify, describe, visualize and relate individual processes to each other. The basic methods and techniques used in process analysis are shown in the figure (Fig. 1).

The top management of each company should choose such strategy and tactics that will be applied in its operation. If an organization wants to be constantly successful in its branch, it must not only keep up with its competitors, but if possible be ahead of them. Therefore, it is important to know your weaknesses and possible external threats, and to know your competitors, but also your partners.

Currently, there are a number of principles such as Six Sigma, TOC (Theory of Constraints), Lean manufacturing etc. By integrating them within the organization (see Tab. 1), a synergic effect can be achieved which will as a result lead to maximum satisfaction of the customer, employees and other stakeholders. [10]

The mentioned principles can be successfully applied in all branches of production and services.

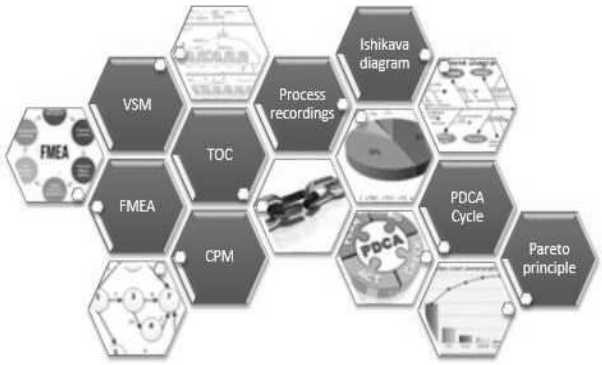

Fig. 1 *Methods and techniques of process analysis*

Tab. 1 *Synergic effect of integration of various principles into the company system [10]*

		Synergic effect
Principle	Purpose	Result
Lean	Minimisation of wastage	More efficient processes
Six Sigma	Minimisation of variability of processes	Competent processes
TOC	Maximisation of flow	High performance processes

The choice of methodology used depends mainly on the type of production, business area, supply chain, continuity and company management. Analyzing the current state and streamlining individual processes, whether in terms of human resources utilization, streamlining of logistics, technology, warehouse space, cost reduction or introduction of a new product or service, should be the goal of optimizing company processes. [11, 12]

3 Case study - utilization of production capacities in burning machines

The case study was focused on the issue of utilization of production capacities of burning machines in CPM (central material preparation) department in an engineering company. Within the analysis of the current situation the company environment was described and the CPM department mapped. Furthermore, the analysis concentrates on machinery of the production section using burning machines and information systems ensuring operation of the department. [13]

3.1 Input analysis

Based on the information and knowledge gained during the observation in the given company, Ishikawa diagram of possible causes and consequences (Fig. 2) was prepared, the aim of which is to find the most probable cause of the problem resolved. [13]

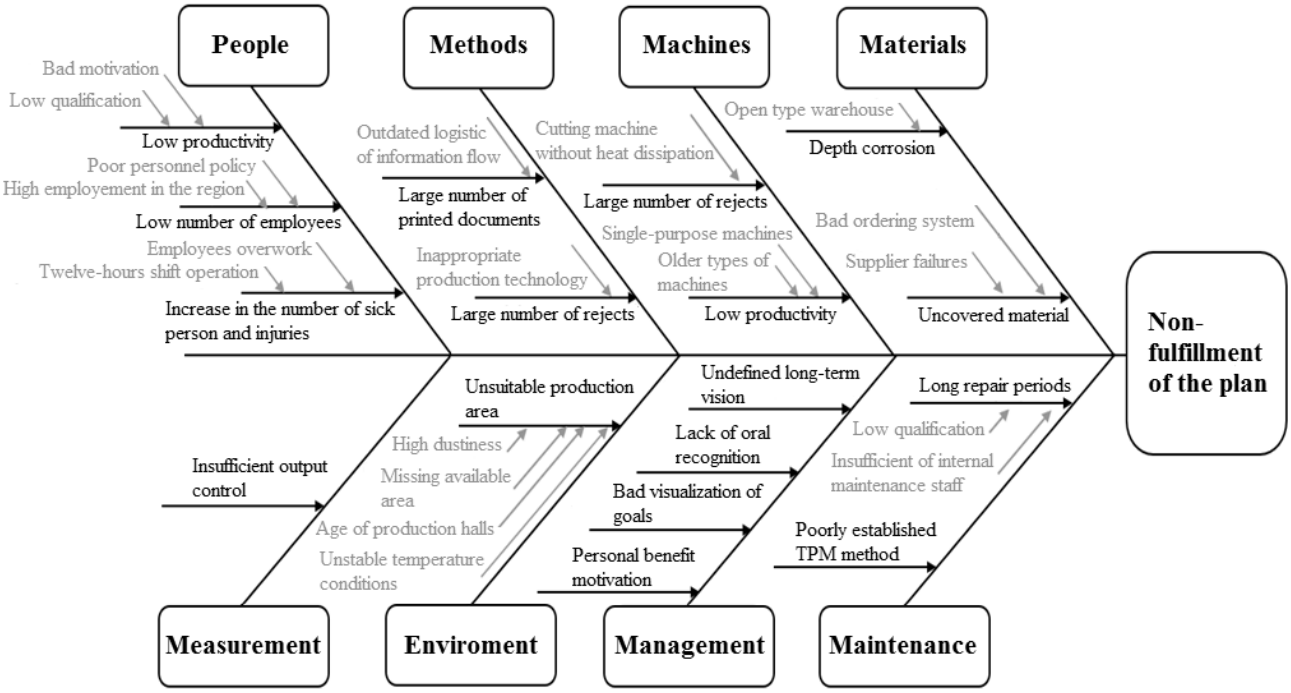

Fig. 2 *Ishikawa diagram*

The causes with the largest proportion of insufficient fulfillment of the production plan and utilization of production capacities in the CPM department are color-coded in the diagram. They were determined based on evaluation of a number of observations and the outcome of the carried out brainstorming.

Further analyzes aimed at controlling the utilization of production capacities were carried out and

several process recordings were taken. This information was needed to evaluate the situation and identify bottlenecks and major sources of problems. Among the main problems there are:

- Inadequate production hall space - lack of storage space.
- Large quantities of residues - these are stored improperly in the company and their reuse in the production process leads to an increase in waste times when searching the material needed (Fig.3).

Fig. 3 *large amounts of residues and their storage [13]*

- Quality of the working environment - the production machines are sensitive to the quality of the environment and during the observation faults of the machines were found out, which were caused mainly as a result of dusty environment. They generated a significant part of the loss times during the observation.
- High proportion of manipulation times in total burning time – every manipulation is an activity that does not participate directly in value creation. This problem was described in the MGM Omnimat 3100 operator's process recording. The figure (Fig. 4) shows a significant proportion of the preparation and completion times of TB1 in the total work shift time, which was 38%. The adjacent graph shows the proportion of activities that are involved in TB1 time. The Omni 3100 is mainly used for burning from sheet metal residues and is therefore intended for frequent operations. [13]

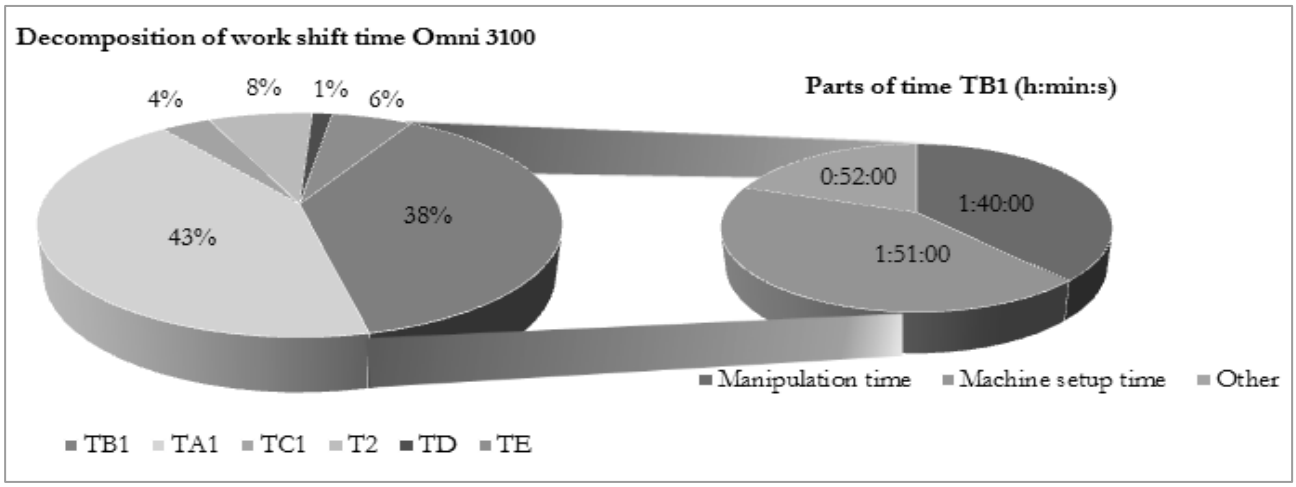

Fig. 4 *Time proportions for Omni machine 3100 [13]*

- Unused production capacities – capacity determination was based on the years 2017 and 2018, which were fully available. Information was obtained from the QAD system on discontinued production orders. (Fig. 5) The graph shows that in the period of 2017 and 2018 the number of processed orders in the CPM department increased. The year-on-year increase was approximately + 18%. The total number of orders in 2017 was 132,559 and in 2018 it was 156,472. [13]

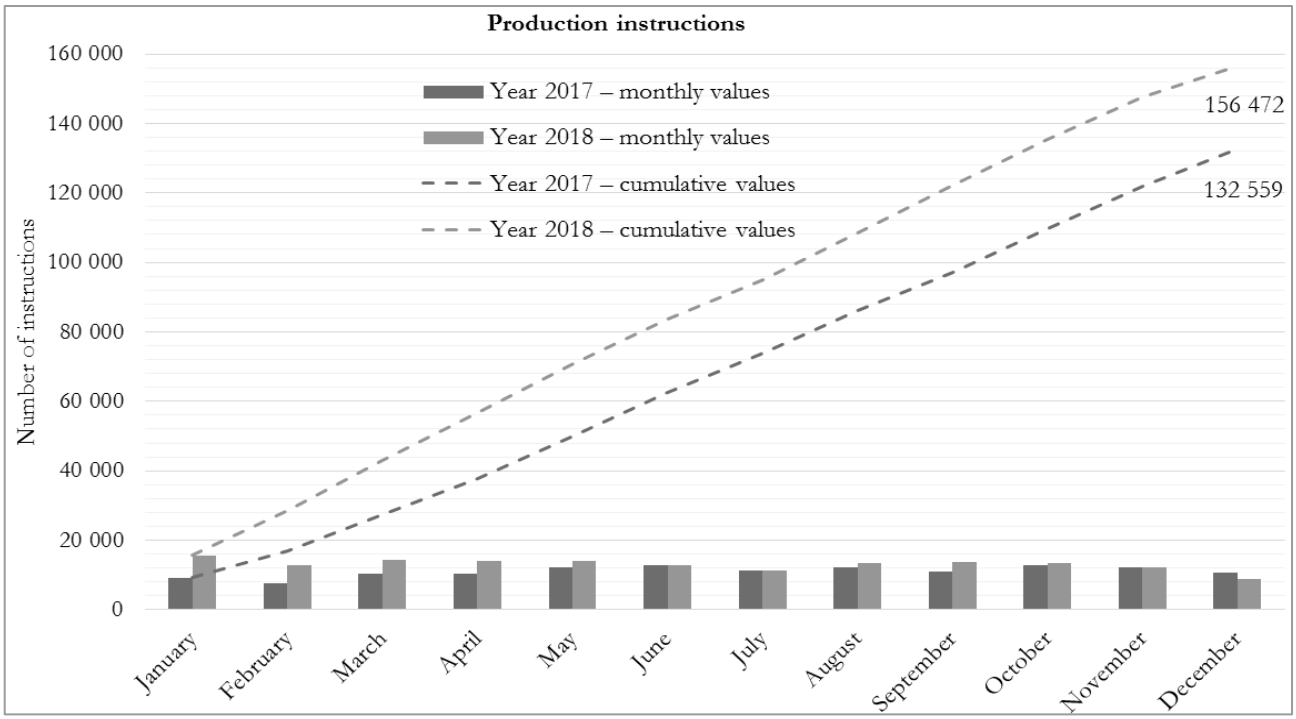

Fig. 5 *Processed production orders [13]*

- In the next step, time fund calculations were carried out. Based on the data available, the calculation and subsequently the graph compilation were performed (Fig. 6), showing the effective time funds for 2017 and 2018. The calculated effective time fund of individual devices (orange bars) does not correspond to their real used time (blue bars). The results of the analysis showed that the workers do not state real burning times to specific equipment, but to other random machines. As a result, some machines (blue) seem to have insufficient capacity, which does not correspond with reality. It has been found out that there is no link between the work done and the assignment of this work to a specific burning device. [13]

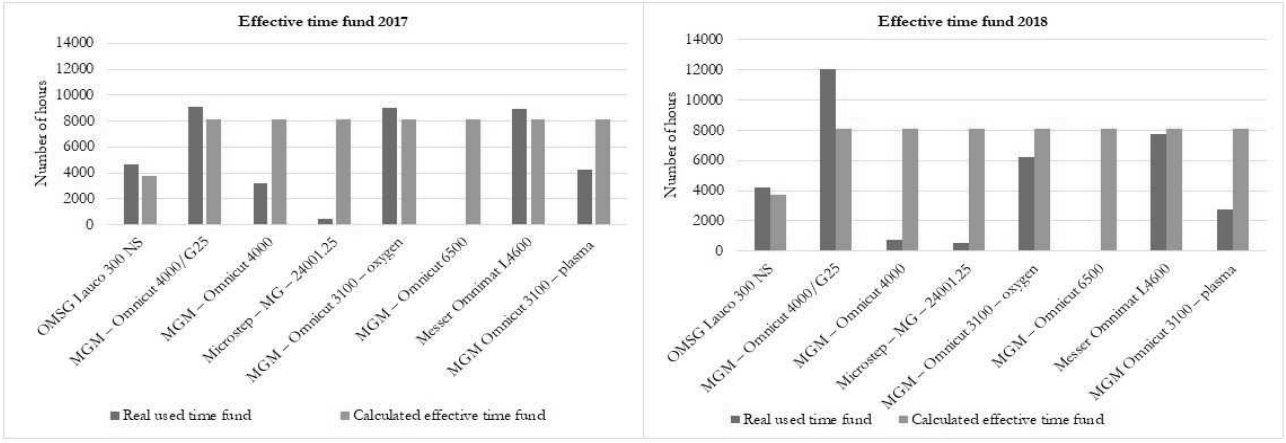

Fig. 6 *Comparison of time funds in 2017, 2018 [13]*

- Low information flow efficiency – in the CPM department, information flows (plans of burning and accompanying documentation) are in paper form.. This printed documentation includes sheets containing important information for the operator of the burning machine (plan of burning, list of items, lengths of operation times), accompanying documen-

tation (so-called waybills) containing information on burnouts (lengths of time, following operations) and last but not least drawings of individual items. Tear-off time cards are another part of this documentation. At the end of a particular operation, the card is torn off. Then, they are collected from all workplaces by an authorized employee. The human factor plays an essential role in this system as it depends on the employee who not only collects the given time cards from the workplaces, but also has to manually and flawlessly enter the information about the completed operation (date of operation, employee number, etc.) into the system. At this point, a certain percentage of error occurs. The information is not entered online into the system, so the work done may be delayed and the actual length of operations may be distorted. [13]

- Material handling – lack of manipulators, handling staff represents a significant proportion to the continuity of the department. The operator of the machine (burner) must carry out all material handling himself, which causes time delays and does not add value to the resulting product.

3.2 Study results, recommendations and solution suggestions

Based on the initial analysis, the bottlenecks of the CPM department have been identified and described, which are of fundamental importance for the future development of the department, or the whole company. All the bottlenecks described share a common essential problem, which is the malfunctioning information flow. Proper communication between individual links of the production chain is a key factor that affects the ability of a department or company to respond to various changes flexibly. The proposed solution involves the introduction of:

- MES (Manufacturing Enterprise Solution) information system (Fig. 6),
- measuring the overall efficiency of equipment (OEE),
- mobile and stationary production terminals,
- a new way of marking,
- a working regime adapted to the required capacities

Fig. 6 *Automation of data collection and evaluation [11]*

The Manufacturing Enterprise Solution (MES) is an operational planning and information system used to immediate evaluation of the production proces data. It enables to control and optimize the production process and processes data in real time this way, which allows to respond more flexibly to non-standard situations in the production process. It should serve for removal of data errors caused by incorrect entry into the system. The MES system in connection with OEE sensors and production terminals ensure correct data handling. It helps to automate a large part of tasks which are involved in entering and then analyzing all process-related data, up to in milliseconds. Furthermore, the MES system simplifies administration and thus reduces the number of managers needed. Based on appropriate assessment methods, the company was within the study recommended to purchase individual production terminals not only for burning machines, but also for blasting machines and the section of burnouts grinding. [13]

4 Conclusion

Nowadays, the importance of collecting and processing all data in a company is one of the key factors which needs to be paid attention in an effort to maximize the efficient use of own resources and thereby ensure a continuous reduction in production costs. Modern companies aim for the closest possible interconnection of all links in the logistics chain so that every information could be transformed into profit.

This paper was focused on information flow logistics, which proved to be the biggest weakness of the CPM department in the bottleneck analysis. Problems such as the high proportion of handling times and unused production capacities have a common place of origin which is the information flow in the department. There is no one all-purpose solution to this unsatisfactory information flow. It was necessary to examine this flow between management and production of the CPM department from all possible angles. As a result, the solution design itself is comprised of more designs which can only be implemented as a whole and then expect the benefits for the company to emerge.

The results of the study have led to the identifica-

tion and elimination of selected root causes and recommendations of suitable solutions which can contribute to the development of the company. The scientific contribution of the resolved issue can be seen mainly in the possibility of interconnecting process analysis and optimization of material and information flows. Optimization of manufacturing systems is a problem faced by many manufacturing companies, which leads to a wider use of this paper in practice.

The complete implementation of these solutions also for the remaining departments in the company is a necessary step for the company to enter the Industry 4.0 area and thus ensure long-term competitiveness in the field of heavy engineering.

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