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DEVELOPMENT OF A COSTING SYSTEM IN A SMALL NAUTICAL COMPANY OF THE MANAUS INDUSTRIAL POLE

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ABSTRACT

Innovation is represented by the constant pressure to reduce costs and increase revenue together with the manufacturing excellence that companies face every day. Cost accounting is a fundamental activity, essentially when it is understood that it is responsible for measuring costs for performance evaluation, inventory balancing, profit margin definition, and decision making. However, cost control arises from the comparison of expectations with the results obtained, thus verifying the importance of information provided by the costing systems. This paper presents the results of the implementation of a new costing system in an SME from the nautical industry, located in the Industrial Complex of Manaus. The costing system was developed, with two proposals for imputation of manufacturing overhead costs, with a simple and intuitive format, where it is possible to relate material costs, manufacturing overhead, unit value analysis and total labor cost, administrative and commercial costs, in the order described, so that all these values are related to obtain the cost of processing.

INTRODUCTION

The industrial competitiveness of the world intensified from the second half of the twentieth century, when quality, product reliability, flexibility and speed of meeting demands became the new business success factors (Lima & Zawislak, 2003). According to Jesus and Viana (2001), the world economy is increasingly dependent on small and medium-sized enterprises, due to its large capacity for job creation and flexibility, which historically played a fundamental role during the period of recovery and organization of the economy after the fall of the Berlin Wall. Currently, SMEs are the basis of the UK economy, which accounts for 59% of the workforce and contributes about 50% of the private sector's output and accounts for 99.9% of the business world (Lucas, Prowle & Lowth, 2012).

SMEs differ mainly from large organizations by immediacy actions, informal strategies and limited resources (Willian, Vinit & Patel, 2013). Cost management is an organizational strategy that can be the difference between survival and disappearance and, when incorporated into technological resources, can be a differentiating factor contributing to the competitiveness and improvement in business performance compatible with large organizations (Mendes & Escrivão, 2007).

Cost management is divided into different initiatives, those that reinforce the company's strategic positioning, those that have no impact on it and those that weaken it. Therefore, converting a company's conventional cost management into strategic cost management can bring benefits when analyzing planned initiatives to strengthen the company's strategic positioning, expansion of the horizon of the performance of internal cost management practices and management program beyond the boundaries of the organization. Initiatives that weaken the strategic positioning of companies are synonymous with revenue reduction programs (Cooper & Slagmulder, 2003).

Costs represent the amount of resources used or lost for a specific purpose, divided into several types that permeate the production chain of a product. For the correct management of these costs, it is necessary to use costing systems, which aim to record the cost of the resources acquired, be they materials, labor and equipment, used in production and also those used in the sale of the products and services. To the costing system, therefore, the important task of recording all the costs of the resources is the possibility of analyzing their behavior (Horngren et al., 2010). In this sense, cost management is an activity of great relevance in current economic conditions, constituting itself as a strategic factor for the competitiveness of companies (Dias & Padoveze, 2007).

A costing system is based on three elements: costing methods, costing forms and accumulation systems. Costing methods are designed to process and track costs to products and are segmented into cost-per-order and process costing systems, the former being best suited for large, single and special production items, where the latter is most suitable for operations continuous. The costing forms refer to the size of the cost object measurement and indicate the respective cost categories (standard, real cost, etc.). In turn, the last element informs the pathways for collecting, processing and outputting

information within the information system and relates to the type of production in question (Dias & Padoveze, 2007; Sharma & Ratnatunga, 1997).
In the specific case of the cost-per-order system, this allows the accruing of costs separately for each product or service, justified by the uniqueness of the product in question that generally uses different amounts of resources. In this way, this system allows knowing in detail the costs and profit margin of each production order, becoming a budgeting tool to determine the costs of subsequent production orders (Horngren et al., 2010).
At times, the absence or low use of instruments of control of materials, labor and general manufacturing expenses are noted, with these costs determined based on the experience and sensitivity of the collaborators. Thus, the elaboration and implementation of costing systems aimed at the specific needs of SMEs are tools used to professionalize management, however, it is important to understand the conditions that propitiate or condition their application in practice (Cardoso, 2011).

CURRENT COSTING SYSTEM

The company analyzed is a manufacturing company in the nautical sector, responsible for the construction of large vessels in naval aluminum, whose study will concentrate only one stage of production. The product system is driven by order, which gives rise to a production order that, in turn, divides the final product into subsets.
The budgets originate from the base project, where the dimensioning of the materials used in the construction is carried out, which in turn, are accounted for the product in question. Once the total weight of the product has been determined, this value is multiplied by the manufacturing rate calculated by the organization's manager, in the amount of R$ 38.00/kg, plus a 2% provision for the logistics service to be contracted.
Analyzing such methodology, some shortcomings can be identified in the budgetary process, given the little detail of information, where there is no differentiation of costs by categories, such as administrative, project, direct labor or indirect costs of production. To identify possible distortions, a survey of the equipment used in the production system, as well as the costs related to human and administrative resources was carried out. With this, it is sought to have a clearer definition of the cost drivers, to obtain a breakdown of the costs that base the total cost rate used.

Data to be entered into the system

For the evaluation of manufacturing costs, it is necessary to survey labor costs and general manufacturing costs. In order to calculate the value of direct labor, it is fundamental to identify the jobs, their respective remunerations and the number of working hours. Therefore, general manufacturing costs represent expenses related to industrial maintenance, mixed production resources and other sectors, such as electricity and calculation of depreciation in the period. This data is available in the organization's administrative sector.
Table 1 provides data that demonstrate the expenses of the productive process under study. This information supports the calculation of the labor charge and factory overload.

Table 1: Historical data of the productive process

Direct Labour Production sector	6
Indirect Labour Administrative sector	2
Working days (year)	276
Months of work	12
Total direct labor costs per year (R$)	180.522,38
Annual administrative costs (R$)	135.886,04
Total annual manufacturing overhead (R$)	32.447,66

Raw material

The control of the exit of any items from the warehouses is made from the material consumption record, checked at the time of the withdrawal of the inputs, relating information on date, quantity, material description, and destination order. Such records are stored in the organization's computer system. Raw material costs are efficiently controlled, recorded by order, based on size, type, quantity, and cost per kilo, thus accounting for material costs of the works that are eventually introduced into the tool.

Direct labor

Due to the dynamics of the productive process and the relative small size of the company, there is no clear definition of employees by activity or sector, since there is a need for each one to carry out a group of activities.
Based on the information about the company, tax regime, values of the composition of employee's compensation, monthly and daily benefits, inputs inherent to the function and social and labor charges it is possible to determine the man-day rate (Table 2).

Table 2: Labor rate calculated with the new tool (R$)

Job description	Base salary	Man-Day Rate
Overseer	2.250,00	176,28
Welder	1.800,00	145,33
Helper welder	1.200,00	102,47
Production assistant II	1.100,00	94,01
Production assistant I	980,00	84,42

Manufacturing Overhead costs

Manufacturing overhead represents all costs related to the inputs that serve the various sectors and activities of the company. In this study, the expenditures in question are on electrical energy, maintenance, and equipment depreciation (Table 3).

Table 3: General Manufacturing Overhead Costs

Electrical energy	R$ 9.791,63
Maintenance	R$ 7.144,38
Depreciation	R$ 15.511,65

In this case, two ways of allocating the factory overhead costs to the products are pointed out. The first alternative (version 1) is based on the number of employees as a function of time for each stage, generating a singular rate, which can be called the "cost of production", to be added to the product together with the rate of labor (or the man-day rate).
However, in the second alternative (version 2), the apportionment of general manufacturing costs is carried out based on the overall costs of overload as a function of the total value of direct labor. In this way, a single rate is created, which will accompany the labor value for each phase of the construction, and may be more interesting, since it is a more practical method.

Apportionment of Manufacturing Overhead Costs - Version 1

Version 1 is a more specific method, built on the company's job and salary plan. In the given plan, the positions are divided into 4 categories. In turn, each position has its respective functions. Each function has certain levels, so the category's participation is divided between the levels, but the difference in salary in percentage, from the higher level to the lower level, is increased by its real participation, that is, the overhead is apportioned proportionally to the remuneration of each employee. Knowing the participation of each function, the overload value is calculated for each function and, knowing that a year has 276 working days, is the daily function cost.

Apportionment of Manufacturing Overhead Costs - Version 2

The alternative approach (version 2) starts from the total amount of indirect manufacturing costs (R$ 32.447,66) and direct labor costs (R$ 180.522,38) both in the same calculation period. The division of values results in the overhead rate, 17,97%, which must be multiplied by the cost of labor budgeted, thus calculating the overhead costs for the product.

Costs of processing

Finally, the manufacturing cost is comprised of the sum of the costs of direct labor, general manufacturing costs, administrative and commercial costs.
In this way, in version 1, a direct labor rate and manufacturing overhead costs were determined for each function, which sum, in turn, represents the transformation costs (Table 4).

Table 4: Manufacturing Costs (R$) (Version 1).

Job description	Daily Cost	Manufacturing Overload	Total Daily Cost
Overseer	176,28	29,39	205,67
Welder	145,33	29,39	174,72
Helper welder	102,47	29,39	131,86
Production assistant II	94,01	16,29	110,30
Production assistant I	84,42	13,10	97,52

The administrative and commercial costs, in this version, are allocated according to the production time, the value being divided by the number of months of one year and the respective installments corresponding to the production period.
However, for version 2, labor costs are calculated by multiplying the daily rates required for each activity by the corresponding labor rates. Then, the relevant values are multiplied with the estimated factors of manufacturing overload (17.97%), administrative costs (75.27%) and commercial costs, which in this case do not occur at this stage of production.

The arrangement of the calculation tool

After the verification of all information about the company's business processes, especially the budgeting activity, the next stage was to present the proposals for improvements studied. It was observed the lack of standardized documents that support the budgeting process, which basically comprised only the material requirements and applied a manufacturing rate calculated by the manager of the organization. Faced with this situation, a tool was developed with two versions, which basically differ in the calculation of the apportionment of manufacturing overhead costs.
In version 1, the tool is composed of eight files: Material cost, manufacturing overhead, labor cost, total labor cost, manufacturing overhead distribution, administrative costs, commercial costs and cost of transformation. In version 2, due to the lower complexity for the determination of the factory overload, this one is composed by all the spreadsheets of the first version, except for the overhead sheet of fabrication and, by virtue of the calculation methodology, received a slight change in the transformation cost sheet.
All files were created to relate as much information as possible in order to facilitate proper adjustments to each period or product modification and serve as a basis for similar processes when budgeting for new products. The only exception is for the transformation cost worksheet, which is responsible for gathering all the values found in the previous steps.

RESULTS

The object of study was the construction of a hull, designed and built by the company, which presents itself as a component of the vessel, exerting a direct influence

on the structural capacity, stability, performance, design, and quality of the element. Therefore, among the mentioned points, the importance of the study on this component is given by its participation in the total cost of the product, since this part of the product concentrates the raw materials of larger dimensions, weight and added value (Figure 1).

Figure 1: Large vessel

The budgeting process starts from the knowledge of the dimensions arranged in the product design (Figure 2).

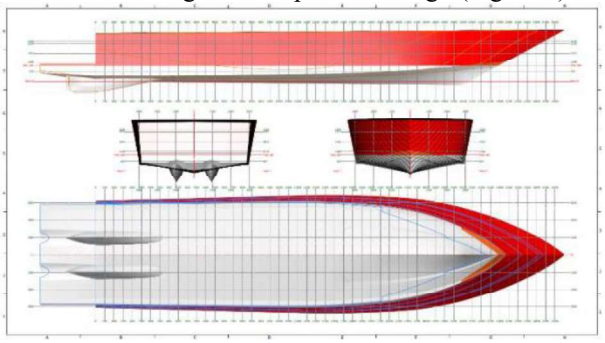

Figure 2: Hull design of a vessel.

Initially, the materials and dimensioning of the components are identified and defined. Subsequently, a quantitative survey of the materials used is carried out and the total weight is calculated. Afterwards, the time spent and the number of employees per function are taken into account.

Current System

Assuming the calculation method of the company's current system, in which a total cost of R$ 38,00 per kilogram of manufactured aluminum is considered, the following value of the work (Table 5) is found.

Table 5: Budget in the current model.

Module 1 – Processing Cost			
Item	Description	Kg	Value (R$)
1.1	Materials	18.211	692.018,00
1.2	Labor		
1.3	Indirect manufacturing costs		
1.4	Administrative costs		
1.5	Commercial costs		
1.6	Other		
	Sub-Total		692.018,00
Module 2 – Direct Expenses			
Item	Description	%	Value (R$)
2.1	Transportation	2,00	13.840,36
2.2			
	Sub-Total	2,00	13.840,36
Total Cost of Processing			
Item	Description	%	Value(R$)
1	Module 1	98,00	692.018,00
2	Module 2	2,00	13.840,36
	Total		705.858,36

As mentioned before, for the company's system, the only value to be added to the manufacturing rate is the 2% value, referring to the logistics service to move the product from the production area to the river. Therefore, for the current version of the company, the budgeted amount is $ 705,858.36.

Proposal Version 1

The cost calculation from the first proposal will be given by the insertion of labor cost data, from the information contained in Table 4. The labor cost for this method is R$ 137.021,10. Remembering that this system adds the value of direct labor and manufacturing overhead, so their values will be higher than version 2 proposal. Then the administrative costs are calculated proportionally to the working period. If so, the value of the product is determined and presented in the next sheet of the proposed system (Table 6).

Table 6: Budget in the proposed system (version 1).

Module 1 – Direct Costs			
Item	Description	%	Value (R$)
1.1	Materials	73,47	379.406,77
1.2	Labor	26,53	137.021,10
1.3	Others		
	Sub-Total	100,00	516.427,87
Module 2 – Indirect Costs			
Item	Description	%	Value (R$)
2.1	Administrative costs	100,00	88.621,31
2.2	Commercial costs	0,00	
2.3	Others		
	Sub-Total	100,00	88.621,31
Module 3 – Direct Expenses			
Item	Description	%	Value(R$)
3.1	Transportation	2,00	12.100,98
3.2	Project	2,00	12.100,98
3.3			
	Sub-Total	4,00	24.201,96
Total Cost of Processing			
Item	Description	%	Value (R$)
1	Module 1	82,07	516.427,87
2	Module 2	14,08	88.621,31
3	Module 3	3,85	24.201,96
	Total	100,00	629.251,14

It is observed that different from the current system, the value of the project, of this stage of the work, is already broken down as direct expenses, in the amount of 2% of the cost of the product. The total cost of processing the

work in question for the proposed system (version 1) is R$ 629.251,15.

Proposal (version 2)

In version 2 proposal, labor costs and manufacturing overhead costs are separate. In this way, the labor cost values are calculated first, and then the manufacturing and administrative overhead take as reference the cost of labor, whose rates are predefined, thus forming the cost of the product (Table 7).

Table 7: Budget in the proposed system (version 2)

Module 1 – Direct Costs			
Item	Description	%	Value (R$)
1.1	Materials	73,47	379.406,77
1.2	Labor	26,53	115.217,85
1.3	Others		
	Sub-Total	100,00	494.624,62
Module 2 – Indirect Costs			
Sub-Module 2.1 – Indirect Manufacturing Costs			
Item	Description	%	Value (R$)
2.1.1	Indirect Manufacturing Costs	17,97	20.704,65
2.1.2	Others	0,00	
	Sub-Total	17,97	20.704,65
Sub-Module 2.2 – Administrative Costs			
Item	Description	%	Value (R$)
2.2.1	Administrative Costs	75,27	86.724,48
2.2.2	Others		
	Sub-Total	75,27	
Sub-Module 2.3 – Commercial Costs			
Item	Description	%	Value (R$)
2.3.1	Commercial Costs		
2.3.2	Others		86.724,48
	Sub-Total	0,00	0,00
Module 2 – Indirect Costs			
Item	Description	%	Value (R$)
2.1	Sub-Module 1		20.704,65
2.2	Sub-Module 2		86.724,48
2.3	Sub-Module 3		0,00
	Sub-Total	0,00	107.429,13
Module 3 – Direct Expenses			
Item	Description	%	Value(R$)
3.1	Transportation	2,00	12.041,07
3.2	Project	2,00	12.041,07
3.3			
	Su-Total	4,00	24.082,14
Total Cost of Processing			
Item	Description	%	Value (R$)
1	Module 1		494.624,62
2	Module 2		107.429,13
3	Module 3		24.082,14
	Total	0,00	626.135,89

The cost of producing the hull of the vessel in the second version of the costing system is R$ 626.135,89.

DISCUSSION OF RESULTS

After the cost of producing the hull of the vessel has been calculated through the three approaches just presented, three different values were obtained (Table 8).

Table 8: Values of the budgets of the analyzed approaches (R$)

Current system	705.858,36
Proposal version 1	629.251,15
Proposal version 2	626.135,89

Confronting the values found by the three approaches, it is possible to affirm that the current system and the second version promote the highest and lowest values, respectively. While in the current version a global rate is used from the weight of the required material, version 2 is based on labor cost, which rate is defined by function and related to the period, to allocate overhead costs and administrative costs. Accordingly, a difference of R$ 79.722,47 was observed, or approximately 11,3%. However, version 1 presents an intermediate value, being R$ 76.607,21 lower than the one found in the current model, or approximately 10.85%, and around 0.5% higher than version 2, which corresponds to R$ 3.115,26. When analyzing the differences, it can be said that the current model overestimates the cost of the works. In contrast, the proposed models can help the organization to become more competitive through more effective calculation methods, which in this case reflects in the reduction of values.

The differences between the proposed versions are presented in the calculation methodology. The cost of materials remains unchanged in both versions, while in version 1, the cost of labor with the added value of overload, calculated according to the contribution of each labor, reflects a difference for version 2 of about R$ 1.098,60. The second model presents the lowest value because in this model the indirect manufacturing costs are allocated through a predefined rate as a function of the labor value. The same is repeated for administrative costs, which method causes a difference of R $ 1,896.33, as these costs are allocated proportionally to the time of service in version 1.

In comparison to the current version, the proposed models allow verification of the quality of the values obtained, due to the level of detail of the information. The proposed systems are largely similar in composition with regard to material costs, determination of labor cost per job, administrative costs and commercial costs. There is a slight change in the transformation costs sheet and, in version 1, there is the overhead spreadsheet, whose values make up the total cost of labor. Based on these spreadsheets and their respective calculation statements, there is a high consistency of the data obtained, especially when compared to the current form of budgeting and its value discrepancy.

When comparing the proposed systems, it is possible to verify that version 2 is a more practical method, mainly for the budgeting of several services in the same period, whose study to define the imputation rates can be done at the beginning of the period and, if necessary, carried out in pre-defined periods to determine the imputation rates. Whereas, in version 1, the study must be carried out

whenever there is a change in the value of overload or change in the number of employees of the company, which, during the stages of the work, will become repetitive work.

Although version 1 presents the most consistent and realistic calculation procedures to obtain the production costs, essentially due to the particularity required to determine the transformation cost, it should be noted that such qualities require more time for planning, controlling and costing, adding a higher labor cost in its elaboration and, noting the reality of the reduced operational framework of this organization's management, this may not be the main system to be used by the company, basically due to the great demand for requests in certain periods of activity. However, in the case of version 2, whose values are more generally determined, being the most widely used, it is possible to use version 1 as a method of comparing processing (or transformation) costs.

CONCLUSIONS AND FURTHER RESEARCH

The study undertaken allowed the deepening of the knowledge of the productive chain of the company. In fact, weaknesses in business processes were identified, in particular in the budgeting process. For example, a lack of documents to support the calculation of the manufacturing rate used was found. This value was treated as a global rate, which did not make any distinction of costs by category (administrative, project costs, direct labor or indirect production costs) and used the weight of the raw material required as a basis for allocating costs.

In this way, it was perceived that the low level of detail of costs could generate discrepancies in the costs budgeted mainly when it was necessary to readjust the rate at the beginning of each period, as well as changes in design or raw material. In view of this, two new costing approaches were proposed, being characterized by having a more organized and sequential set of procedures, easy to understand, consisting of spreadsheets that aim at detailing the costs and the ease of corrections or adjustments in any steps that make up the budgeting process.

The focus of the study was directed to the bases of cost allocation because the cost driver is the way in which resource consumption is related to an activity and the consumption of activities is related to a product. In other words, it means the process by which indirect manufacturing costs are distributed across the products in order to obtain the industrial cost of the products.

For version 1, the imputation bases followed the proportion of participation per position, being subdivided by each function, creating a labor rate with the aggregate overhead cost for each position. In this way, it is possible to calculate a particular overload rate for each sector and job position. The administrative costs are allocated in function of the elapsed time of the work. However, for version 2 the cost driver is the value of direct labor, which affects the manufacturing overhead and administrative costs for each construction.

Because of the particularity of the values in version 1, it will require updates at every change in the number of jobs or functions or in the amount of overhead costs. However, version 2 is presented as a more simplified overhead distribution system but can cause distortions in the cost of the product, especially if the rates for the period are not well cleared and potential damages to the company in the case of products that require a low level of manufacturing.

In summary, the main contribution of this research was the structuring of the budgeting process through the proposal of a costing system. The stages of the system promoted the ordering of processes and detailing the expenses that make up the transformation cost, facilitating the correction and updating of amounts for identical services or serving as support for unpublished works, refuting the use of a standard rate and generating realistic values and in a well-founded manner. Another benefit of detailing the information is the possibility of analyzing the sources of expenses, aiming at optimizing the resources, making the company more competitive and prepared for growth.

Finally, for future work, a series of improvements are forseen to be made, such as effective control and data collection of direct expenses with the product, comparing planned and actual data, accounting for depreciation costs, and conducting a more accurate analysis of administrative costs in order to raise possible cost classification misunderstandings.

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