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IMPROVEMENT OF MATERIAL FLOW IN SYSTEM FOR MANUFACTURING OF COOLING AND COOKING DEVICES

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Abstract.*The paper describes transformation of material flow in a system for manufacturing of cooling and cooking devices. Group methodology is used for moulding an optimal production system layout. Based on production flow analysis and the incidence matrix, groups of products and work units are formed.*
Keywords: *group approach, cellular manufacturing,production flow analysis (PFA).*

1. INTRODUCTION

Production of cooling and cooking devices is conducted in a system which consists of thirty six work stations. Complexity of a material flows, in the analysed case, is vast – more than one hundred and eighteen, with lots of backflows.Efficiencyof such a system is low and its structure has to change. Group approach is introduced through method II of PFA methodology[2]. Production flow analysis is conducted and work units are designed.

This paper is organized in four sections. Second section describes methodology and its benefits. Third section is divided into two parts, first analyses condition of a production process, second shows solution to analysed problems. Fourth section presents conclusion.

2.LITERATURE PREVIEW

Group technology is a manufacturing technique in which target grouped machines (producing parts or products with similar characteristics) are organized into work units (cells) [11][2]. Each of these work units is specified for a family or group of parts.

There are two ways of introducing group approach, depending on the analysis of system/environment relationship, analysis of the production programme and product's characteristics analysis [8].Analysis of a production program will result with a coding system that has the purpose of processing part attributes and to store their classification codes for module and group design[5]. Second method for introducing group approach is by conducting production flow analysis (PFA) [3].

Introducing group technology changes the way a company operates [4]. In production systems based on group approach, group of parts follow the same procedures of production: same machines, order of operation, require relatively proportional time requirements on operations and share setup time of the machines[7][10].The objective of group technology is to form small organizational units (cells or working units) which complete all the set of products or components which they make, through one or a few major processing stages and are equipped with all the machines and other processing equipment they need to do so [3].

Production flow analysis (PFA) is used as a tool for planning a revitalization of a system that is process based to a product organization and to plan its layout from process to product layout [2][10]. The partsthat are classified and grouped into families produce a much more tractable database [9]. In production systems based on group approach time of production cycle is shorter and machine setup times for each individual part/product are avoided [7].In general, GT simplifies and standardizes. The approach to simplify, standardize, and internalizethrough repetition produces efficiency [1][6].

3. CASE STUDY

Analysis of material flow in a system for cooling and cooking devices manufacturing

In this case, twelve types of devices are observed. Most of them are cooling devices, but twenty percent of the production programis cooking devices. Each type of device is produced in between fifty and a hundred varieties. In the production plant it has been noticed one hundred and eighteen different material flows between thirty-six workplaces and three warehouses (Figure 1).

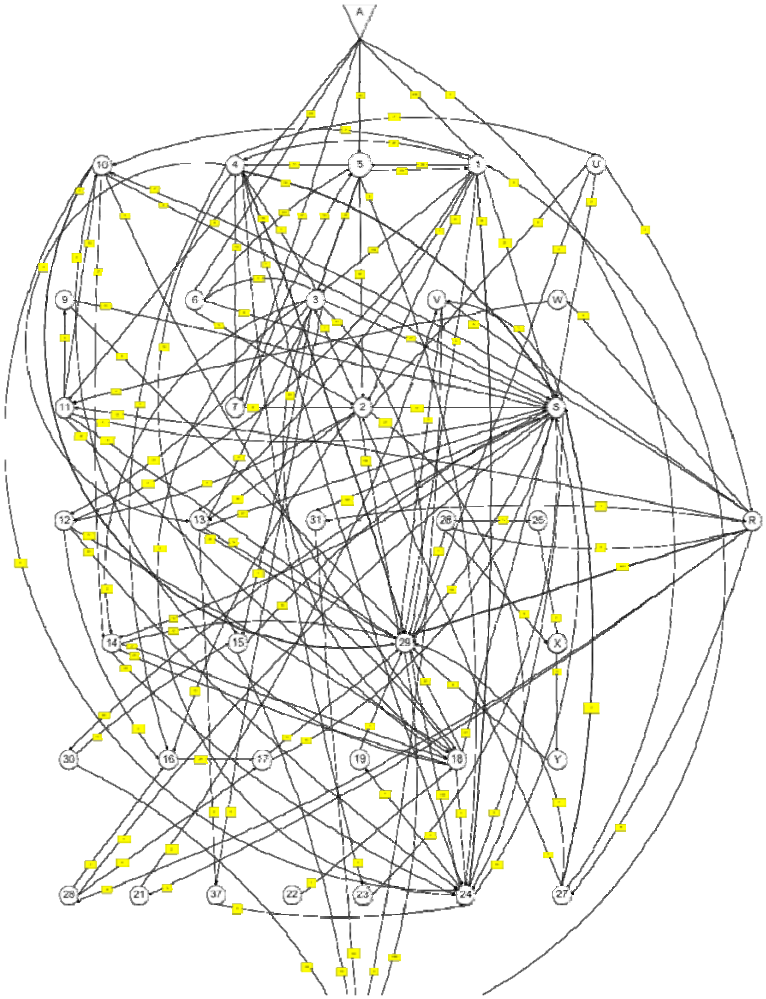
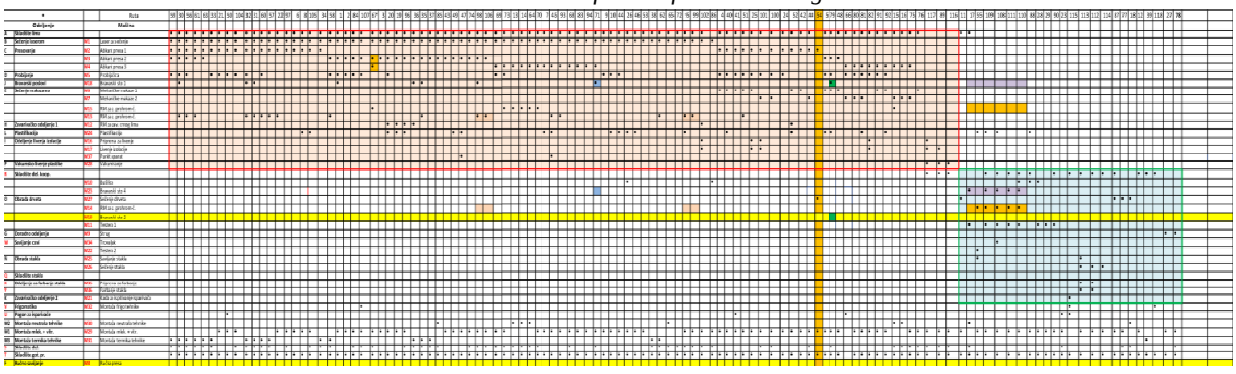


Figure 1.*Analysis of materials flows*

Figure 1 shows the main disadvantages of work organization in production of such complex production programme, and illustrates why it is necessary to change the approach to material flow managing. The figure uses a flow network to show workplace processing (thirty-six workplaces and three warehouses–marked with the letters R, S and T). This primary network is very complicated, which leads to a complicated flow of information and such systems is extremely difficult to manage. The product flow analysis and other indicators show us that there is a need for reengineering and revitalization of manufacturing structure.

Table 1*. Incidence matrix between machines and material flows – final clustering results*



The basic technique of group analysis (PFA analysis) is the resolution of a matrix. Normally in such a matrix the machines will be listed in type number sequence, parts in part number sequence, and the association of machines and parts will appear to be random. It is always possible to find a solution for division into groups and families by reordering the sequence in which parts are listed and reordering the sequence in which machines are listed. Some machine types, which are specific by type, will be required in more than one group, and will be shared. The reordering of columns and rows leads to the solution - two work units in production (marked with red and green square in the Table 1), and one work unit for assembly.

Forming of groups and work units

Based on the obtained information from incidence matrix and by grouping machines that perform the same or similar operations, work units are designed (Figure 2), and a new spatial structure of the factory is suggested (Figure 3).

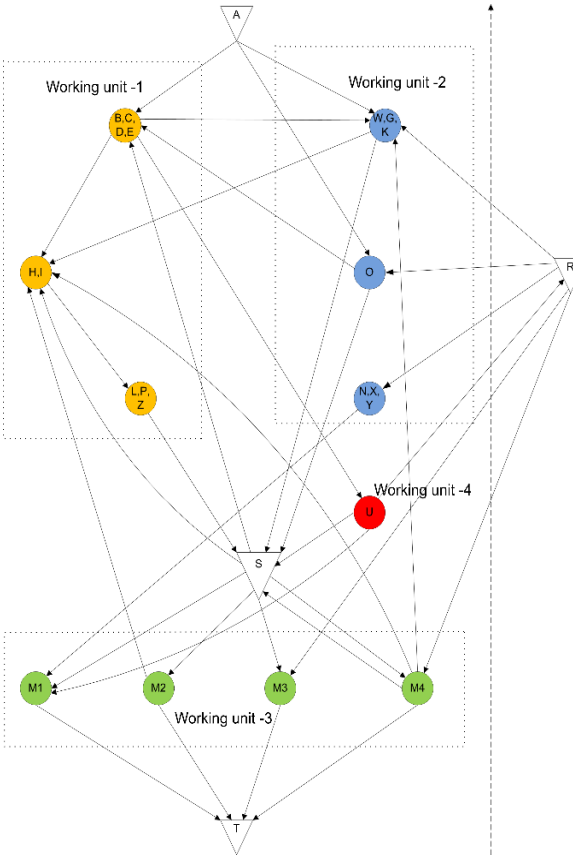


Figure 2. *Analysis of materials flows – simplified system*

The first working unit consists of machines for punching, slitting and cutting of sheet metal. The second work unit consists of machines for turning, drilling, milling and welding, and the third work unit consists of workplaces for assembly (Figure 2). The fourth working unit has already been designed and is not included in this analysis.

This analysis do not consider a department that deals with the production of evaporators (right side of the production hall – Figure 3), because the PFA for that department is done earlier, and revitalization is conducted. In accordance with the production hall that already exists, proposal for a new spatial structure of the plant is given (Figure 3). Workplaces which are numbered with 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, are the first working unit, workplaces which are numbered with 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, are the second working unit, and workplaces which are numbered 24, 25, 26, 27 are third working unit. Warehouses are numbered with 28, 29, and 30.

4. CONCLUSION

Process organization is obsolete, and it has to be replaced by product organization. The paper presents example of transformation from process layout to product layout by using group methodology. PFA is the best technique for planning the change from process organization to product organization. It is desirable to use one of just in time (JIT) single cycle methods of production control to obtain the full advantage of group technology. Downside of PFA analysis is that there is a segment of machines and parts that cannot be included into the formed groups and work units. For those machines and parts, material flow will still be complex, no matter how good the spatial structure is, but number of them will be almost imperceptible. Advantages are:reducedmaterialhandlingandtransittime, reducedsetuptime, and reducedwork-in-process inventory.

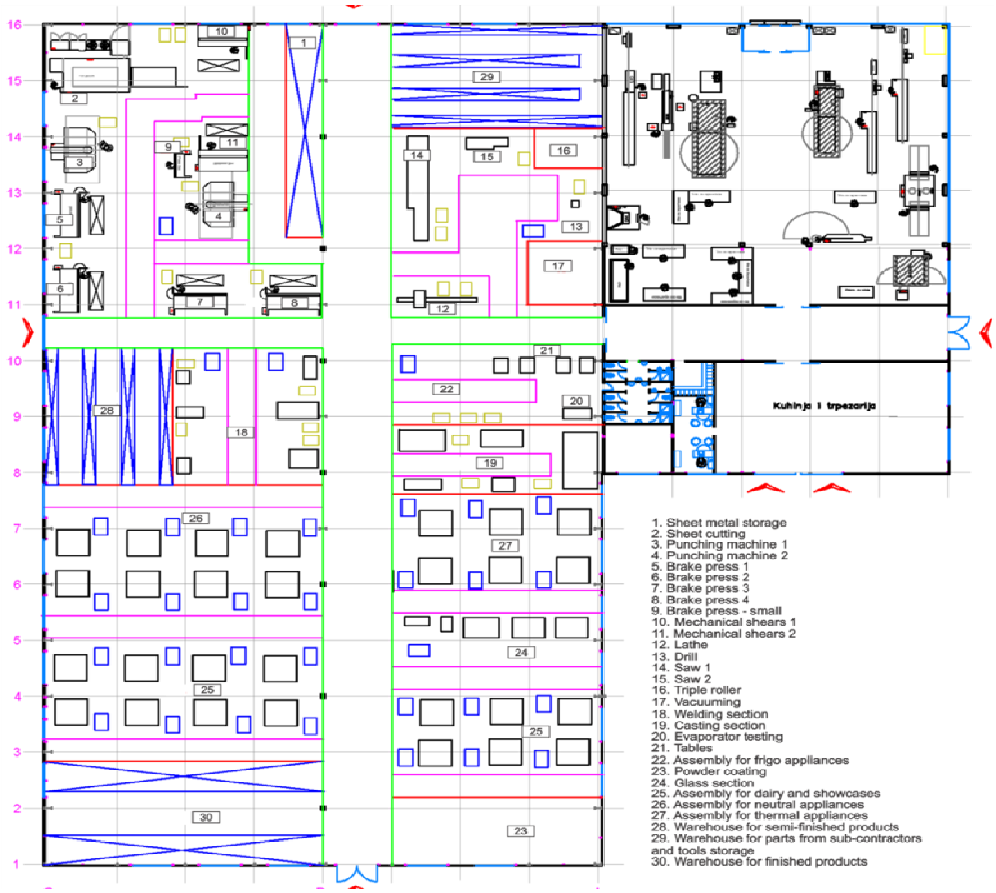


***Figure 3**. Proposed spatial structure of the factory*

5. ACKNOWLEDGEMENT

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