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Analysis of effects on budget variation: A tool to help reduce manufacturing costs

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ABSTRACT
This work aimed to develop a work tool that would allow the company to identify the causes of the most penalizing cost variations in relation to its budget. Initially, the productive sectors complained about unit price increases, without keeping up with the progress that could be made. This tool separates the influence of changes in production volume, unit price and specific consumption of materials, in order to make clear the performance that is being obtained by the factory and its origin. As a result, it is possible to identify the causes of budget variations, as well as actions to return to the norm, helping the industry to meet its manufacturing cost budget engagement.

Keywords: Electric Energy Costs, Effects Analysis, Cost Reduction.

1 INTRODUCTION

The present work describes the elaboration and implementation of a tool to identify the causes of the most penalizing cost variations of the production process of a metal products factory of Metal Brasil, a manufacturer of metal products used in the manufacture of pneumatics.

Initially, there was a deviation of costs from the budget planned in the years 2020 and 2021. The year 2020 is remembered as a year of factory progress in terms of improving process quality. Until the middle of this year, although the level of quality of the product released to the customer was satisfactory (level of quality of the product that reaches the customer), the level of quality of the manufactured product (level of quality of the product in the production process) was significantly below what was expected for this type of product. There was a level of defects in the process equal to twice the objective in terms of processability of the product, that is, for each ton of final product produced, 10 defects were obtained, while the objective was 5 defects. With this, the quality problem has become a priority of improvement for the entire plant, since this low quality level impairs the performance of the factory in terms of compliance with the production program and productivity of

the machines and labor. Reportedly, this became the No. 1 (one) goal to be addressed and only security issues were a priority over it.

In this way, a better performance of the process began to demand from people a greater rigor regarding the means of processing, among them the main maintenance parts and the main production parts that have contact with the manufactured product during the processing of the same. For a better level of manufacturing quality, some defects in the parts that process the product are no longer acceptable. However, an important point should be noted. The difficulty of determining the extent to which a bad part harms the process is certainly an aspect that has caused the specific consumption of the parts to increase. This is a fact, but it is not clear and, often, the piece began to be exchanged for the doubt of harming or not the process, that is, in doubt, the piece is changed. These accounts until then accounted for 10% of manufacturing expenses. From this moment on, a greater number of parts began to be exchanged and the quality of the process improved. It is important to remember that this was one of the actions that allowed the improvement, not being the only one.

As of the second half of 2020, parts prices have skyrocketed. Its share of manufacturing expenses now represents 17%.

Based on the actual data for the year 2020, the budget for the year 2021 was prepared. From the first months of this year, it was noticed that these two accounts still did not meet the budget provided for them. It should be remembered that the budget for this year already contained the real increases in consumption of production and maintenance materials that occurred in 2020.

There was also an increase in the price of steel in the market in 2021, of the order of 50%. As most of the parts have as origin this product, the unit prices of the parts had the transfer of this increase.

Once again, the budget was disregarded and was not sufficient for the expenditure incurred.

A defense is then initiated by the maintenance and production technicians that the explosion of the budget is due to the increase in unit prices. The specific consumption of materials, which would be the indicator of technical performance of maintenance, lost focus, and the increase in the unit price of parts became the main justification for the cause of the explosion of the budget.

It is a fact that the price increase was relevant. While the average annual inflation was around 6%, the price change of the items in account 60400 (maintenance parts) was 32% and in account 60730 (production parts) was 63%. At the time of determining the budget for 2022, it became necessary to identify the effect of increasing prices, specific consumption and production volume in relation to the year 2021. The finding is shown in Table 1.

Table 1 – Analysis of effects between 2020 and 2021

Conta contábil	Efeito volume	Efeito consumo	Efeito preço	Valor total 2010	Valor total 2011	Variação (2011-2010)
60400 em 2010	80.378	-73.661	231.138	729.708	967.564	237.855
60400 em 2010 + efeitos	810.086	656.047	960.847			
% de variação em relação a 2010	**11%**	**-10%**	**32%**			
60730 em 2010	20.931	-10.221	100.491	159.404	270.604	111.201
60730 em 2010 + efeitos	180.334	149.183	259.895			
% de variação em relação a 2010	**13%**	**-6%**	**63%**			

Source: Industrial Management Sector – Metal Brasil

As can be seen from Table 1, in these two main accounts, there was progress of specific consumption in all items. On the other hand, the increase in the volume of production justifies the increase in the overall consumption of the part. Meanwhile, the unit price change is well above inflation in the year.

With this, it was seen that the opinion of the technicians really was fact. But this was not enough, because, despite all the price variation, the reduction of the specific consumption of the materials needed to be done. On the other hand, this fact is a clear way to seek actions of the shopping service to reduce unit prices.

Thus, the punctual analysis of Table 1 in relation to the year 2021, showed the need to have a tool to continuously monitor these effects and show where progress needs to be made. Prioritizing is necessary, since it is not possible to make improvement actions on all items, considering that resources are limited. If the prioritization is not done correctly, a lot of time and effort are lost, not having the necessary and sufficient effectiveness to have evolution in reducing costs.

1.1 PURPOSE

Creation of a cost management tool with the objective of allowing the studied industrial activity to have evolution in the reduction of its costs.

1.2 RELEVANCE OF THE STUDY

Considering that Metal Brasil is a company that practices as a competitive strategy the differentiation by cost, this work has become of essential relevance for the putting into practice.

1.3 DELIMITATION OF THE STUDY

The study, as well as the cost management tool developed, applies only to Metal Brasil.

2 CHARACTERIZATION OF THE COMPANY

In this chapter a presentation of Metal Brasil is made, showing its main products, customers and production process.

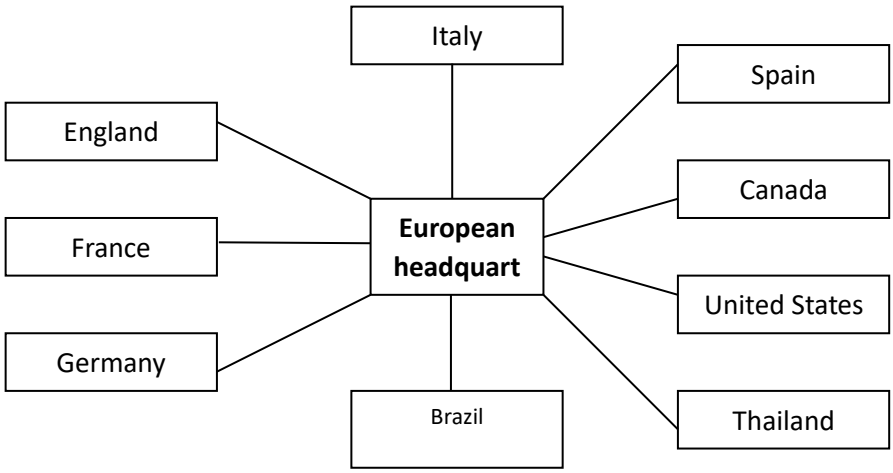
2.1 GENERAL COMPANY INFORMATION

The company Metal Brasil or BRA plant, fictitious names that will be used in this work to refer to the industrial unit studied, is intended for the production of metal products.

These metal products are semi-finished products used on the inside of the tyres – popularly known as tyres – of trucks, buses, automobiles and pickup trucks.

This metallurgical plant is located in Brazil and is part of a European multinational company, which has several other factories in other countries such as the United States, Canada, France, Germany, Italy, Spain, England and Thailand. Thus, the situation described above can be summarized by Figure 1.

Figure 1 – European multinational and its industrial units in the world



Source : Industrial Engineering of Metal Brasil

The various industrial units of tires, semi-finished metals and other semi-finished products make this company one of the largest in the world in the tire market.

2.2 HISTORY

Metal Brasil was installed in Brazil in the early 80's, along with a factory of the same multinational tires for buses and trucks. At the end of the 90s, he returned to invest in Brazil with a factory of tires for cars and trucks.

2.3 MAIN PRODUCTS

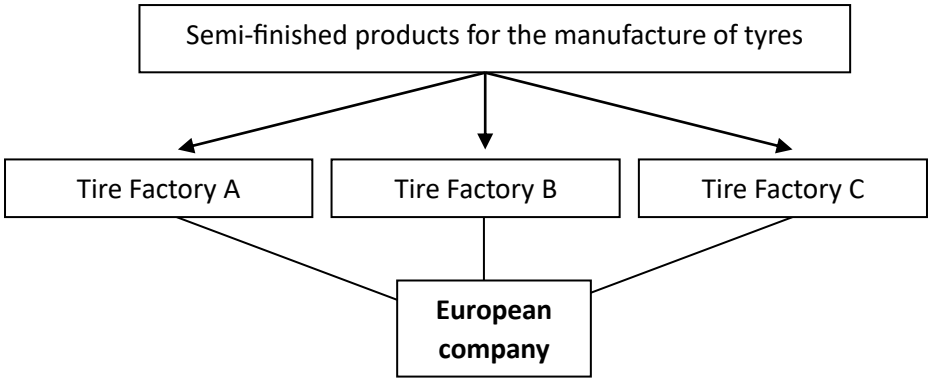
Its main products are cables and metal rims.

The main function of metal cables for tyres is to give mechanical resistance to the tyre. Already the metal rims are used in the tyres in order to fit these to the wheels. They can be of two types: braided rims with circular profile wires, which are intended for tires that use inner tubes, and braided rims with rectangular profile wires, which are used in the assembly of rims intended for tires manufactured without an inner tube.

2.4 CUSTOMERS

The production of the BRA plant is mainly destined to the factories, also belonging to the same multinational, which produce tires in Brazil. Only a small part of the metal cables produced are exported to other tire factories of the company. In any case, all its production is dedicated only to the domestic market, that is, the production of semi-finished products intended only for the production of the company's own tires and not for the foreign market, as shown in Figure 2.

Figure 2 – Production of Metal Brasil destined to the domestic market



Source : Industrial Engineering of Metal Brasil

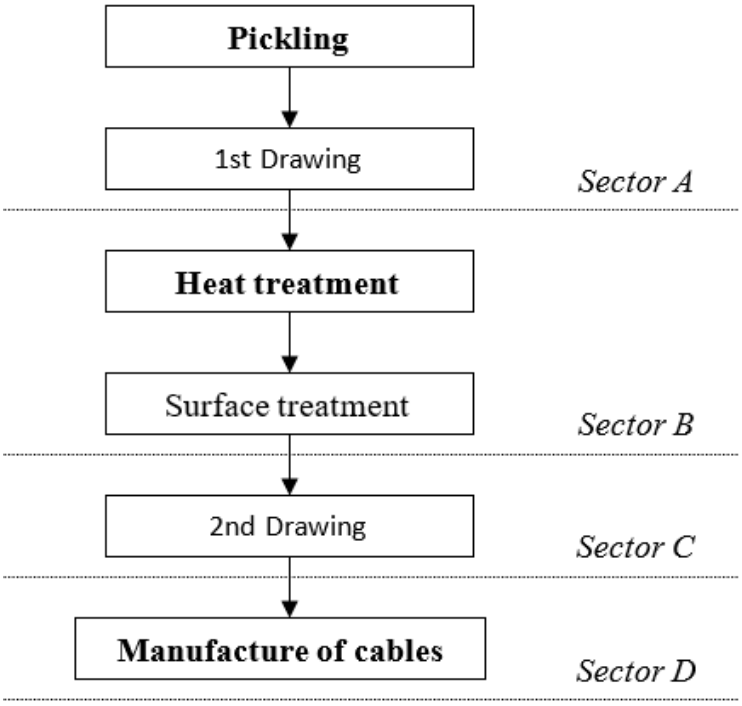
2.5 SUPPLIERS

The company's main supplier is a metallurgical company located in Brazil and belonging to another European multinational. However, sporadically it imports raw materials from other countries.

2.6 PRODUCTION PROCESS

The process of production of metallic cables, on which the study will be concentrated, can be described by Figure 3.

Figure 3 – Production Process of Metallic Cables



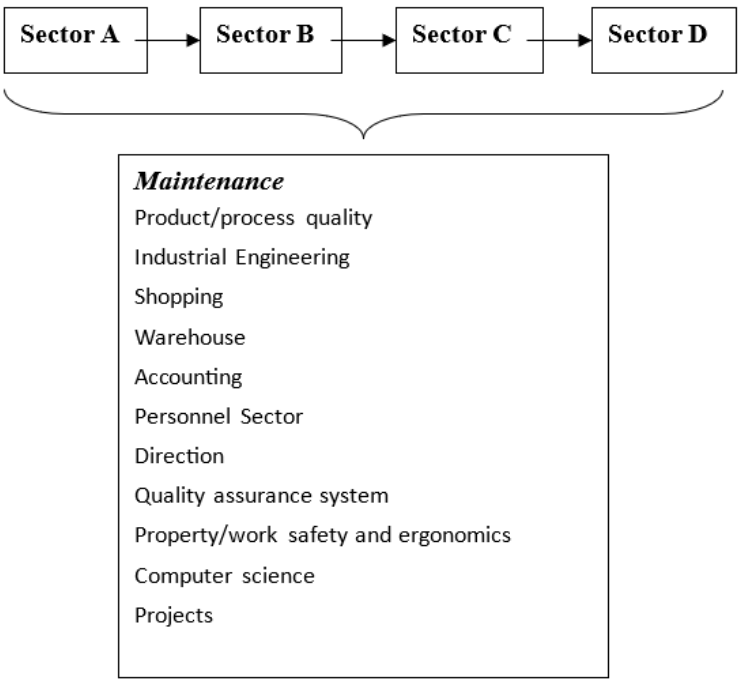
Source : Industrial Engineering of Metal Brasil

- Pickling: aims to remove the layer of iron oxide that comes from the supplier covering the wire rod – which is the raw material – in order to protect it from oxidation;
- 1st Wire Drawing : first reduction of diameter of the wire rod by the drawing process;
- Heat treatment: aims to restore the mechanical characteristics of the wire so that it supports a 2nd drawing;
- Surface treatment: serves to protect the wire and in the future the metal cable against oxidation and assist in the gluing of the cable to the tire;
- 2nd drawing : second reduction of the diameter of the wire through the drawing process, leaving it in a position to withstand the twisting efforts in the production of the cable;
- Cable manufacturing: is the operation of braiding various wires, forming the metal cables, which are one of the semi-finished in the manufacture of tires.

2.7 ORGANISATIONAL STRUCTURE

The functions of the production process are divided among the sectors of the plant, as seen in Figure 3. The support functions are shown in Figure 4.

Figure 4 – Manufacturing Support Sectors



Source : Industrial Engineering of Metal Brasil

In this way, the plant is divided between departments, having an administration by function and not by process.

3 LITERATURE REVIEW

The Production Function within a company must be well managed to contribute to the progress of the business. According to Slack et al (1999), it has three basic roles: to serve as a support for business strategy, to be an implementer of business strategy, and to drive business strategy.

For companies that compete directly on price, cost will be their main production objective. The lower the cost of producing your goods and services, the lower the price can be to your consumers. Even those companies that compete in aspects other than price will be interested in keeping their costs low, since they can increase their profit margin, since the price is determined by the market.

Also according to Slack et al (1999), cost is affected by other performance objectives: high quality can mean low costs, since they do not waste time or effort in rework and do not bother the customer; Fast operations decrease the level of inventory in process, as well as decrease indirect administrative costs; reliable operations do not generate the loss of interruption and loss of efficiency (interruptions in the supply of electricity to an industrial unit are extremely penalizing for its performance); Flexible operations contribute to producing what is desired by the customer, without loss of time and capacity.

According to Almeida (2001), producing products with quality or the "good of the first time" avoids the need for a new production to serve the customer and the flexibility of production is essential to actually serve the customer. Sometimes, one sees the industrial practice seeking to reduce its internal costs without observing or even neglecting the market. This occurs, for example, in the case of the production of a product that the market does not buy. The cost of the product, although excellent, does not add value to the company, since it will be converted into inventory and not into revenue. The market that asks for some differentiated product can not be seen as an external threat, but rather as an opportunity to win customers not yet captive of another supplier. It is therefore necessary to align the functioning of the industry with the business strategy, so that they do not become incoherent.

According to WOMACK et al. (1996) Lean Thinking can be described as a work methodology that aims to reduce the existing losses in the production process. Contradicting recent reengineering processes, it can be said that the lean system proposes a way to create value, rather than simply destroying jobs in the name of efficiency.

Still according to Womack, one of its basic principles is the specification of value. It describes value as all the features of the product desired by the user, that is, what the customer is willing to pay. Therefore, all activities that contribute to the product meeting the requirements demanded by the consumer add value. Even features that are not required, but that are well regarded by the customer, add value. An example would be the prompt delivery of a purchased refrigerator, while the other stores deliver in a week. The customer went to the store willing to wait for the product for a week, but the immediate delivery surprised him, valuing the product. On the other hand, activities that do not add value are merely sources of waste and must be eliminated. When there is doubt about the activity, whether or not it adds value, it is enough to apply a question to it: is the customer willing to pay for it? In case of a positive response, it adds value. The same does not occur if the answer is negative. Therefore, it is said that who defines the value of the product is the customer and not who idealizes, designs or produces it.

According to HINES et al. (2000), there are three types of activities within an organization:

- value-adding activities: those activities that, in the eyes of the final consumer, make a product or service more valued;

- non-value-adding activities: those activities that, in the eyes of the end consumer, do not make a product or service more valued and are not necessary depending on the circumstances. These activities are obvious losses and should therefore be subject to immediate or short-term removal;

- necessary activity without adding value: those activities that, in the eyes of the final consumer, do not make a product or service more valued, but are necessary, unless the existing process is radically altered. This loss is more difficult to remove in the short term and should be a long-term goal or a radical change.

One caution that companies must take is not to define value as what suits them. An example of this is the tendency for companies to define "value" in the way most appropriate to their own interests, since this posture that distances the products currently offered from the real needs of consumers. That is, the final configuration of what will be offered is subordinated to what the company assumes as more efficient in its production process.

The final element in the value specification step is the determination of the target cost. Target cost is that free of waste, considering only the activities that really contribute to the product meeting the requests of consumers. It serves as a reference to indicate the distance between what is produced and what is desired and to alert to the need for changes in the company's conduct.

According to NERES et al. (1998), "one of the major problems of most Brazilian companies is the evaluation of costs and losses associated with their processes.

The absence of cost information associated with processes makes the application of process management very difficult, since one of the most important elements in process management methodologies is the analysis of the added value in the activities, which ultimately depends on the resources consumed in the activities.

If an organization does not know the costs incurred for the execution of its processes, the choice of a critical process, based on the consumption of resources, is impossible.

If the consumption of a resource, raw material, for example, is not associated with the process that consumed it, it is very difficult to analyze the losses of the resource, and, consequently, to identify the opportunities for improvements.

Thus, it is necessary to create a structured mechanism of association of resources and losses to processes, with emphasis on the application of process management. From processes, we move on to sub-processes and, subsequently, to activities and tasks."

The ABC or *Activity Based Cost* is a system of costing of products that is based on the resources used for the production of the same.

According to CHING (1997), the ABC describes the way a company spends time and resources to achieve certain goals. It is a method to track the costs of a business or department for the activities carried out and to verify how these activities are related to the generation of revenues and consumption of resources. Thus, it evaluates the value that each activity adds to the performance of the business or department.

In this way, it distributes the cost of the product among the activities necessary for the manufacture of the same. At another lower level, one discovers what gives rise to the activities, that is, the factor that generates or causes cost. For example, *the* improper layout of a factory is a factor that generates the cost of moving material and product in process. If a factory is organized in functional *layout*, this will require a significant volume of material handling. If, however, it were organized into

manufacturing cells that occupied the same space, this would certainly minimize the amount of products in process, as well as the movement of material.

The fundamental concept of ABC is that instead of the company making cuts in resources indiscriminately and randomly, it should concentrate efforts and energy to influence the cost-generating factors. If the company succeeds in eliminating or reducing the negative generating factors, the activities that give rise to these factors will cease to exist by themselves and, consequently, the resources previously consumed by these activities will no longer be necessary. With this, resources are "cut" in a rational and effective way.

Thus, ABC cost directs its costs not to departments, but to business processes and then to activities.

Also according to Ching, the ABC cost helps in the analysis for improvement of business processes, which is described by the activities that compose it, in order to simplify it, make it more agile and / or reduce the cost.

Activity analysis is a technique that raises questions about the existing process from an activity perspective. It forces managers to ask themselves the why of each activity. The answers to the questions lead in the desired direction of reengineering, which is to redesign existing processes. The analysis of activities also involves the classification of activities into activities that add and do not add value to the product, identifying the factors that generate cost and, finally, eliminating the activities that do not add value and improving the efficiency of those that add value.

COGAN (1997) explains that the traditional costing system accurately measures the direct resources that are consumed, proportionally to the number of components produced from industrial products. These resources include direct labor, direct material, machine hours, and energy in companies where this input can be directly related to products. However, there are many other resources in the organization that occur in activities that are not directly related to the physical volume of the units produced. As a result, the traditional system of costing indirect expenses presents distortions when these expenses are allocated to individual products, simply using the apportionment criterion based on direct labor or direct materials or machine hours or processing time or through the volume of units produced.

On the other hand, as in the past the indirect cost represented relatively small values, the distortion pointed out was acceptable in the name of greater simplicity in the distribution of indirect expenses to the products, as is done by the traditional costing system. Today, with the gradual reduction that has been observed in the participation of labor in total costs and with the addition of indirect costs, mainly due to new manufacturing processes, the increasing support costs associated with the maintenance and operation of automatic equipment and expenses with engineering and data processing, it is no longer possible to passively accept this form of conventional costing. In fact, what

is observed is a migration of direct labor expenses to indirect expenses, through the increase of automation, the emergence of technical and administrative innovations that allowed production with a lower incidence of labor, etc.

Today, the area of calculation of costs of companies, in general, is behind compared to other areas of activity. Thus, in companies that use traditional costing methods to calculate their costs, some products are hopelessly "undercosted", perhaps, even causing losses without the company noticing, while others, "overcosted", are carrying other products with a lower contribution margin. If, today, techniques such as *Just in Time*, *Total Quality Management* and others seek to eliminate or reduce the waste of companies to their simplest expressions, incomprehensible is the scenario that presents itself, where companies deal with their cost results that may be quite far from their reality. It is essential that companies turn to the use of methodologies for appropriating indirect expenses, through activities that consume resources – as preached by the ABC costing system.

Through the ABC, the costs are monitored by the critical control of the activities, that is, the entrepreneurs start to manage the activities and not the costs. Activities are measured according to the value they embody such as quality, costs, flexibility and customer satisfaction. On the other hand, the *Economic Value Added* or EVA tells you what level of efficiency capital is being employed with. Thus, investment costs are also accounted for and serve to assess whether the company is creating or destroying value. By identifying the points of creation or destruction of value, the company can take corrective and preventive measures such as restructuring of the capital employed and activities and even the elimination of some product from its production line (PEREIRA, 2000).

Also according to Pereira, the importance of uniting the concepts of value creation and ABC cost comes from the lack of transparency of traditional costing systems with regard to value addition. Allocating costs to products erroneously not only does not allow but disrupts the costing of products and the visualization of the company's real value creation. Thus, the ABC cost becomes the appropriate tool. Through the union of EVA concepts and ABC cost, companies are able to evaluate their aggregation and value creation today and in the future in their production chain, and can become increasingly competitive. This capability is independent of the size and location of the company.

4 DEVELOPMENT OF THE WORK AND THE TOOL

4.1 EFFECTS ANALYSIS METHODOLOGY

Some definitions become necessary in order to allow the understanding of the analysis of effects:

- Base period: period of time that provides production data, total quantity consumed and average monthly price in order to serve as a basis for comparison for the following months, identifying the progress and returns of the business in relation to this period.

– Qbase: Average monthly amount consumed by each item in the base period

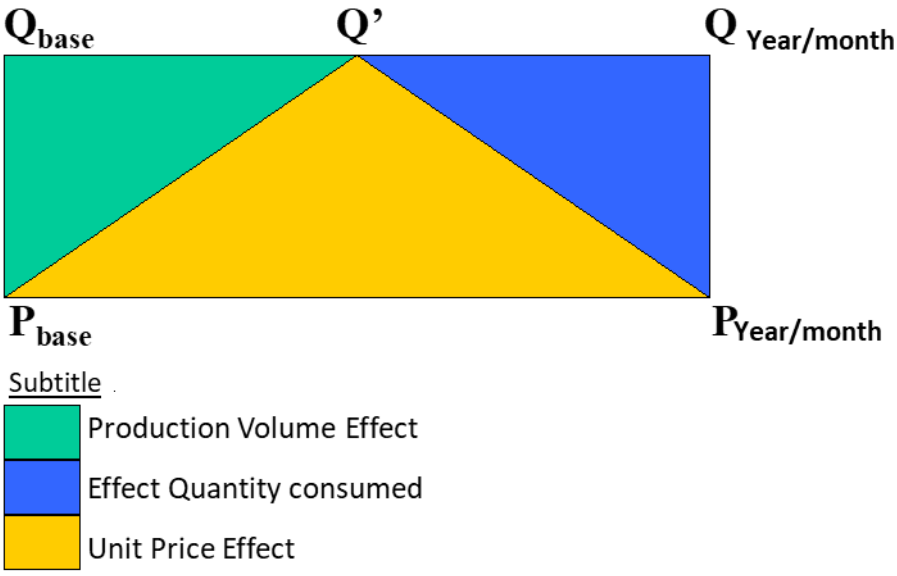
$$Q' = \frac{\text{Average monthly quantity consumed for the base period}}{\text{Average monthly production of the base period}} \times \text{Actual monthly production} \quad \text{(Equation 1)}$$

– Pbase: Average monthly price for each item in the base period
– Qano/month: Actual amount consumed by each item in the year and month under consideration
– Cloth/month: average monthly price of each item in the year and month under consideration

Year/month composition: The first digit refers to the year and the last two digits identify the month. Examples: 2109 – year 2021 and month 9 or September; 2201 – year 2022 and month 1 or January.

The methodology of effects analysis can be represented by Figure 5.

Figure 5 – Schematic representation of effects analysis



Source : Industrial Engineering of Metal Brasil

In the present work, at least 3 effects can be considered relevant: the effects quantity, volume of production and price.

The volume of production effect refers to the amount of financial resources that have varied according to the change in the volume of production. In other words, if, for example, during the base period a certain item A had a Qbase consumption of 10 units and a production of 100kg, in the year/month 2201, when it obtained a production of 150kg, it should have a Q' consumption of 15 units.

In this way, 15 units becomes the expected amount consumed or Q'. The definition of Q' can be seen in Equation 1.

This quantity valued by the average price of the base period Pbase, which, for example, would be R $ 25.00, constitutes the effect volume of production, which is the amount of financial resources that was spent more or saved – if the production was lower in the year / month 2201 – due to the variation in the volume of production. This effect is valued in reais (R$). In the case of the example, cited the production volume effect would be (15 un – 10 un) x R $ 25 / un = R $ 125. Equation 2 aims to represent this effect.

Production Volume Effect = (Q' - Qbase) x Pbase (Equation 2)

In the case of the quantity consumed effect, this is represented by the real variation of the quantity consumed Qano/month in relation to the expected amount of consumption as a function of production in the year/month in question Q'. The valuation is made, however, by the actual cloth/month, since, if consumption were reduced, the benefit to the company would be obtained at the current price. Continuing the example, Q2201, which is the amount consumed in January 2022, was 32 units, that is, 7 more than the expected Q'. With a P2201 of R$50.00, that is, twice the price of Pbase, one has an effect quantity consumed of (32 un – 15un) x R$50/un = R$850, which is represented by Equation 3.

Quantity Consumed Effect = (Qyear/month - Q') x $P_{year/month}$ (Equation 3)

For the unit price effect, in turn, the change in unit price between the base period, which is identified by Pbase, and the unit price of the year/month in question is weighted by the expected quantity to be consumed Q' determined by the production of the same year/month. Thus, the example cited has a unit price effect of (R$50/un - R$25/un) x 15un = R$375. This effect is defined by Equation 4.

Unit Price Effect = (Cloth/month - Pbase) x Q' (Equation 4)

Thus, the total variation between the base period and the year/month period considered is given by the sum of the effects volume of production, quantity consumed and unit price, as shown in Equation 5.

Total Change = Ef. production volume +
+ Eph. amount consumed + Ef. unit price (Equation 5)

In example 1, we have:

Total change = 125 + 850 + 375 = R$1,350 or

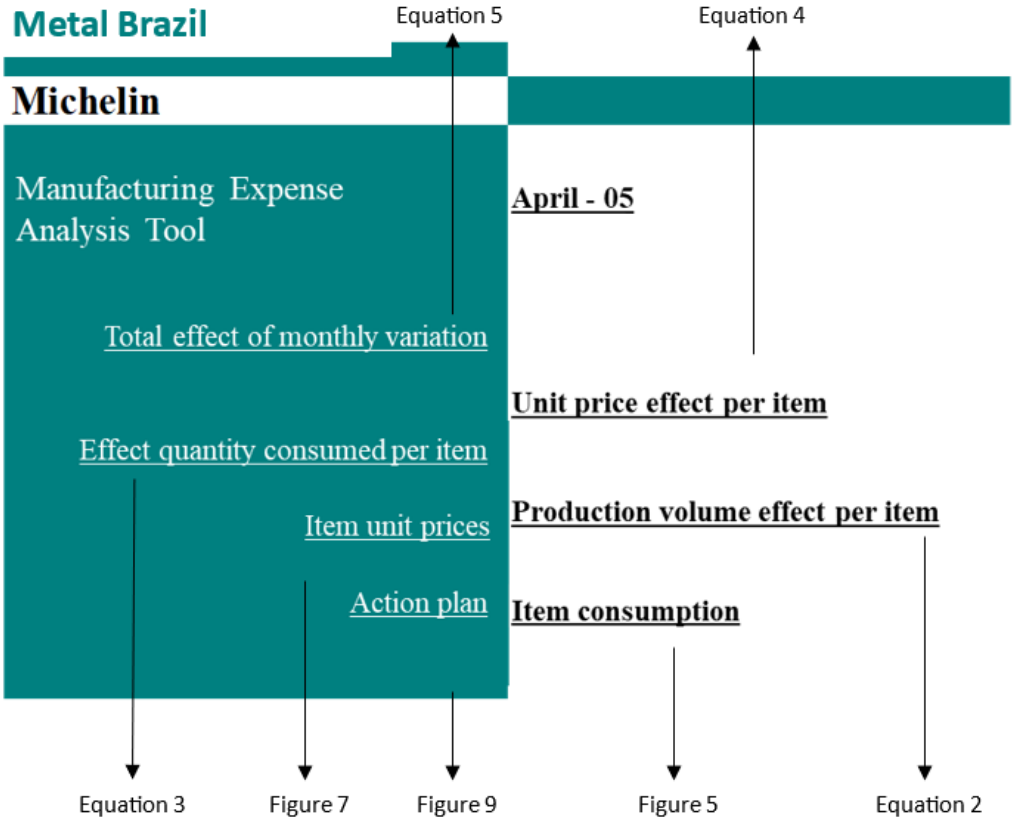
Total variation = (32 x 50) – (10 x 25) = R$1,350, which is represented by Equation 6.

Total Variance = (Qano/month x Cloth/month) - (Qbase x Pbase) (Equation 6)

The main objective of this analysis methodology is to allow the monthly identification of the most penalizing items in terms of variation of quantity consumed and unit price. It can be sectioned by sector, by accounting account or other grouping that is of interest to the business.

Although the calculations of the analysis, which were shown by Equations 1 to 6 are performed in a database in Microsoft *Access*, the exploration by technicians and buyers is done with the aid of a tool developed in *Microsoft Excel*, because it is of greater use by the target audience. The tool's input screen is shown in Figure 6.

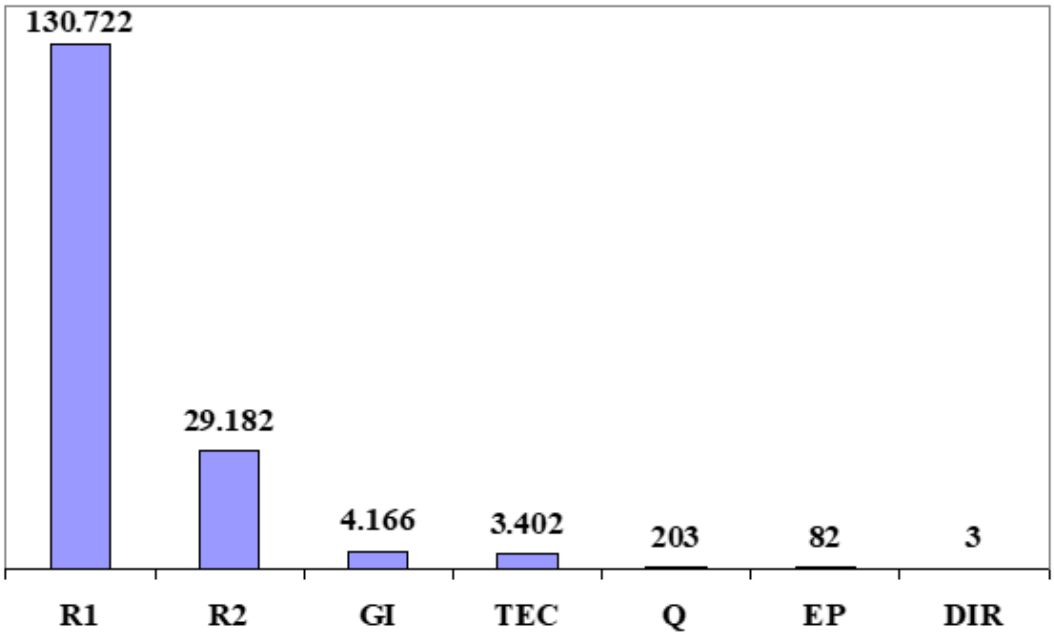
Figure 6 – Input screen of the tool of the analysis of effects on the budget variation



Source : Industrial Engineering of Metal Brasil

With the help of the tool, it is possible to identify which are the most penalizing items in terms of specific consumption or amount consumed. See, for example, the case of sector R1 counts 60400 (maintenance parts) through Figures 7 and 8. Account 60400 represents 28% of the manufacturing expenses of the business unit in question.

Figure 7 – Effect Quantity Consumed by Sector

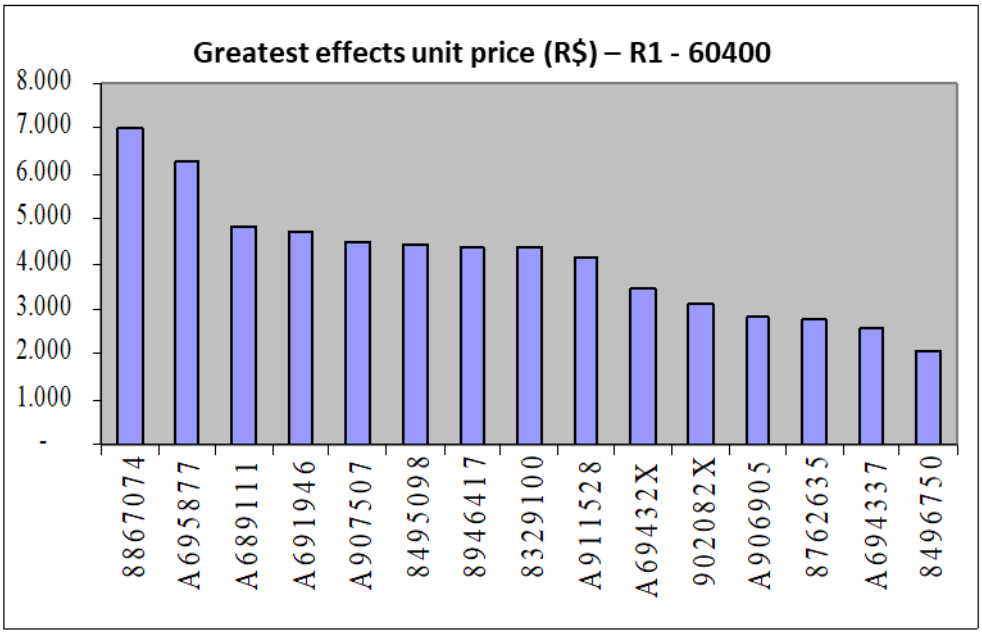


Source: Industrial Management Sector – Metal Brasil

Figure 7 shows that sector R1 is the most penalizing in relation to the amount consumed, that is, it is the sector that presents the greatest deviation of consumption of parts per kg produced in relation to what was foreseen in the budget of the year.

Figure 8 shows the most penalizing items in terms of quantity consumed from sector R1 in the ledger account 60400 (maintenance parts). This means that the specific consumption deviation of item 8867074, for example, represented in the month of April/22 an impact of approximately R$7,000. The items presented in Figure 8 represent only the impact of R$61,490, and not the totality of the impact shown in Figure 7, which is R$130,722. This is because the methodology aims to identify the most penalizing items in relation to the impact on the company's costs and not all items, to centralize efforts in reducing the consumption of the most representative items.

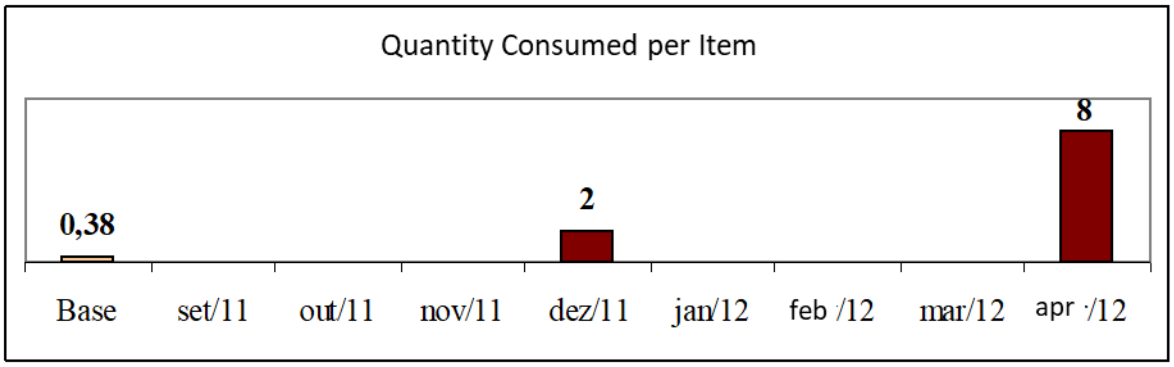
Figure 8 – Most penalizing items of sector R1 counts 60400 in relation to the amount consumed



Source: Industrial Management Sector – Metal Brasil

Figure 9 aims to show the amount consumed by item 8867074 over the months of the analyzed period. In the month of April/22, this item was considered the most penalizing.

Figure 9 – Amount consumed by the item 8867074 monthly



Source: Industrial Management Sector – Metal Brasil

On the other hand, with respect to the unit price effect, Figures 10 and 11 can again show the situation of sector R1 in the ledger account 60400.

Table 2 – Unit Price Effect by Sector

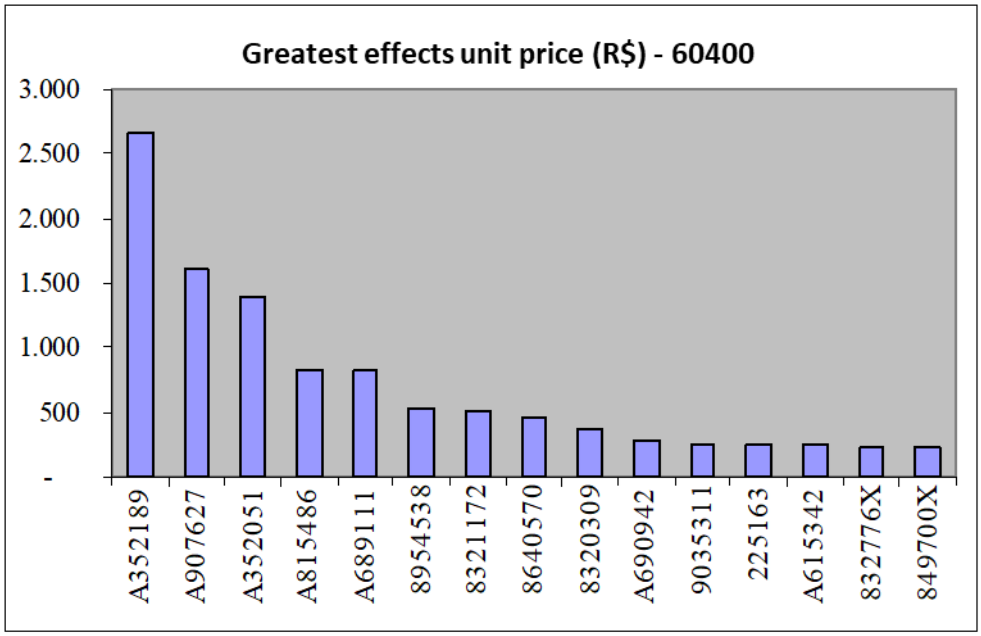
Sector	Unit Price Effect
DIR RES	0
EP	0
GI	0
P	-1
Q	-11
R1	-48.687
R2	-43.338
R3	-34.787
TEC	-7.452
Global Total	-134.276

Source: Industrial Management Sector – Metal Brasil

Table 2 shows that sector R1 is benefiting from the decrease in the unit price in relation to the forecast, and the same occurs in the month of April/22 with other sectors, that is, as the unit price of all items is lower than expected, the impact is negative, bringing a lower expense in the budget realized than expected.

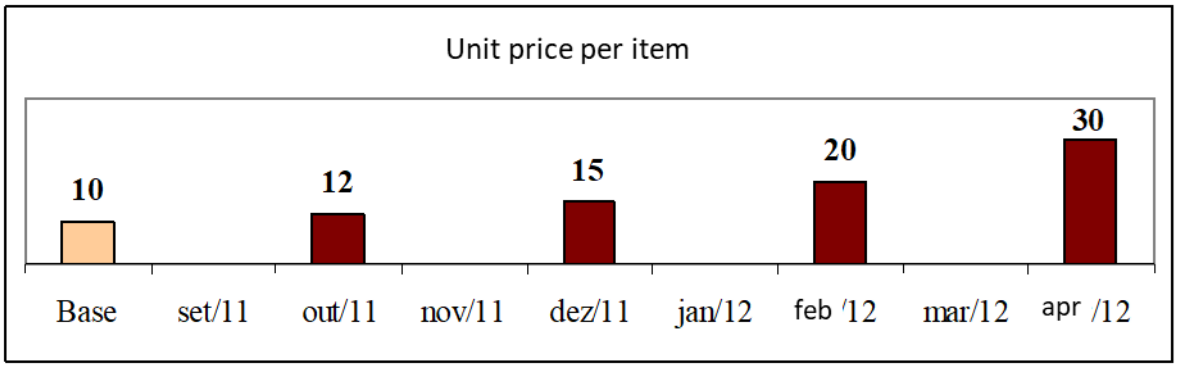
Although the total amount of the 60400 account in sector R1, which represents the maintenance parts, has a negative impact of R$48,687, there are still items that negatively penalize the total amount spent that are offset by other items in order to have the negative impact globally. They are shown in Figure 10. Not for this reason should one fail to identify the most penalizing items in relation to unit price so that actions to reduce the value by the purchasing service are sought. Item A352189 is the most penalizing in the case presented, as shown in Figure 10, and caused an impact of R$2,673 in the month of April/22.

Figure 10 – Most penalizing items of the sector R1 counts 60400 with respect to unit price



Source: Industrial Management Sector – Metal Brasil

Figure 11 – Unit price of the item A352189 monthly



Source: Industrial Management Sector – Metal Brasil

The production volume effect of sector R1 can be seen in Table 3.

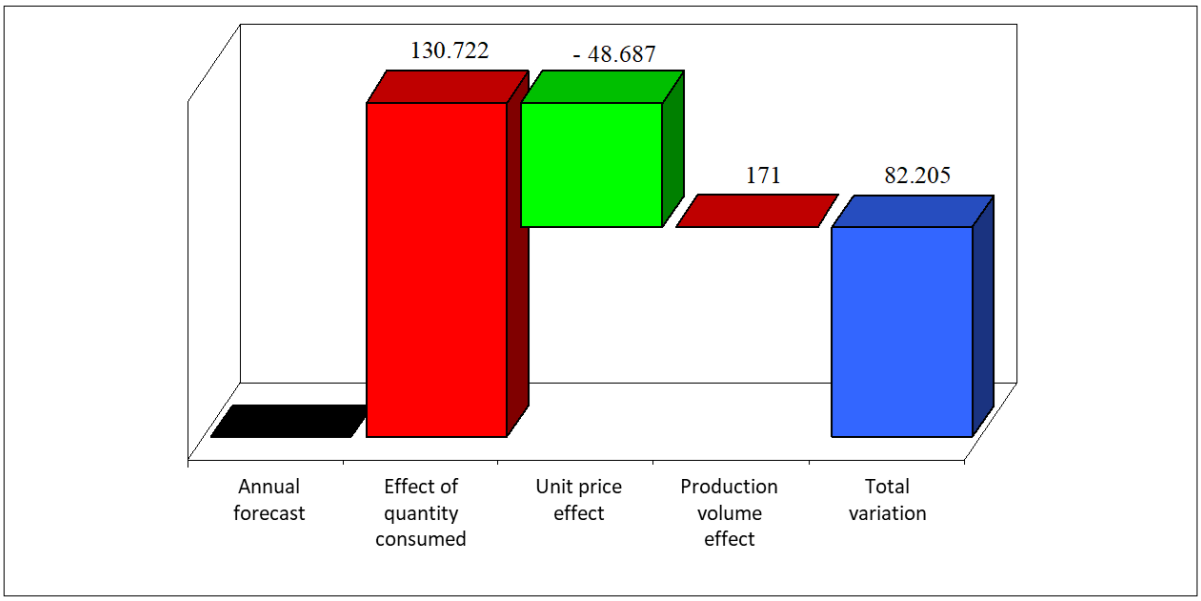
Table 3 – Production Volume Effect by Sector

Setor	*Efeito Volume de Produção*
DIR RES	0
EP	0
GI	0
P	0
Q	0
R1	171
R2	-7.568
R3	10.218
TEC	0
Total Global	2.820

Source: Industrial Management Sector – Metal Brasil

The total effect of sector R1 was R$82,205, which is exactly the sum of the effects quantity consumed (R$130,722), unit price (-R$48,687) and production volume (R$171). This is shown by Figure 12.

Figure 12 – Total budget variation of sector R1



Source: Industrial Management Sector – Metal Brasil

From this analysis an action plan is established, either with the objective of verifying the causes of variation in the amount consumed, when they are not known, or to make a modification in the production process. On the other hand, actions are also sought by the purchasing sector to reduce unit prices. An extract from the ongoing action plan is shown in Table 4. The goal of this action plan is to pursue the continuous reduction of manufacturing costs.

Table 4 – Action plan to reduce manufacturing costs

Code	Expense / Problem	Share	Accountable	Term	Evolution
8868374	8868374-kit gear machine 335 - increased consumption	Check because of increased consumption	John	Apr-22	Increase in the number of machines from 5 to 40 machines 345; Mass detection circuit is being turned off by operators to avoid random stops. With this, the machine does not disarm and continues to force the kit when the machine has a problem, and it ends up working as a fuse. Reduce the number of random machine stops 345.
8867074	8867074 - DENT WHEEL P/CORR ISO 06B-1 Z=0	Check cause of increased consumption	Joseph	Apr-22	

A816803	A816803 copper brake canvas	In buying a Teflon-bronze canvas much more expensive for quality orientation. On the other hand, pieces of copper material had around 100% variation; evaluate the price at the time of homologating the new material and the gain from the modification.	Peter	Apr-22	In test on machines 356/2 and 456/7. Old durability: 1st head 4 months.
A352189	A352189 - unit price increase over the months	Contact current supplier to search for causes of price variation Search for new suppliers if the supplier does not tend to return to the old price	Ana	May-22	
A352189	A907627 - the unit price of the item did not vary, but rather the shipping value	Identify the amount of shipping paid month-to-month and the cause of variations	Mary	Jun-22	

Source: Industrial Management Sector – Metal Brasil

5 CONCLUSION

The analysis tool presented sought to explain the effects quantity consumed, unit price and volume of production to enable the identification by each sector and by its accounting accounts the most penalizing items in terms of quantity consumed or specific consumption and unit price in relation to the forecast.

With this, it is possible to identify the causes of these variations, as well as actions for the return to the forecast or to the performance previously practiced at the time of the forecast, helping the sector to meet its commitment of manufacturing expenses budget in the year.

As a result, the production and maintenance sectors can see the part of the budget penalized due to the increase in the unit price of the parts, while the quantity consumed effect shows the most penalizing items in terms of consumption. With the identification of these items, it is possible to analyze the causes of consumption increases, as well as reduction actions. Therefore, it becomes an effective tool with the objective of reducing costs.

The calculation bases in *Microsoft Access* and *Microsoft Excel* make this tool of immediate use by other industrial units of Metal Brasil, and also of easy adaptation to other companies.

The next step is to make this tool an instrument to help the reprediction of the costs of the productive unit over time by the trends of variation of the effects over time.

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