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USING BENCHMARKING TO REDUCE THE FABRICATION COST – A TECHNOLOGICAL ANALYSIS FOR A PART

Abstract: *Benchmarking is an approach that involves confronting your organization's own practices with those of other organizations. The benchmarking term involves the measurement that can be obtained by comparing internal and external practices and the result of significant differences can be analyzed and taken into account. This type of approach can lead to higher chances of success because it requires a good understanding of the quality of the products in the competing groups and are being analyzed the competitor's strategies for development, production, supply and financial. In this article we will analyze the technological flow of obtaining a part, which we will call "plastic niche reinforcement", for which the realization costs will be identified. The objective is to see if the cost of achieving this part falls within the proposed target and if not what decisions can be taken from a constructive point of view to reduce costs.*

Key words: *cost production, benchmarking, assembly cost, product comparison, part analysis.*

1. INTRODUCTION

An important influence on the proper functioning of an enterprise is the cost of production. Estimated cost of production allows making some special decisions with regard to production process, allows the evaluation of the level of efficiency and substantiating policies reduction of expenses [1][2].

The cost considerations are nowadays critical in the engineering field because depending on the cost of production, the sales price of the product is determined, which means that it can influence the competition and the demand market [3][4].

Benchmarking is an approach that involves confronting your organization's own practices with those of other organizations [5]. Practice benchmarking is equivalent to going into search of the best methods used in an activity, these methods allowing the company to improve his performance.

Benchmarking is a process of management that manifests itself through self-amplification, so it is a process that must be continuously done to prove its effectiveness [6]. Benchmarking must be a continuous process because practices are constantly changing. The term benchmarking involves measurement.

Measurement can be obtained by studying internal and external practices, they can be compared and a result of significant differences can be analyzed and taken into account [7]. This result provides the opportunity to reach best practices.

2. INFORMATION

To reach the highest quality standard, household appliances manufacturers they have focused their attention on design but especially on performance of the device.

In order to maintain the highest level of products produced by the company, a method of systematically comparing two or more organizations or domains was adopted by analyzing precisely determined indicators to determine the performance to be compensated or exceeded and managerial practices and economic ones that can be taken into account and adopted. This method is called benchmarking.

So we will benchmark the two types of products shown in Figure 1, there are two refrigerators that are part of the same product range.

Fig. 1 Internal VS external product. [8]

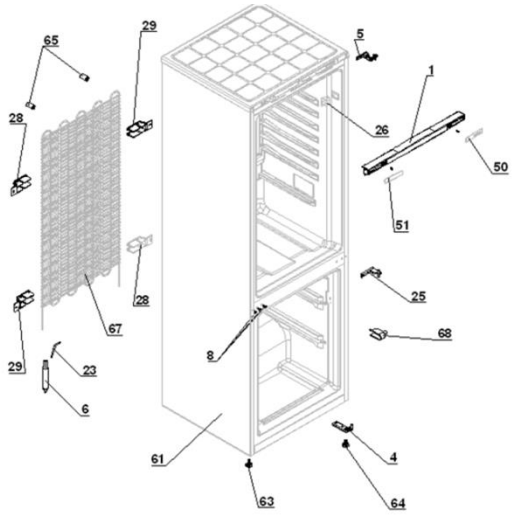


Fig.2 Appliance components.

The two devices have been compared technically and constructively.

A table was produced in which 74 components were compared. Figure 2 shows a part of the components on which a comparative analysis was performed. These were analyzed from the point of view of the materials used, size, weight and quantity.

The area that attracted our attention after benchmarking is the area called niche reinforcement (Fig.3). Two reinforced polypropylene reinforcements are used in these two areas, while a metal reinforcement is used on the appliance used for the comparison.

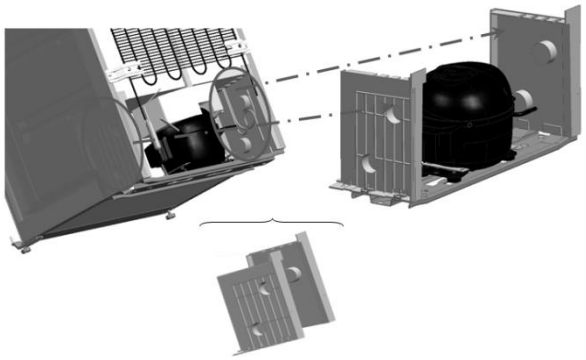


Fig. 3 Niche reinforcement areas.

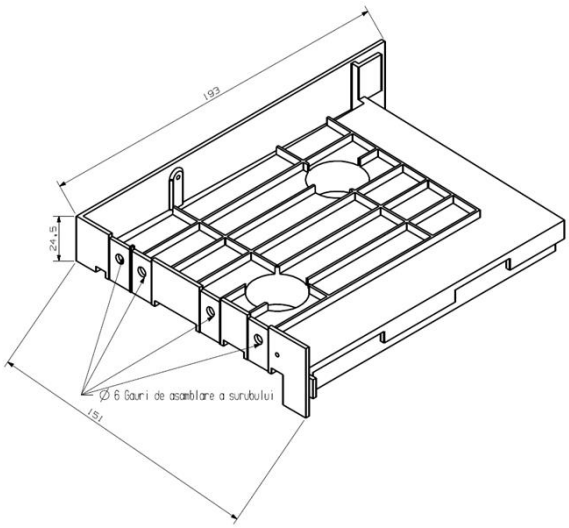


Fig. 4 Plastic niche reinforcement.

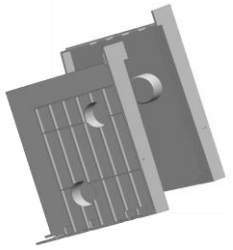
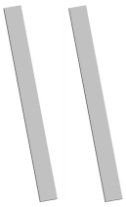
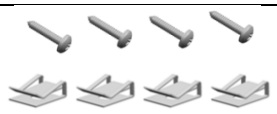
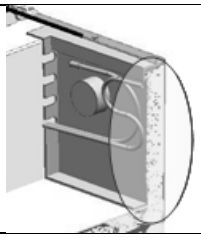
This reinforcement is of two types (left-right / "mirror image"). In figure 3 and 4 we outlined the "Plastic niche reinforcement" from a constructive point of view

Table 1 lists the components required for the assembly from plastic niche reinforcement area.

Also, if we make a section in the niche reinforcement area after foaming, it can be noticed that a certain amount of polyurethane foam enters between the side wall and the reinforcement, which in turn involves some costs.

Table 1

Components in the plastic niche reinforcement area.

Step	Description	
1.	Assembling the plastic reinforcement is done by two people (left and right). Two pieces are used.	
2.	Assembling the sealing elements. In this step sponges (a) and adhesive tapes (b) are used to isolate the assemblies between the reinforcement and the other parts of the appliance. Consideration should be given to the correctness of the seals with sponges and adhesive tapes to avoid leakage of polyurethane foam.	 (a)  (b)
3.	Assembling fasteners - 4 pcs. of screws M3.5x13, - 4 pcs. of clips.	
4.	After assembling the fastening and sealing elements, the next step in the technological flow is the foaming process.	

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3. CALCULATION OF PRODUCTION COSTS FOR THE "PLASTIC NICHE REINFORCEMENT"

To highlight the initial cost situation, the calculation was made on each part.

The two plastic niches that are assembled with adhesive sponge and screws are made at an external firm and are supplied by the company according to the number of devices that are produced.

Calculation of benchmark production costs is done on a device.

Calculation of polyurethane foam price:
Weight required for foaming - (WF)
$(WF) = 0.052€/\text{kg}$ (1)
Price polyurethane foam - (PP)
$(\text{PP}) = 1.7€/\text{kg}$ (2)
Price polyurethane foam used in the plastic reinforcement area - (PRA)
$(\text{PRA}) = (\text{WF})\text{x}(\text{PP})$
$= 0.052\text{x}1.7 = 0.09€/\text{kg}$ (3)
Work price – (WP)

The components listed in Table 1 are assembled by 2 workers for each appliance (given that the factory works in three shifts in 24 hours, 6 workers will be paid for each appliance). The price was estimated at 0.013€/appliance for one worker.
$(\text{WP}) = 6 \text{ x } 0.013 \approx 0.08€/\text{appliance}$ (4)
Calculation of price for sealing elements – PSE

Two adhesive tapes of 55mm each and two sponges are used. In order to include in the calculation of the production costs their value was estimated to 0.01€/appliance.
$(\text{PSE}) = 0.01 €/\text{appliance}$ (5)
Calculating the price of the fasteners - (PF)
According to Table 1, we use 4 pcs of screws and 4 pieces of clips and their cost was estimated at 0.02€/appliance.
$(\text{PF}) = 0.02€/\text{appliance}$ (6)
Cost plastic niche reinforcement – (PNR)
For one appliance, two niche reinforcement parts are used and the cost of a single part is 0.38€.
$(\text{PNR}) = 0.38€$ (7)
Total cost - (TC)
$(TC) = 2X(PNR) + (PF) + (PSE) + (WP) + (PRA)$
$= 2X0.38 + 0.02 + 0.01 + 0.08 + 0.09 =$
$= 0.96 €/\text{appliance}$ (8)

4. TARGET ANALYSIS

After the constructive detailed analysis that we have done on the product, we aim to simplify the area of "Plastic niche reinforcement" by using a new piece. The purpose of this simplification is to reduce total costs.

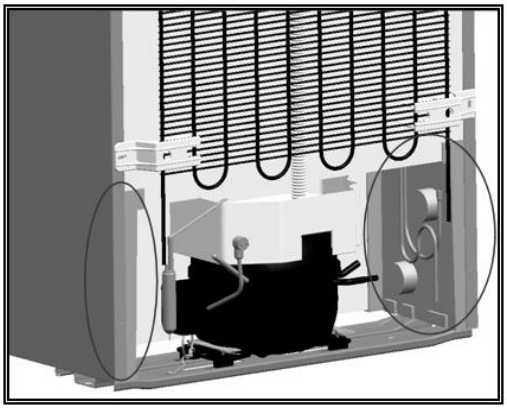

Fig. 5 Area that need improvements.

It must also be taken into account that the change made by replacing the "plastic niche reinforcement" with another piece must not affect the appliance constructively if it is to be subjected to the transport test.

As you can see in the diagram below (Fig.6), the initial production cost of the materials used is 0.96 € / appliance. We are proposing a cost reduction in these two areas of the appliance by about 20%.

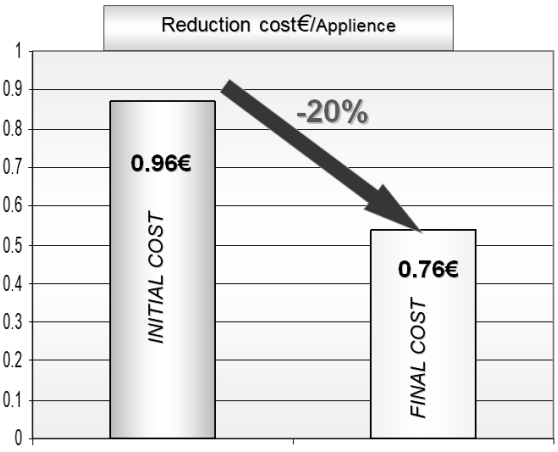

Fig. 6 Target reduction cost.

To make plastic niche reinforcement it was necessary to use a mold that had two nests in the mirror image. In this case, we thought about designing a single piece of metal but we could use it on both sides. When using a single piece, there are many advantages both from the constructive point of view of the piece and from the point of view of the organization of the production.

Figure 7 shows the solution proposed to reduce production costs.

Regarding the material from which the new part has to be exported, we took into account the types of material that the factory has on stock and it is the same type of material from which the compressor support is made.

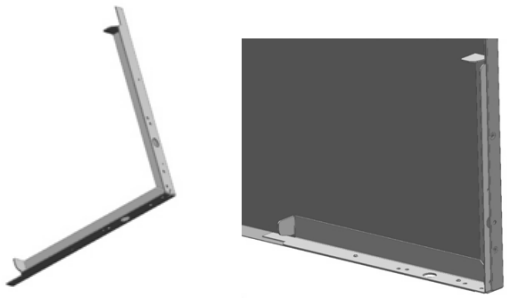

Fig. 7 Solution proposed to reduce costs.

In order to calculate the production cost for the new part, we need to calculate the cost of the materials from which it is made:
Sheet price/kg – (SP)
$(\text{SP}) = 0{,}83€/\text{kg}$ (9)
New part weight – (WP)
$(\text{WP}) = 0.29\text{kg}$ (10)
Calculation price sheet reinforcement – **(**PSR)
$(\text{PSR}) = (\text{WP})\text{X}(\text{SP}) =$

$$= 0.29 \text{ x } 0.83 = 0.24 \text{ €/part} \quad (11)$$

Two parts are assembled on the device, which means that the cost per appliance is 0.48 €.

Screws costs – (SC)

To assemble the sheet part, 12 pieces of M3.5 screws are used and their cost has been estimated at 0.01€/appliance.

$$(SC) = 0.01€/\text{appliance} \quad (12)$$

Work price for the new part– (NWP)

The left and right sheet part components are assembled by 2 workers for each appliance, this leads to the fact that the work price for assembly this part are equal to the work price for assembly the "plastic niche reinforcement".

$$(WP) = (NWP) = 0.08€/\text{appliance} \quad (13)$$

New total cost - (NTC)

$$(NTC) = 2X(PSR) + (SC) + (WP) = \\ = 2X0.24 + 0.01 + 0.08 = \\ = 0.57€/\text{appliance} \quad (14)$$

Using this new part leads to lower production costs from 0.38€ to 0.24€ and the cost of the studied area decreases from 0.96€ / appliance to 0.57€ / appliance.

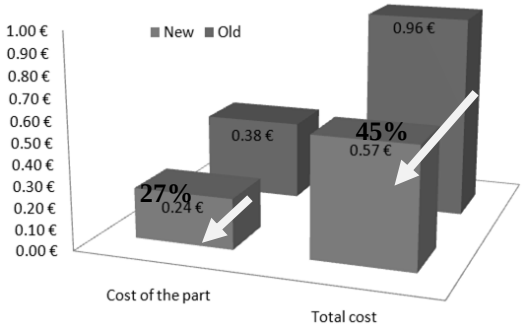

Fig. 8 Cost analysis.

5. CONCLUSION

As a result of the production cost analysis and detailed studies in this area, it has been found that another part could be used without affecting the performance of the refrigeration system, but must be taken into account the rigidity of the corners to comply with rules and stiffness standards for shocks during transport.

In the initial situation, two parts of polypropylene were used in the assembly area of a compressor that had the role of stiffening this side of the appliance. The proposed solution leads to a cost reduction of 27% for the part and a 45% reduction in assembly cost.

After the execution of some prototypes, tests will be carried out:

-functional - to check the performance of the appliance;

- transport tests - two appliances will be appropriate packed and certain operations will be carried out to check the stability or the resistance to certain impacts that may occur during the transport of the refrigeration appliance.

Following the transport test will be checked so much the commercial appearance of the appliance, as well as its integrity from a functional and constructive point of view.

It is also desirable to use this type of part for other refrigerating appliances that are produced within the same enterprise.

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