COST CALCULATIONS WITH METHOD OF DESIGN FOR MANUFACTURE AND ASSEMBLY (DFMA)

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Abstract: Using the Design for Manufacture and Assembly (DFMA) method gives a chance to reduce the costs of production. With help of this method it was possible to examine the arising of costs as function of numbers of pieces on different technologies. We show the determination of fabrication and assembly costs in case of different products.

INTRODUCTION

Considerable research and development in the area of product design for manufacture and assembly (DFMA) has been carried out in the past 25 years. The underlying philosophy of this work is the early design decisions on product configurations, together with the selections of materials and processes, lock in a large proportion of the subsequent manufacturing costs. The DFMA software is a combination of two complementary tools, Design of Manufacture (DFM) and Design for Assembly (DFA).

The DFM analysis is focused on the early assessment of component manufacturing costs and selection of the best process / material based on realistic cost estimates. The overall aim of DFM is to enable design teams to make cost trade-off considerations while these decisions are being made. The DFM cost program uses an extensive materials database that includes the materials related parameter for each process. This database also includes processing limits data that aid material and process selection by indicating combination suitability for a given part.

DFA method is used to reduce the complexity of product by consolidating parts into elegant and multifunctional designs resulting in significant cost savings. The basic input to a DFA analysis is the product structure: a listing of items in assembly order, including the main assembly and all subassemblies. Each item is then considered in order assembly. An essential feature of DFA is the analysis of the proposed product by multidisciplinary design teams as part of design review process.

Product simplification and part number reduction is facilitated by applying simple criteria for the existence of separate parts [1]. In the following we show the usage of the two methods.

1. DFM ANALYSIS OF MOUNTING BASE

Here we do the analysis of the fabrication costs of mounting base (*Figure 1.*) with different fabrication technologies. We calculate on the following technologies:

– turret press working with bending
– automatic sand moulded casting
– metal injection moulding
– welding.

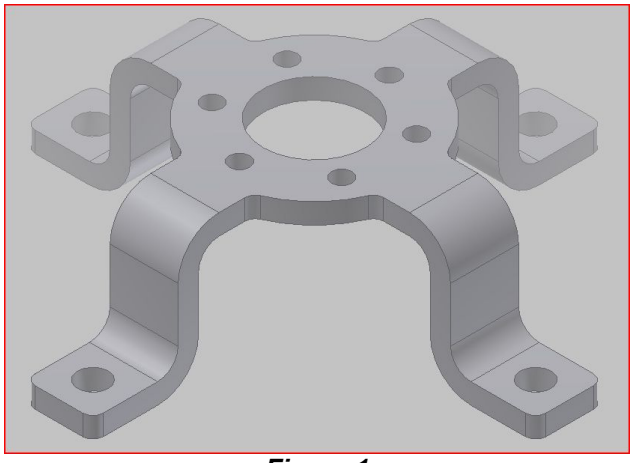

Figure 1
The mounting base

Figure 2 shows the arising of costs as function of numbers of pieces at different technologies. One can see that the mounting base could be produced the cheapest till $1*10^7$ number of pieces with press working and bending.

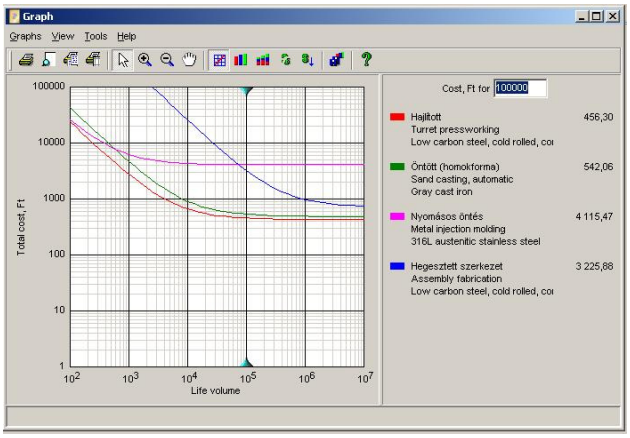

Figure 2
Total manufacturing costs vs. Life volume

Figure 3 shows the cost components of four different die technologies (material, set up, process, rejects, tooling).

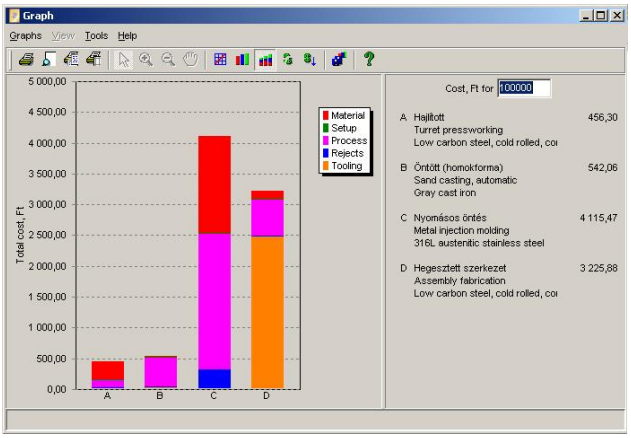

Figure 3
The cost components in case of different die technologies

The comparison of the costs of the same part produced by the different technologies helps us to choose the cheapest technology as function of piece numbers in fabrication. We can study the components of the costs.

2. DFM ANALYSIS OF GENEVA DRIVE

We perform the DFM analyses of the left side wheel of Geneva Drive mechanism (*Figure 4)* in case of life volume with 10 000.

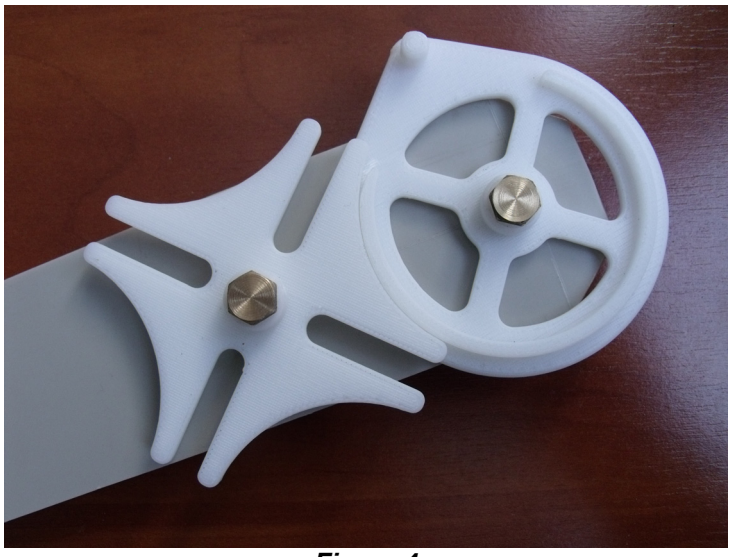

Figure 4
Geneva drive

The parts could be made with different production technologies. We examine the changes of fabrication costs by fabrication technologies mentioned below:

- sheet metal laser cutting
- sheet metal plasma cutting
- compound die stamping.

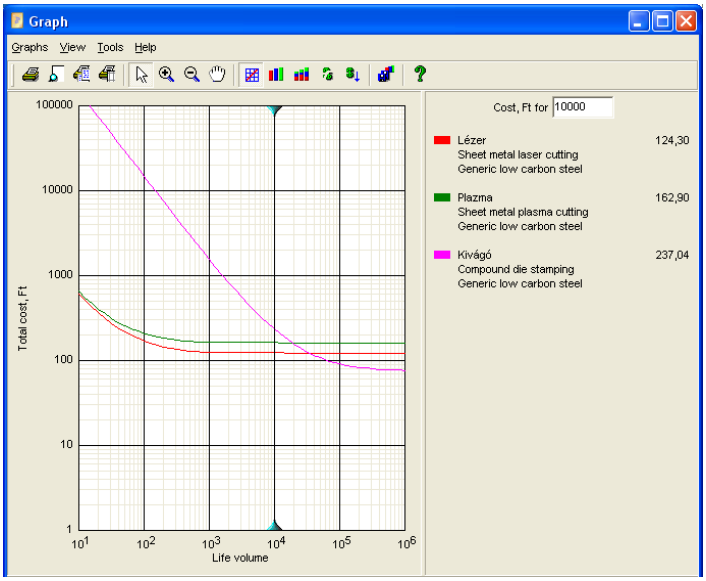

Figure 5
Total manufacturing costs vs. Life volume

The *Figure 5* shows the fabrication costs as function of serial number in fabrication. In the picture we can determine that in the case of the actual piece number (10 000) the most economical one is fabrication with the laser cutting.
In *Figure 6* we see the costs components at different production technologies.

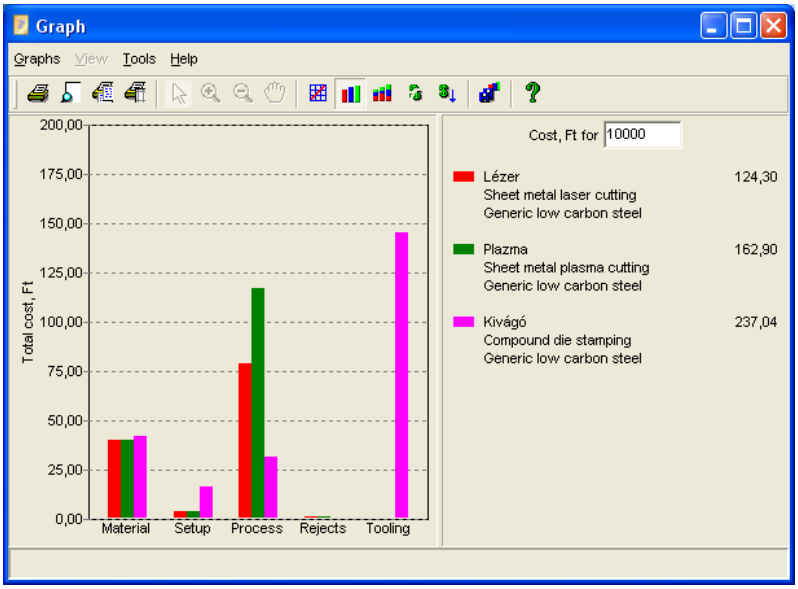

Figure 6
The cost components in case of different die technologies

1. DFA ANALYSIS OF BEARING BLOCK

We execute the cost analysis of the mounting of SNL 511-609 bearing block with two type of seals. The seals are the next:

- double-lip seals (two half ring),
- V ring seals (four round ring).

The measure of axe: the diameter is 50 mm, length of axe is 400 mm. We choose the assembly by hand and the life volume is 50 000 pieces.

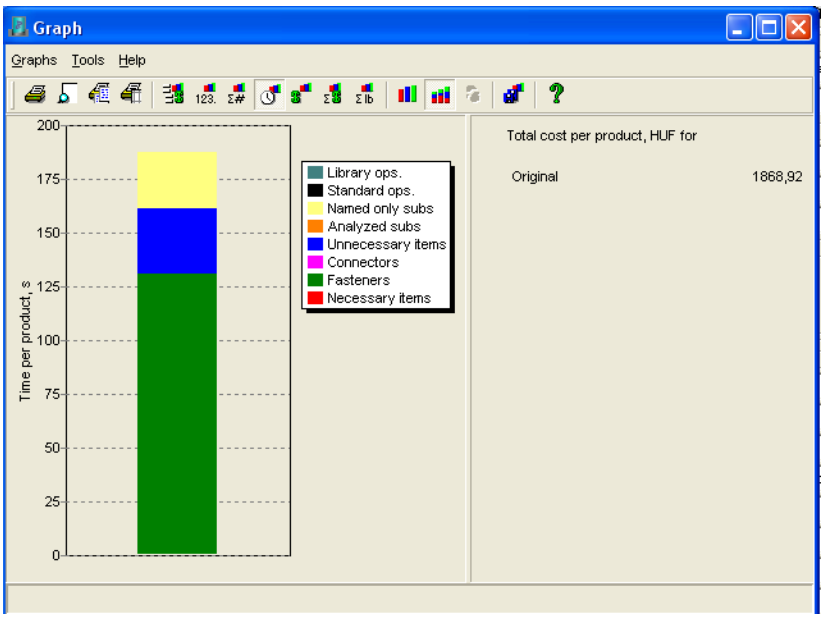

Figure 7
Assembly costs of bearing block with V-ring seals

Figure 7 shows the assembly cost of bearing block with V-ring seals and *Figure 8* with double-lip seals.

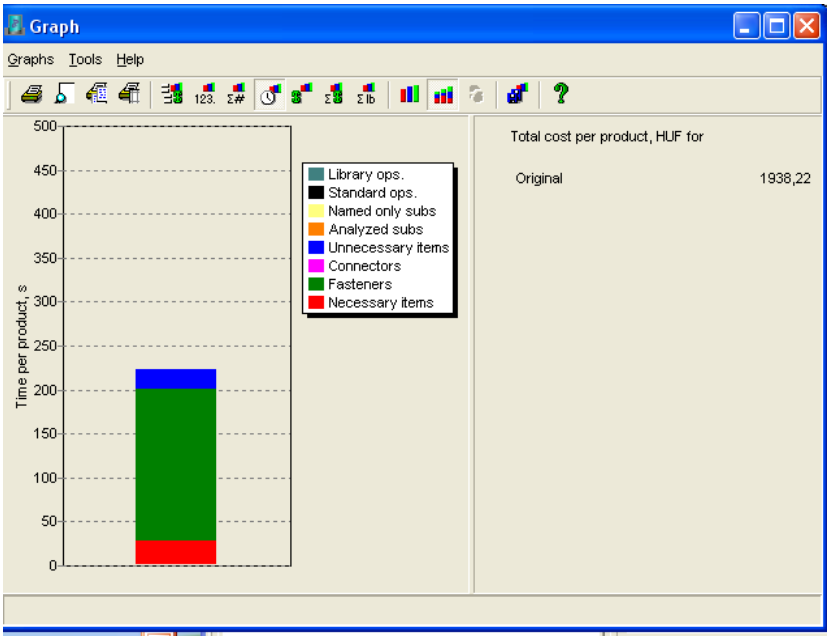

Figure 8
Assembly costs of bearing block with double-lip seals

The costs involve the fasteners price, too. The results show that the fabrication costs by V-ring is 1938.2 HUF and by double-lip seals is 1868.9 HUF. It is seen that the difference is 69.3 HUF/piece and the double-lip seal is chipper.

SUMMARY

The introduced examples show that DFM method allows the calculation of fabrication costs and selection of economical fabrication technology in the function of piece number. With the help of DFA method one could determine the fabrication costs in case of different fabrication ways. The combination of the two methods makes possible to estimate the costs of products and to rise competitiveness.

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LITERATURE

[1] Knight, W. A.: Integrated product life cycle design. 2004 International Forum on DFMA. Providence R. I., June 22-23, 2004. Boothroyd Deuhurst, p.: 243-245.