MODEL OF SELECTION PROCESSES ON MACHINE TOOLS MANUFACTURING IN CORRELATION WITH THE BATCH SIZE OF PIECES

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Rezumat: *Una din principalele tendințe, care caracterizează viața economic contemporană, impusă de înseşi mecanismele pieței concurențiale, dar şi de caracterul limitat al resurselor, o reprezintă reducerea costurilor. Dată fiind această realitate, fiecare agent economic trebuie să înțeleagă că procesul complex al reducerii costului şi sporirii competitivității este condiția esențială, de care depinde asigurarea profitabilității, dezvoltarea şi activitatea sa pe piață. Lucrarea dezvoltă noțiunea de proces de fabricare, a pieselor realizate pe maşini unelte explicându-se modul cum trebuie să se facă identificarea şi planificarea proceselor de fabricație în funcție de marimea lotului de piese.*

Abstract: *One of the main trends that characterize contemporary economic life, itself necessitated by competitive market mechanisms, but also the limited resources, is to cut costs. Given this reality, each trader must understand the complex process of reducing costs and enhancing competitiveness is the key, which depends on ensuring profitability development and marketing activities. The paper develops the concept of production process for pieces made on machine tools, explaining how it should be the identification and planning of production processes based on batch size pieces.*

Key Words: process of manufacture, cost of production, batch, piece.

1. Introduction

The analysis below is based on its expertise in manufacturing metallic materials, but can be adapted to other production areas studied any mechanical product from multiple components can establish the following elements:

- mechanical parts that can be completely manufactured by removing material from a solid block;

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- elements which could be based on finished castings or forgings, the primary process of casting or forging to obtain approximate geometric shape of the finished piece;
- pieces which can be assembled by welding or riveting, from standardized pieces.

The most important elements to be considered are those which have the largest impact on costs.

Principles for selecting manufacturing process:

- Cost of product
- Batch size pieces
- Resistance mechanical and weight relative to the chosen material
- Geometry
- Tolerances imposed
- Duration of product use
- Time until product becomes available

Design integrated with the following concepts:

Design for Assembly Design for Manufacturing

Design for Quality Design for Minimum Cost

2. Analysis production of cost

Calculation of cost of production of a product can be determined based on the relationship:

$$C = (D/N + T/N) + (M + L + P) + R \qquad (1)$$

where:

- N represents the number of pieces of product sold throughout the entire cycle life of the product;
- D represents the cost of design and product development. This cost includes conceptual design, detailed design and prototype production;
- T represents the cost of tools and devices used in processing.

These two costs are amortized for the entire number of products manufactured, that unit cost is obtained by dividing the number of products N. The following three costs are required for each product and ultimately is obtained by summing the total cost;

- M is the cost of materials needed for product development;
- L is the labor costs per product for all operations performed on machines work: processing conventional or unconventional, assembly, inspection, product packaging;
- P is the costs of production per product associated with the use of machinery including car rental costs and installation work, if is case;
- R is the overhead costs.

Purpose design and computer aided manufacturing is to reduce the cost of the product obtained by reducing the ratio of components D and L.

Figure 1 presents an overview of all costs not be represented at the scale involved in the design, manufacture and sale of an additional product. Additional costs - *Manufacturing overhead* includes costs to run the whole factory, the cost of materials consumables such as: fixation accessories and other costs maintenance.

Time to deliver product on the market - Time to market - is the time elapsed between (a) the first time the product design engineer starts and (b) when selling the product to the customer first, when the first payment is made.

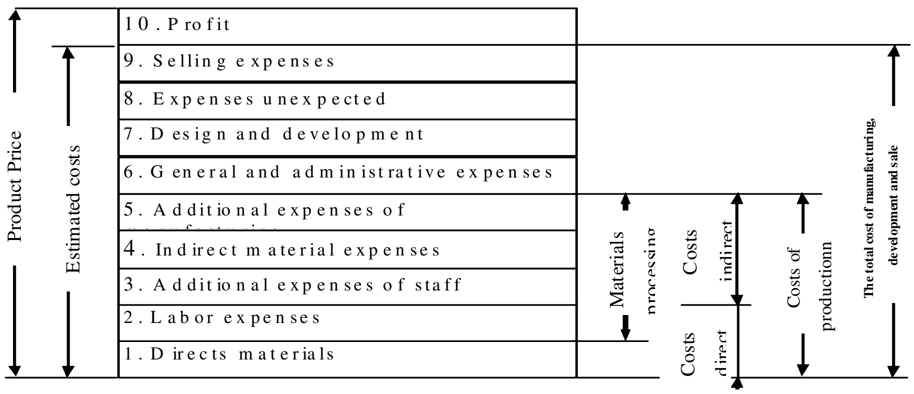

Fig. 1. Decomposition of the cost of making a product

3. Batch of pieces and manufacturing process selection cost

Individual production, the performance of a single product: If you need a single produc can use one of the processes of production through rapid prototyping, such as stereolithography (SLA), sintering using selective laser (SLS), fused deposition of material, (FDM) processing on CNC machine tools or castings, which are each a suitable method for obtaining an efficient product.

Should be emphasized that stereolithography can produce a model of polymer has little structural resistance mechanical. SLS process creates metal pices with a relatively low rigidity, and the process FDM obtains plastic pieces ABS with low rigidity. Rigidity in the latter case is lower than in the case of the plastic injection molding. Processes for obtaining the shape of the product with rapid prototyping and machine tools CNC are economical even for a unique production because they do not require the use of molds or models whose production is expensive.

Unique pieces with complex geometry, such as a toroidal shaped piece, not only can be obtained by rapid prototyping processes. On a milling machine NC, toroidal piece can be achieved only if it is considered as consisting of two halves, is separation being the equatorial plane. Generally speaking, the processes are achieved rapid prototyping most complicated pieces of forms.

Batch size pieces is in 2-10: If the lot is only a few pieces to about ten parts, then cutting or plastic deformation processing on CNC machines with numerical control is the best. In cases where the geometry is extremely complex, it can get a good cost only using SLS and FDM processes.

Batch size between 10 and 500 pieces: At this size batch, most situations require processing on CNC machines. The batch size may require implementation of workshops begin production at the expense of a workshop solution rapid prototyping. Manual transfer of pieces between two machines is preferable when the batch size is so important that you can invest in automation.

Batch size from 100 to 5000 pieces: Working with CNC machines introduced flexible manufacturing complex systems (Flexible Manufacturing Systems - FMS) are compatible with the use of batchs of pieces of high value. In these systems using robots or autonomous transportation systems, automated guided (Automated Guided Vehicle - AGVs) to transfer pieces from one machine to another within the manufacturing system. Efficiency of these systems is dependent on the software required to establish communication between different parts of the system.

A batch size of parts of several thousand pieces even justify making a mold for its manufacture cost is high.
Size *production greater than 5000 up to millions:* As you increase the batch size of pieces, automation plays an increasingly important role. However, if production of a large number of pieces, may be more economical to return to work without computer numerical control. That type of production system to obtain a mechanized line, automation is rigid, with no possibility to be able to reschedule to perform other operations on other pieces.

The choice of material: Material that the designer chooses the component pieces of the product will depend on weight, cost and mechanical resistence required. Mechanical resistence of the piece is the determining factor. Sometimes, even if metals are more durable than plastics, molding and injection molding processes for melting plastic are preferred in residential applications, electronics, automotive supplies.

Geometry: Geometry of the product meets aesthetic qualities and functional properties, on the one hand, but also presents elements of restriction imposed by selecting optimal production process. Figure 2. JA Schey's (1999) shows how the overall geometry of the part determine the choice of manufacturing process.

For easy understanding of figure 2 is noted that the process of rolling or roller near the x axis will produce thin metal strips and big surface. To obtain thick bands older material used hot forming processes. None of the cold forming process is not suitable for large thicknesses of material. Cold forming processes, or cutting, decoupling, stamping, are used for pieces of an automobile body sheet metal forming, machines guards, protective gear, caps or other items belonging to the mechanical assemblies and configuration complex geometry.

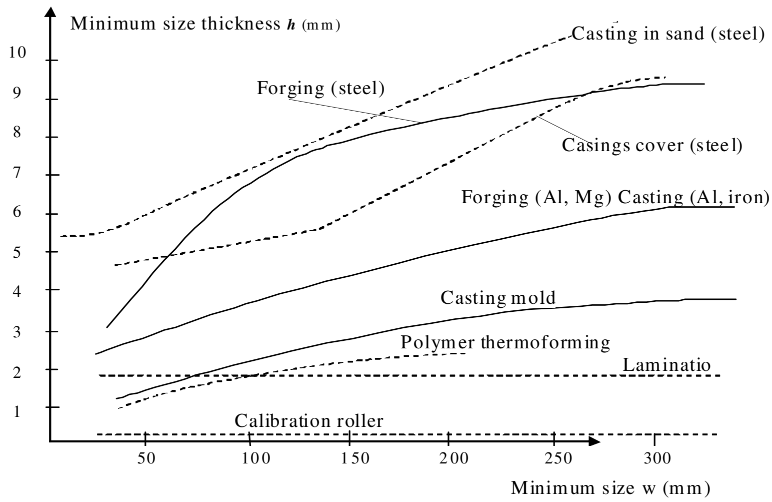

Fig. 2. Capabilities to develop processes related size and thickness of a blank piece

4. Dimensional accuracy and compatibility of CAD/CAM

Setting and monitoring of implementation of each process in the manufacturing cycle of a product is complex activities to be correlated with the following factors eminent:

- semi-finished material properties to be acquired, processed, stored;
- properties of tools and devices used in operations within technological process;

- working characteristics of machines used and the structure of command and control systems;
- number of physical or chemical parameters of the process.

It should be noted that it is highlighted in an analytically rigorous enough that the production and ancillary costs for obtaining a product depends directly on the dimensional accuracy and tolerances required by the designer.

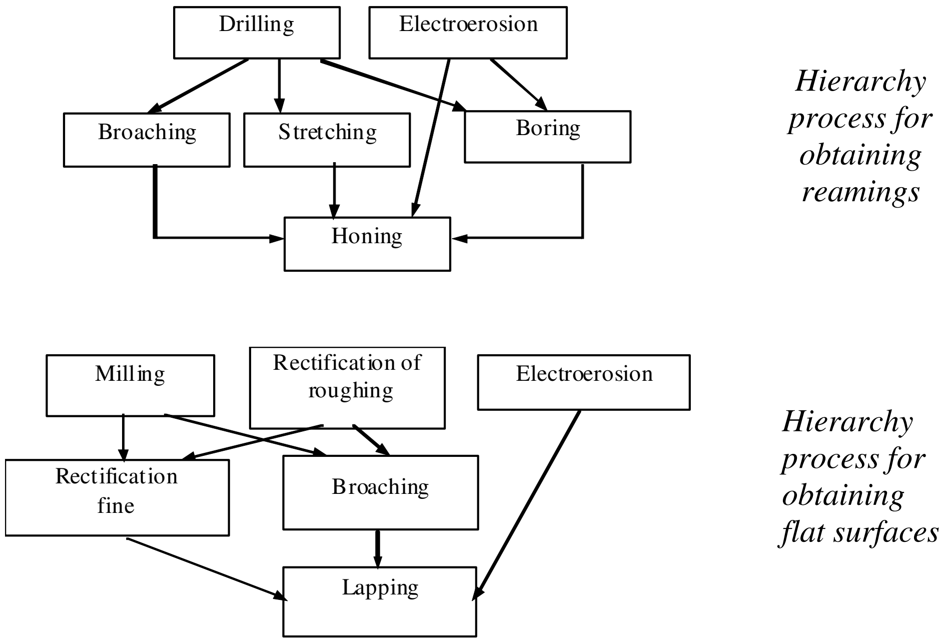

Fig. 3. Chain processes for obtaining reamings and flat surfaces

5. Manufacturing time and costs related to assembly pieces

The time of manufacturing is defined as the time interval between the release of detailed CAD files by manufacturing and performance of the product itself. It may be a small percentage of the total time required from concept to product launch to market. Batch size of pieces, geometry and precision are key factors to be taken into account in this decision.

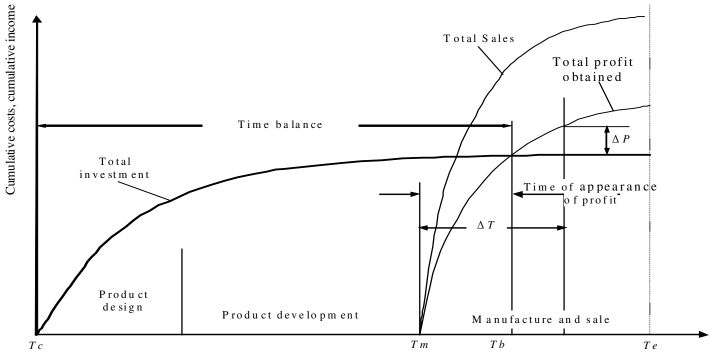

Fig. 4. Diagram of recovery the investment, according to Hewlett – Packard

Figure 5 shows the costs and income according to the time represented in logarithmic scale: *Tm* – point where manufacturing has made the first product and it was sold; *Tb* – point of equilibrium at the beginning of "conceptual definition of the product" to the point where profit is (*Tb–Tc*). Is noted that the diagram shows the time elapsed between the time of (*Tb–Tm*) and commencement of construction and time of the profit highlighted in particular productive technological process; ΔT and ΔP - any point (ΔT, ΔP) after time (Tm), to be calculated payback factor RF. This parameter is dimensionless and is calculated cumulative total investment with total profit, the result being divided by the total investment.

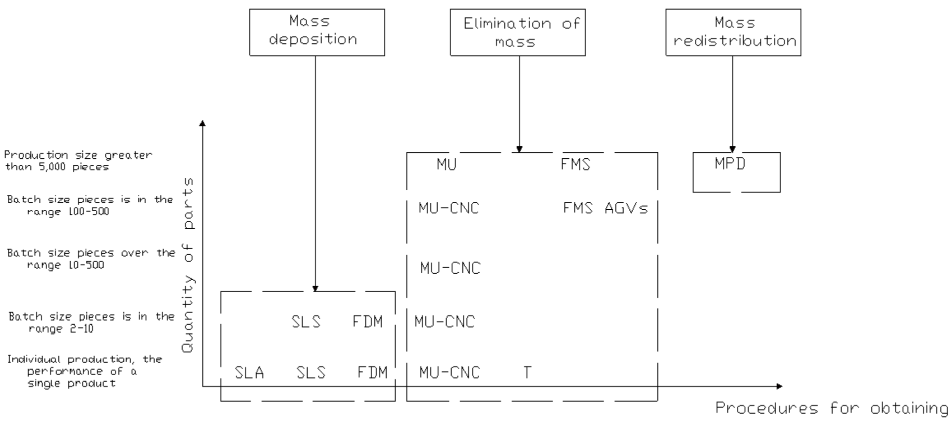

Fig. 5. Processes obtained from the quantity of pieces in the batch

The study revealed the need for bibliographic graphic representation divided into three categori existing technology:

• Mass deposition • Mass redistribution • Elimination of mass

From this figure shows that there is technology based on principle elimination of mass and namely the process could be achieved by cutting all types of production.

The decision to call the machines that process by cutting or machines with mass redistribution mass deposition is important because further investment in this technology.

Conclusions

We recommend new machines tools with 3 axis and if there are a greater number of pieces in batch with complex certain areas, we recommend switching to the 4-5 axes.

The paper main contribution is the establishment of appropriate manufacturing proceselelor technically in direct correlation with the number of pieces. Other variables will be studied later in step two, is proposed for calculating the cost of production technologies adopted.

Through this work we wanted to know the range of technologies, the adoption of a unique technology with the smallest risk of the company.

With knowledge acquired in the four years of study i tried ordering operations by putting us in the position of consulting firms for beneficiaries who want these answers at their request execution of parts:

With what technology?

At what cost?

Until?

R E F E R E N C E S

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