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MANAGEMENT OF CLASSIFICATION AND CODING SYSTEMS USED IN GROUP TECHNOLOGY-BASED PRODUCTION PROCESSES

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Abstract: Due to the fierce competition in the market for engineering products, and not only, a growing importance is given to the technologies that optimize the increasingly scarce and expensive resources. In the machine building industry, more and more frequently arises the problem of implementing a scientific management system able to adopt a manufacturing method based on the group technology (TG), aimed at harnessing the benefits of similar workpieces processing, in terms of morphology and processing methods. But, this method requires coding of the workpieces, in addition to their classification.
Keywords: group technology, management, classification, coding

1. INTRODUCTION

It has been found that, in the current practice, there are a variety of similarities among the workpieces, i.e. dimensions & shapes, nature of material, technological processes, which led to the formation of workpiece groups that can be processed according to the principles of mass and high volume series production, emerging therefore the concept of group technology.

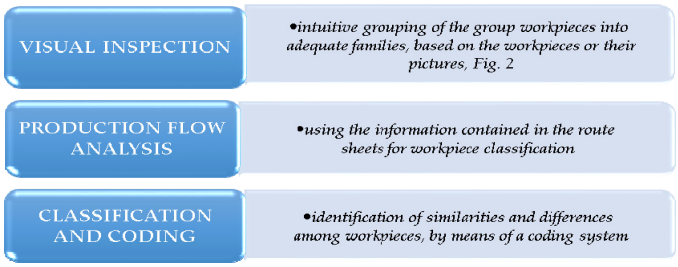

Fig. 1. Methods for identifying the workpiece families

The essence of this concept is to organize the manufacturing system in cells (cellular manufacturing system), in which there is a relatively small group of machine tools of the same type. The literature presents three methods for identifying the families of workpieces.

a. The visual inspection method requires an intuitive grouping of the group workpieces into adequate families, based on the workpieces or their pictures;
b. The production flow analysis method requires using the information contained in the route sheets for the classification of workpieces;
c. The classification and coding method required the identification of similarities and differences among the workpieces by means of a coding system.

Figure 2 presents the visual inspection method. The production flow analysis involves four steps (Fig. 3), and for analysing the production flow we use a matrix, in which the rows represent the machines and the columns represent the workpieces, numbered on the first line. An example of a matrix is shown in Fig. 4.

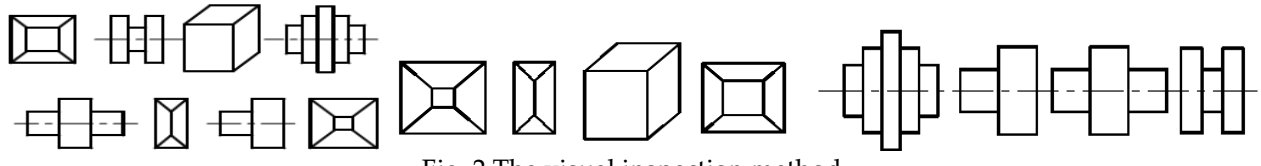
Fig. 2 The visual inspection method

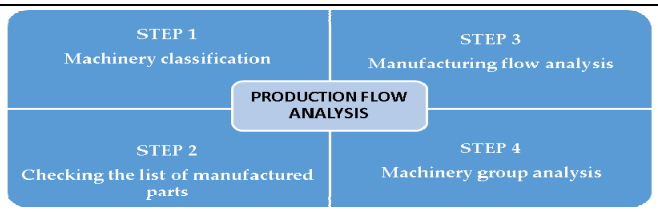

Fig. 3. Production flow analysis

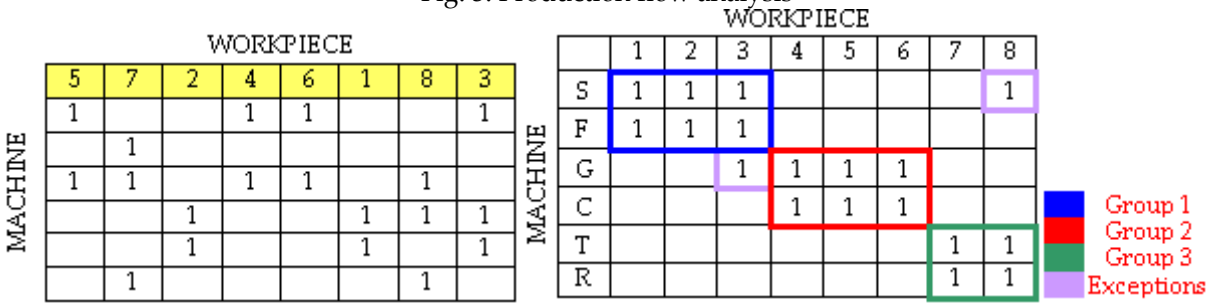

Fig. 4. Example of matrix used in the production flow analysis

In practice, the machines are placed according to a certain scheme. The main schemes for organising the machine-tools, specific to the engineering technology, are presented in Fig. 5:

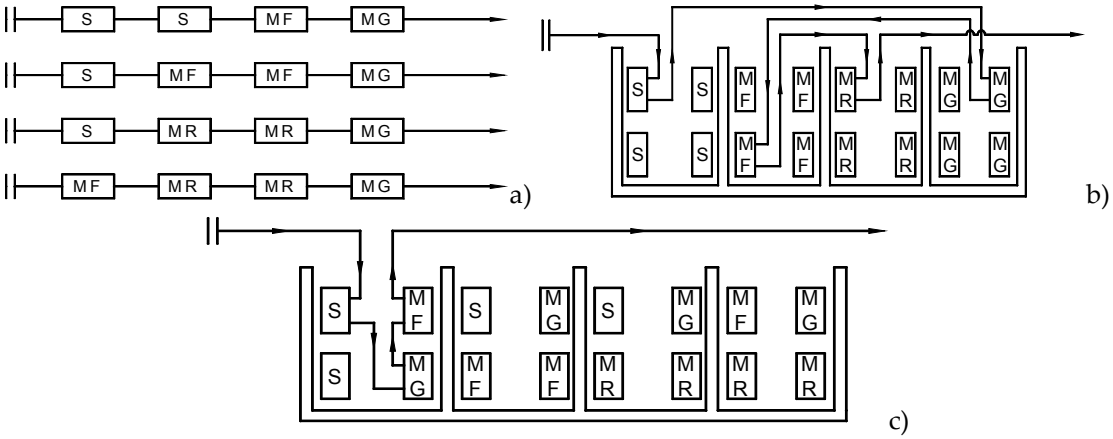

Fig. 5. Schemes for organizing the machine-tools. a) liniar aspect; b) functional aspect; c) group aspect

The third method, being adapted to a specific company typology. So, the "classification" refers to the selection of a workpiece set in the component elements of a family, whilst the "codification" represents the process of workpiece symbol assignment.

2. THE CLASSIFICATION SYSTEM AND A CODING SYSTEM

The classification system means a lot of rules applied for the separation of a workpiece group, based on well-defined criteria. The coding consists of associating to each element of the classification a usually numerical value. There are four issues in building a coding system, namely:

1. Workpiece population (composition);
2. Code for details;
3. Code structure;
4. Presentation structure (digital).

Nevertheless, the code changes resulting from the symbol assignment process can be classified into three different code structures:

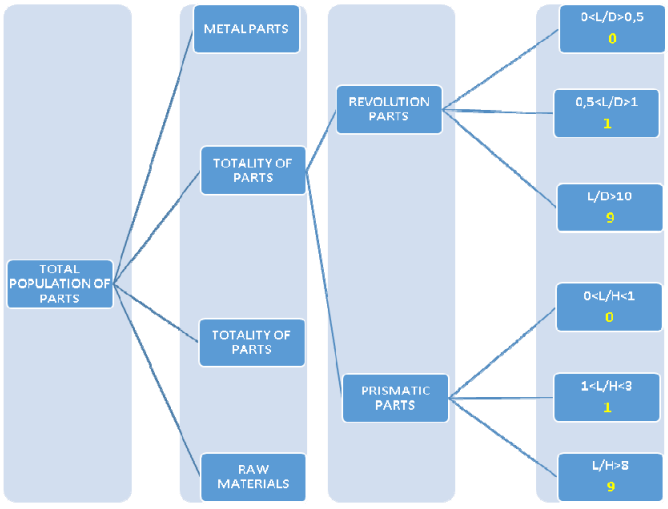

Fig.6. Scheme for obtaining a monocode

a) The monocode, i.e. the hierarchical code. The structure of these codes is like a tree, in which each symbol is qualified through the previous characters (Fig.6).

Advantages:

- ✓ It can represent a large amount of information with very few code functions;
- ✓ The hierarchical nature of the code makes it useful for storage and retrieval of information relating to the design, such as: geometry, material and dimensions.

Disadvantages:

- ✓ The complexity of the coding system;
- ✓ The applicability of these codes in the manufacturing process is limited, because it is difficult to hierarchically cover information on the production sequences.

b) The chain (matrix) code or polycode. The polycode digits are independent of each other. Each digit, in the code specific location, represents a separate piece of information. Number 3 in the third position means always the axial and transverse hole, regardless of the numbers placed in the positions 1 and 2. Table 1 presents the structure of a chain code.

Table 1. Structure of chain code

Position number	1	2	3	4
Features class	OUTER SHAPE	INNER SHAPE	HOLES	
Possible values				
1	SHAPE 1	SHAPE 1	AXIAL	...
2	SHAPE 1	SHAPE 1	TRANSVERSAL	...
3	SHAPE 1	SHAPE 1	AXIAL AND TRANSVERSAL	...
...				
...				

c) The hybrid code or mixed code

The mixed code is a mixture of hierarchical code and chain code (Fig. 7). It preserves the monocode advantages and polycode benefits. Therefore, most existing encoding systems use a mixed structure. Opitz coding is probably best known coding system. It was developed by H. Opitz of Tech Aachen University in Germany. The code uses a hybrid structure. Opitz form uses five-digit code that focuses on:

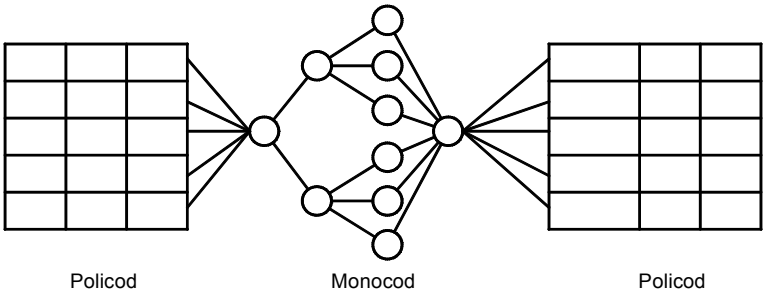

Fig.7. The hybrid structure of the code

1. class piece;
2. the shape of the base 2;
3. surfaces by rotation;
4. prismatic surfaces;
5. holes auxiliary, teeth and channels.

An extra or additional code (polycode four digit numbers) is usually attached to Opitz system.

Table 2. Opitz code structure

Shape code							Additional code			
First digit Part class			Second digit Main shape	Third digit Revolution surface processing	Fourth digit Surface processing	Fifth digit Auxiliary hole teeth deformation	6	7	8	9
0	Revolution part	L/D<5	Outer element Outer profile	Inner shape Inner profile element	Surface processing	Auxiliary holes Teeth	Dimensions	Workpiece material	Workpiece shape	Accuracy class
1		0,5<L/D<3								
2		L/D>3								
3		abnormalities L/D<2	Main shape	Revolution parts Inner & outer profile element	Surface processing	Auxiliary holes Teeth				
4		abnormalities L/D>2								
5		special parts								
6	Prismatic part	A/B<3 A/C>4	Main shape	Main holes	Surface processing	Auxiliary holes Teeth				
7		A/B>3	Main shape							
8		A/B<3 A/C<4	Main shape							
9		special parts								

3. CONCLUSIONS

The group technology (GT) can produce significant improvements in case of diversified production, but can be also used, if necessary, in other manufacturing environments. In this context, a typical approach of the group technology could be the use of composite part families.

The advantages of the type and group technology over the classical methods are real, because:

1) It limits the unjustified multitude of different technological processes for identical or similar parts;
2) It ensures saving of design efforts, as well as materials;
3) It reduces the requirement of existing technological options;
4) It uses the advantages of the technological processes applied in the large series & mass production, through the use of high productivity technological equipment.

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