

Analysis of The Application of Mathematical Methods in the Cost By Absorption in the Customization of the Cost of Joint Products In A Moe Industry: A Management Contribution

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Abstract: *The present case study has as objective to analyze the application of mathematical methods in the absorption costing in the calculation of the cost of joint products in a milling industry. It presents the attribution to the products of the joint costs based on the criteria: by revenue, net realizable value, unit gross profit equality, percentage gross profit equality, profitability equality and physical units. Refers to an applied, quantitative, descriptive approach, with data collected in a documentary form. It demonstrates the comparison of the applied criteria, evidencing that each mathematical method used presents different net results for the company, even negative. It emphasizes that the analyzes of productive costs can bring important management information to the company, since the established allocation criterion directly interferes with profitability and can lead the company manager to make improper decisions regarding some products that apparently can Opinion does not contribute to the positive outcome of the business institution. Thus, the importance of strategic cost management in industries, as an aid and decision-making tool and the respective model reflexes and mathematical criteria, is highlighted.*

Keywords: *Joint costs. Allocation criteria. Strategic management.*

I. Introduction

The ability of a business organization to know and perform an efficient analysis of its production costs can contribute significantly to the processes of decision making. Thus, management in this area brings to the manager different visions regarding the products, revenue generation and profitability of the company. In this context, it is observed that some industries use joint production, that is, two or more products made from the same raw material, with the same cost structure until a certain stage of production. These costs, which are common to all products, must be appropriated to them, according to some established criteria. These industries exploit activities that generate, in addition to the main product, also by-products and residues, which can not be excluded from the production process. These factors are called joint production, since the same inputs are used. The industries with joint production should seek a way to allocate their costs to the products, seeking the application of strategic cost management.

It is important to remember that some industries, such as mills, oil companies, timber companies, or dairy producers, produce the main product of their activity, and they also generate by-products and waste. These can not be excluded from the production process and can be an alternative to generating revenue. Joint Costs arise when one process simultaneously generates several products and, up to a stage called the separation point, consumes the same inputs. With joint costs, there is a need to allocate these to each individual product, since no more sophisticated criteria can determine the quantity of resources individually consumed by the products to the separation point in an indisputable way and in a viable way. [1] However, absorption costing allows for the attribution of costs through mathematical methods the equality of the gross profit percentage and, also, the equality of profitability. This assignment allows the company a broader, managerial and strategic vision, contributing to decision making. Thus, it is important to verify, among several alternatives of cost allocation, the possible contributions at the managerial level when it comes to joint products, evidencing the most appropriate option for the industry studied.

II. Methodological procedures

The specification of the research methodology is the one that encompasses a greater number of items, since they answer, at one and the same time, to the questions how?, with what?, where?, how much?. "This is a description of the methods and techniques chosen for The collection of data in the search to solve the research problem. [2] Regarding the nature of the research, it was applied, since it sought to carry out the data collection

on the subject, with the purpose of generating knowledge with practical application, aiming to obtain favorable results regarding the problem and the objectives.

As for the objectives, this research was classified as a descriptive one that worries about observing the facts, registering them, analyzing them, classifying them, and the researcher does not interfere with them. Thus, the phenomena of the physical and human world are studied, but are not manipulated by the researcher. [3]

Therefore, this classification is identified as to its objectives, since this research sought to record, analyze and classify the data provided by the milling company. In this way, this research is classified in a case study, with documentary data collection and case study. The documentary research has the purpose of studying, analyzing and interpreting documents already published, seeking to extract important information. This research has this classification since it verified and analyzed documents made available by the company. From the point of view of the approach to the problem, the research design was quantitative research, since it is specially designed to generate accurate and reliable measurements that allow a statistical analysis. [3] Thus, this classification is justified in approaching the problem, since the research used numerical tables as well as graphical representation of the results found. In the present research, documents such as accounting, financial, managerial and cost reporting were used for data collection.

The collected data were analyzed according to the presented criteria where the costs of the joint production are allocated through the amount, through the revenue, of the net realizable value, of the unitary gross profit, [1] and also through the gross percentage profit. Also for analysis of the data, spreadsheets were used in Microsoft Excel, for calculations and simulations.

III. Development

As for the products manufactured, these are basically divided into four types: flour type 1, flour type 2, bran and glue flour, with sales prices, gross and net of taxes shown in table I:

Table I - Sales prices practiced by the milling industry, with taxes levied on sales

Product	Selling Price (Kg) (R\$)	ICMS – SC (R\$)	PIS (R\$)	COFIN S (R\$)	Final Sales Price (R\$)
Flour Type 1	1,03	0,12	0,00	0,00	0,91
Flour Type 2	0,82	0,10	0,00	0,00	0,72
Bran	0,44	0,00	0,01	0,03	0,40
Paste	0,66	0,11	0,01	0,05	0,49

Source: Authors (2017)

The studied milling industry has a manufacturing process, that is, a sequence of actions taken to obtain the finished product. This process begins with the arrival of the cart with the raw material that, in this company, is the wheat in grain. This cart passes the balance for weighing, and is conducted for unloading in the hopper. Then, the grain of wheat goes through the pre-cleaning and remains in the storage silos. Before the grain comes into the grinding process, you need a new cleaning and rest of approximately 24 hours. Then it goes to the grinding, to the aspiration and to the sifting, where the four products are separated. Therefore the sifting system is the separation point of this industry. After this process, in the type 1 flour is added some products for the formation of the mix, and this product goes to the storage silos for further bagging. The other products go directly to the storage silos and are then bagged. So, the products are now ready for sale.

This highlights the point of separation of this industry, which is where products can already be identified separately. In this case, the separation point occurs with the sieving system, where the wheat grain, after the transformation actions, is separated into type 1 flour, type 2 flour, bran and glue flour. Production costs are composed of raw material, direct and indirect labor, packaging, depreciation, in addition to other indirect costs. The raw material cost is given by the amount processed monthly, which is approximately 500,000 kg (five hundred thousand kilograms) of wheat grain, multiplied by the acquisition value, deducting the value corresponding to ICMS which is a recoverable tax for the company, Therefore it is not included in the cost, according to Table II, while Table 3 presents the utilization of the raw material processed monthly

Table II - Cost with raw material used in the milling industry.

RAW MATERIALS - Wheat (in grain)	
Monthly Amount in Process (kg)	500.000
Acquisition Amount (kg)	R\$ 0,61
Total Acquisition Amount	R\$ 305.000,00
Recoverable Tax (ICMS - 12%)	R\$ 36.600,00
Purchase cost	R\$ 268.400,00
Acquisition Cost Per Kg	R\$ 0,54

Source: Authors (2017)

Table III - Utilization of the raw material by product, in the milling industry.

Harvesting wheat			
Raw Material	500.000,00	kg	100%
Flour Type 1	340.000,00	kg	68%
Bran	95.000,00	kg	19%
Flour	20.000,00	kg	4%
Flour Type 2	45.000,00	kg	9%

Source: Authors (2017)

The cost of packaging the products, which is identified from the purchase price of each package, deducting the recoverable taxes, in this case PIS and COFINS, since these are not included in the cost, as shown in Table IV.

Table IV - Cost per product packaging, used in the milling industry.

PACKAGING COST						
Product	Capacity (in kg)	Price (R \$)	Uni d.	(-) Taxes (R\$)	Cost of Packaging (R \$)	Cost Per Kg (R \$)
Flour Type 1	5	0,26	pct	0,02	0,23	0,05
Flour Type 2	50	0,64	sc	0,06	0,58	0,01
Bran	30	0,89	sc	0,08	0,81	0,03
Flour	50	0,64	sc	0,06	0,58	0,01

Source: Authors (2017)

IV. Application of the method

For the application of the method, after collecting all production costs, it was necessary to identify and classify the joint, separable and even indirect costs. Therefore, it was verified that part of the direct labor and the total raw material, are joint costs, that is, they are common to all the products until the point of separation. In the case of direct labor before the point of separation and posterior, proportional values were used based on the total hours and used. Thus, joint production costs were calculated according to Table V.

Table V - Total joint costs in the milling industry.

JOINT COSTS	
Feedstock	R\$ 268.400,00
Direct labor	R\$ 6.133,86
Total	R\$ 274.533,86

Source: Authors (2017)

The separable costs in this industry, however, are formed by the remainder of the direct labor, along with the cost of packaging the products. Direct labor after the point of separation is considered, in this case as fixed direct cost. Since this is a fixed cost, it needs to be prorated to the products. The utilization of the raw material was then used as the apportionment criterion, since there is an expressive complexity in identifying the hours used in each department of this industry. The apportionment of these fixed costs can be verified in table VI.

Table VI - Fixed direct cost assessment, used in the milling industry.

Product	Use of Raw Material	Labor Cost(R\$)
Flour Type 1	68%	4.413,95
Flour Type 2	19%	1.233,31
Bran	4%	259,64
Flour	9%	584,20
Total	100%	6.491,11

Source: Authors (2017)

The cost of packaging the products in this case is considered as a variable direct cost, and for a production of 500,000 kg of raw material, according to table VII and the fixed costs are presented in table VIII.

Table VII - Total cost with packaging in the milling industry.

Product	Cost Per Kg Packed (R \$)	Production (in kg)	Total cost (R\$)
Product	0,05	340.000,00	15.743,46
Flour Type 1	0,01	95.000,00	1.106,97
Flour Type 2	0,03	20.000,00	540,27
Bran	0,01	45.000,00	524,35
Total	-	500.000,00	17.915,04

Source: Authors (2017)

Table VIII - Total indirect fixed costs in the milling industry

Indirect Fixed Costs	
Indirect Labor Force	R\$ 5.242,18
Depreciation	R\$ 8.500,00
Other Costs	R\$ 27.748,50
Total	R\$ 41.490,68

Source: Authors (2017)

Since it is a fixed cost, there is a need to apportion the products, based on the use of the raw material:

Table IX - Indirect fixed costs prorated, of the milling industry.

Product	Use of Raw Material	Fixed Rate Costs (R \$)
Product	68%	28.213,66
Flour Type 1	19%	7.883,23
Flour Type 2	4%	1.659,63
Bran	9%	3.734,16
Total	100%	41.490,68

Source: Authors (2017)

Thus, with all costs identified and classified, it becomes possible to apply the method, which consists in assigning the joint costs to each product according to different directions.

A) Mathematical Method of Assigning Revenue-Driven Joint Costs

When using the criterion of allocation of the joint costs through the revenue, after calculating it in a net form of taxes individually for each product, the joint costs are allocated proportionally to this one. Identifying the total of the joint costs is divided by the total revenue and this result multiplies by the revenue of each product. [4]

Table X - Application of the method of allocation of joint costs, according to revenue.

	Flour 1	Flour 2	Bran	Flour	Total
Quantity (in kg)	340.000,00	45.000,00	95.000,00	20.000,00	500.000,00
Description (R\$)	(R\$)	(R\$)	(R\$)	(R\$)	(R\$)
Price Kg (net of taxes)	0,91	0,72	0,40	0,49	
Liquidrevenueofsales	309.400,00	32.400,00	38.000,00	9.800,00	389.600,00
Joint Costs	218.020,47	22.830,84	26.776,92	6.905,63	274.533,86
Separation Point Profit	91.379,53	9.569,16	11.223,08	2.894,37	115.066,14
DirectVariableCost	15.743,46	1.106,97	540,27	524,35	17.915,04
FixedDirect Rate Charge	4.413,95	584,20	1.233,31	259,64	6.491,11
Fixed Rate	28.213,66	3.734,16	7.883,23	1.659,63	41.490,68
IndirectCosts					
Profit	43.008,46	4.143,83	1.566,28	450,75	49.169,31
AfterSeparation Point					
Gross profit (%)	29,53%	29,53%	29,53%	29,53%	29,53%
Profitability	13,90%	12,79%	4,12%	4,60%	12,62%

Source: Authors (2017)

The gross profit, that reached by the company at the point of separation, when compared to net sales revenue, represents a percentage of 29.53% for all products. However, when observing the profitability in relation to the same recipe, it is verified that the flour type 1 is the one that receives the greater percentage, being 13.90%. Then, the flour type 2, with 12.79%, followed by the glue flour with 4.60% and finally the bran with 4.12%. Complementing the analysis of the allocation according to the revenue, it is verified that of the total of the profit obtained in the separation point, R \$ 115,066.14 (one hundred and fifteen thousand and sixty-six reais and fourteen cents), 79% refers to flour type 1, 10% to the bran, 8% to the flour type 2 and only 3% to the glue flour. Also, when analyzing the composition of the company's total profitability, of the amount of forty-nine thousand, one hundred sixty-nine reais and thirty-one centavos (R \$ 49,169.31), 88% refers to flour type 1, 8% To type 2 flour, 3% to bran and only 1% to glue flour.

B) Assignment of Joint Costs Directed by Net Realizable Value

This method, which consists of allocating the joint costs according to their net realizable value, requires an initial calculation. Thus, in order to find the basis of the allocation, the net cost of sale, the costs after the separation point, are subtracted from the direct variable cost, prorated fixed cost and prorated fixed indirect costs in this case study. [5]

Table XI - Application of the method of allocation of joint costs, according to net realizable value.

	Flour 1	Flour 2	Bran	Flour	Total
Quantity (in kg)	340.000,00	45.000,00	95.000,00	20.000,00	500.000,00
Description	(R\$)	(R\$)	(R\$)	(R\$)	(R\$)
Price Kg (net of taxes)	0,91	0,72	0,40	0,49	
Net Realizable Value	261.028,93	26.974,67	28.343,20	7.356,38	323.703,17
Liquid revenue of sales	309.400,00	32.400,00	38.000,00	9.800,00	389.600,00
Joint Costs	221.379,60	22.877,32	24.037,97	6.238,97	274.533,86
Separation Point Profit	88.020,40	9.522,68	13.962,03	3.561,03	115.066,14
Direct Variable Cost	15.743,46	1.106,97	540,27	524,35	17.915,04
Fixed Direct Rate Charge	4.413,95	584,20	1.233,31	259,64	6.491,11
Fixed Rate	28.213,66	3.734,16	7.883,23	1.659,63	41.490,68
Indirect Costs					
Profit After Separation Point	39.649,33	4.097,35	4.305,23	1.117,41	49.169,31
Gross profit (%)	28,45%	29,39%	36,74%	36,34%	29,53%
Profitability	12,81%	12,65%	11,33%	11,40%	12,62%

Source: Authors (2017)

It is observed that when the joint costs are attributed through net realizable value, the gross profit at the point of separation of type 1 flour is 28.45% when compared to the income of this product, in type 2 flour this percentage is 29, 39%, in the bran of 36.74% and in the glue meal the percentage is 36.34%.

Regarding profitability in relation to the revenue of each product, type 1 flour has a percentage of 12.81%, flour type 2, 12.75%; The bran, 11.36% and the glue flour, 11.40%. It is interesting to verify the proximity of percentages between type 1 and type 2 flour, as well as between bran and glue flour. This is because all the costs after the separation point were prorated according to the same criterion: the use of the raw material. In addition, to verify the composition of the total gross profit obtained at the separation point, which is R \$ 115,066.14 (one hundred and fifteen thousand, sixty-six reais and fourteen cents), it is verified that 77% of this amount is obtained through flour type 1, 12% of the bran, 8% of the flour type 2 and only 3% through the flour of glue,

Regarding the composition of the profitability after the separation point, a total of forty-nine thousand one hundred sixty-nine reais and thirty-one centavos (R \$ 49,169.31), it is observed that 81% is obtained by flour type 1, 9% for the bran, 8% for the flour type 2 and only 2% for the glue flour.

C) Allocation of Joint Costs Directed by the Equality of Gross Unit Profit

The method of assigning the joint costs by means of the unit gross profit equality consists of: To assign the joint costs according to the unit gross profit equality, it is first necessary to find it. To obtain this value, the total profit obtained at the separation point is identified and divided by the total amount of raw material, in this case 500,000 kg. Then, the unit gross profit found must be multiplied by the amount of raw material used for each product, thus obtaining the profit at the separation point. If the value of the revenue and the value of the profit at the separation point, the joint cost will be The difference between the two. . [7]

Table XII - Application of the method of assigning the joint costs, according to the unit gross profit equality.

	Flour 1	Flour 2	Bran	Flour	Total
Quantity (in kg)	340.000,00	45.000,00	95.000,00	20.000,00	500.000,00
Description	(R\$)	(R\$)	(R\$)	(R\$)	(R\$)
Price Kg (net of taxes)	0,91	0,72	0,40	0,49	
Gross Unit Profit	0,23	0,23	0,23	0,23	
Liquid revenue of sales	309.400,00	32.400,00	38.000,00	9.800,00	389.600,00
Joint Costs	231.155,02	22.044,05	16.137,43	5.197,35	274.533,86
Separation Point Profit	78.244,98	10.355,95	21.862,57	4.602,65	115.066,14
Direct Variable Cost	15.743,46	1.106,97	540,27	524,35	17.915,04
Fixed Direct Rate Charge	4.413,95	584,20	1.233,31	259,64	6.491,11
Fixed Rate	28.213,66	3.734,16	7.883,23	1.659,63	41.490,68
Indirect Costs					
Profit After Separation Point	29.873,91	4.930,62	12.205,76	2.159,02	49.169,31
Gross profit (%)	25,29%	31,96%	57,53%	46,97%	29,53%
Profitability	9,66%	15,22%	32,12%	22,03%	12,62%

Source: Authors (2017)

It can be observed that, by assigning the unitary gross profit, the bran concentrates the highest percentage of gross profit (in relation to revenue), 57.53%, followed by glue flour with 46.97%. The type 2 flour reaches 31.96% while the flour type 1, only 25.29% of gross profit. This is because the gross profit per kg is equalized for all products, however the selling price is different, so the product with a lower sales price per kg, has the highest profit in the separation point in percentage, while the product that Has the highest selling price per kg, has the lowest profit at the point of separation in percentage, since it is attributed a higher joint cost value.

Profitability after the point of separation follows the same line of reasoning as gross profit. The bran, which is the product with the lowest selling price, is 32.12%, followed by glue flour with 22.03%, while type 1 and 2 flour is 9.66% and 15.22% , Respectively. On the other hand, if the composition of the gross profit at the point of separation, which is a total of R \$ 115,066.14 (one hundred and fifteen thousand, sixty-six reais and fourteen cents) is analyzed, 68% of this value corresponds to flour Type 1, 9% to flour type 2.19% to bran 19% and only 4% to glue flour. As to the composition of profitability, which is obtained after the separation point, a total amount of forty-nine thousand one hundred sixty-nine reais and thirty-one centavos (R \$ 49,169.31) is 61% of the flour type 1, 25% of the bran, 10% of the flour type 2 and 4% of the flour of glue.

D) Allocation of Joint Costs Driven by Equal Gross Profit Percentage

To achieve the allocation of the joint costs through the equality of gross profit, it is initially necessary to identify it. Find the total profit at the point of separation, divide by the total revenue and multiply by the revenue of each product. In this way, the profit value can be obtained at the point of separation of each product, which represents the same percentage of revenue. With the values referring to revenue and profit at the point of separation in each product, the difference between these values will be the corresponding joint cost. . [8]

Table XIII - Application of the method of allocation of joint costs, according to the equality of the gross percentage profit.

	Flour 1	Flour 2	Bran	Flour	Total
Quantity (in kg)	340.000,00	45.000,00	95.000,00	20.000,00	500.000,00
Description	(R\$)	(R\$)	(R\$)	(R\$)	(R\$)
Price Kg (net of taxes)	0,91	0,72	0,40	0,49	
Liquidrevenueofsales	309.400,00	32.400,00	38.000,00	9.800,00	389.600,00
Joint Costs	218.020,47	22.830,84	26.776,92	6.905,63	274.533,86
Separation Point Profit	91.379,53	9.569,16	11.223,08	2.894,37	115.066,14
DirectVariableCost	15.743,46	1.106,97	540,27	524,35	17.915,04
FixedDirect Rate Charge	4.413,95	584,20	1.233,31	259,64	6.491,11
Fixed Rate IndirectCosts	28.213,66	3.734,16	7.883,23	1.659,63	41.490,68
Profit AfterSeparation Point	43.008,46	4.143,83	1.566,28	450,75	49.169,31
Gross profit (%)	29,53%	29,53%	29,53%	29,53%	29,53%
Profitability	13,90%	12,79%	4,12%	4,60%	12,62%

Source: Authors (2017)

After applying this possibility of joint cost allocation, it can be seen that gross profit, when compared to revenue, represents the same percentage for all products, which is 29.53%.

Comparing profitability with revenue, the percentages are 13.90%, 12.79%, 4.12% and 4.60% for type 1, type 2, bran and gluten meal, respectively. In addition, the profit composition at the point of separation can still be evaluated. Of this amount, which amounts to R \$ 115,066.14 (one hundred and fifteen thousand, sixty six reais and fourteen cents), 79% is obtained through type 1 flour, followed by bran, 10% of type 2 flour, 8% and glue flour with only 3%. As regards the composition of profitability after the separation point, it can be seen that, out of the total of forty-nine thousand, one hundred and sixty-one (R \$ 49,169.31) Real and thirty-one cents), 88% corresponds to type 1 flour, 8% corresponds to type 2 flour, 3% to bran and only 1% to glue flour.

E) Assignment of Joint Costs Directed by Equality of Profitability

When using the method of assigning the joint costs to equality of profitability, it must be calculated as follows: identify the profit after the separation point in the total column which, divided by the total revenue and multiplied by the revenue of each product, will result in Profit of each product, in reais after the point of separation. This profit added to the direct costs (variable and fixed) and indirect costs, will result in the profit referring to the separation point. This, if subtracted from the revenue generated by each product, will result in the allocated total cost. [1]

Table XIV - Application of the method of allocation of joint costs, according to the equality of profitability.

	Flour 1	Flour 2	Bran	Flour	Total
Quantity (in kg)	340.000,00	45.000,00	95.000,00	20.000,00	500.000,00
Description	(R\$)	(R\$)	(R\$)	(R\$)	(R\$)
Price Kg (net of taxes)	0,91	0,72	0,40	0,49	
Liquidrevenueofsales	309.400,00	32.400,00	38.000,00	9.800,00	389.600,00
Joint Costs	221.981,23	22.885,64	23.547,42	6.119,57	274.533,86
Separation Point Profit	87.418,77	9.514,36	14.452,58	3.680,43	115.066,14
DirectVariableCost	15.743,46	1.106,97	540,27	524,35	17.915,04
FixedDirect Rate Charge	4.413,95	584,20	1.233,31	259,64	6.491,11
Fixed Rate IndirectCosts	28.213,66	3.734,16	7.883,23	1.659,63	41.490,68
Profit AfterSeparation Point	39.047,70	4.089,03	4.795,77	1.236,81	49.169,31
Gross profit (%)	28,25%	29,37%	38,03%	37,56%	29,53%
Profitability	12,62%	12,62%	12,62%	12,62%	12,62%

Source: Authors (2017)

Thus, when allocating the joint costs according to this criterion, it is possible to observe that the gross profit in type 1 flour, when compared to its revenue, is 28.25%. In type 2 flour this percentage is 29.37%, 37.56% in glue flour and 38.03% in bran. Profitability, according to this method, is 12.62% for all products. A total of R \$ 115,066.14 (one hundred and fifteen reais and fourteen cents), 76% refers to the flour type 1, 13% To the bran, 8% to the flour type 2 and only 3% to the glue flour. The composition of the company's total profitability, which is a total value of forty-nine thousand, one hundred and sixty-nine reais (R \$ 49,169.31), is made up of type 1 flour, representing 79% of the total . The remaining 21% is divided into 10% for the bran, 8% for the flour type 2 and 3% for the glue flour.

F) Assignment of Joint Costs Directed by Physical Units

The joint cost allocation method directed by the physical units aims to allocate the costs before the separation point in proportion to the quantity produced, in the case under study, in kilos. Thus, the total of the joint costs is divided by the total amount (500,000 kg) and this result is multiplied by the quantity of flour type 1 (340,000 kg) to find the joint cost share corresponding to this product. This is also done with flour type 2, with the bran and with the glue flour. [5]

Table XV - Application of the method of assigning joint costs, according to the physical units.

	Flour 1	Flour 2	Bran	Flour	Total
Quantity (in kg)	340.000,00	45.000,00	95.000,00	20.000,00	500.000,00
Description	(R\$)	(R\$)	(R\$)	(R\$)	(R\$)
Price Kg (net of taxes)	0,91	0,72	0,40	0,49	
Liquidrevenueofsales	309.400,00	32.400,00	38.000,00	9.800,00	389.600,00
Joint Costs	186.683,02	24.708,05	52.161,43	10.981,35	274.533,86
Separation Point Profit	122.716,98	7.691,95	- 14.161,43	- 1.181,35	115.066,14
DirectVariableCost	15.743,46	1.106,97	540,27	524,35	17.915,04
FixedDirect Rate Charge	4.413,95	584,20	1.233,31	259,64	6.491,11
Fixed Rate IndirectCosts	28.213,66	3.734,16	7.883,23	1.659,63	41.490,68
Profit AfterSeparation Point	74.345,91	2.266,62	- 23.818,24	- 3.624,98	49.169,31
Gross profit (%)	39,66%	23,74%	-37,27%	-12,05%	29,53%
Profitability	24,03%	7,00%	-62,68%	-36,99%	12,62%

Source: Authors (2017)

Following this reasoning, it is possible to verify that through this direction, the bran and the glue flour obtained damage already at the point of separation. When compared to the recipe, these two products (bran and glue flour) obtained 37.27% and 12.05% of negative results, while type 1 and type 2 flour had a profit at the separation point of 39.66 % And 23.74%, respectively.

Regarding the profitability after the separation point, the bran and the glue meal again had a negative result, being 62.68% and 36.99%. The type 1 flour had a profit of 24.03% and flour type 2 of 23.74%. In addition, the composition of gross profit at the point of separation, which is a total amount of R \$ 115,066.14 (one hundred and fifteen thousand, sixty six reais and fourteen cents), type 1 flour represents the highest percentage (84%). , Followed by type 2 flour (5%). On the other hand, the bran and the glue flour suffered losses (10% and 1%, respectively).The composition of the company's total profitability, amounting to R \$ 49,169.31 (forty-nine thousand, one hundred sixty-nine reais and thirty-one centavos), 71% refers to type 1 flour and 2% to flour Type 2. The bran represents a loss of 23% and the glue meal of 2%.

V. Conclusion

In applying the various attributions of the joint costs, based on the different possible criteria, it is emphasized that the allocation criterion according to the physical units, which would be the quantity produced, becomes impracticable, as it ends up leaving two products at a loss, Point of separation. Another justification for the unfeasibility of this method in this industry is the fact that the wheat grain (raw material used) has several layers, which produce different qualities of flour. In this way, it would not be correct to distribute the cost equally per kg of flour produced, for those of superior quality.

The allocation criteria according to the equality of unit gross profit and equality of profitability favor the lower products, those that have lower selling prices, bringing a gross profit and a significant profitability to them. Allocating joint costs according to the net realizable value would be a criterion that might fit this company, since the allocation is given considering the revenue that would be possible at the point of separation.

Another assignment that could fit the said company would be through the ability to generate revenue. In this way, the products that bring the highest revenue to the company absorb higher joint cost value. Equally, the gross profit equality method which, although calculated in a slightly different way, brings the same result of the revenue allocation criterion, could suit the industry. Since it is impossible to eliminate the by-products of the production process, they can represent a percentage of profit for the company that is equal to the other products.

It has been found that a product which, apparently, does not bring profit to the company but can not be excluded from the production process, can be an alternative to obtain revenue. Even depending on the criteria used, it can contribute significantly to the positive outcome of the business organization. In this context, it is possible to observe that each criterion used, brings individually for each product, different values of profit in the point of separation.

Table Xvi- Comparison of gross profit, based on the different allocation criteria applied.

Gross profit %	Flour 1	Flour 2	Bran	Flour	Total
Targetedtargeting	29,53%	29,53%	29,53%	29,53%	29,53%
Byrecipe	28,45%	29,39%	36,74%	36,34%	29,53%
Net realizablename	25,29%	31,96%	57,53%	46,97%	29,53%
Equityofgrossunitprofit	29,53%	29,53%	29,53%	29,53%	29,53%
Bythepcentagegrossprofit	28,25%	29,37%	38,03%	37,56%	29,53%
Equityofprofitability	39,66%	23,74%	-37,27%	-12,05%	29,53%

Source: Authors (2017)

Likewise, the profitability after the separation point, when compared to the revenue of each product, also varies according to the criterion used.

Table XVII - Comparison of profitability, based on the different allocation criteria applied

Target allocation	Flour 1	Flour 2	Bran	Flour	Total
Byrecipe	13,90%	12,79%	4,12%	4,60%	12,62%
Net realizablename	12,81%	12,65%	11,33%	11,40%	12,62%
Equityofgrossunitprofit	9,66%	15,22%	32,12%	22,03%	12,62%
Bythepcentagegrossprofit	13,90%	12,79%	4,12%	4,60%	12,62%
Equityofprofitability	12,62%	12,62%	12,62%	12,62%	12,62%
Byphysicalunits	24,03%	7,00%	-62,68%	-36,99%	12,62%

Source: Authors (2017)

The milling industry in question currently uses the absorptive costing method and the apportionment basis of all fixed costs (whether set or not) is obtained through the raw material. An improper allocation of costs may induce those responsible for the company's management action to make incorrect decisions regarding some products. In some cases, the disposal, which would bring higher production costs to other manufactures. [9] The importance of the strategic cost management in the industries, as a tool in the decisions to be taken and aid to the management of the productive area is emphasized.

References

- [1]. SOUZA, Alceu; CLEMENT, Ademir. Cost management: operational and strategic applications: exercises solved and proposed using excel. São Paulo: Atlas, 2007.
- [2]. MARCONI, Marina de Andrade; LAKATOS, Eva Maria. Fundamentals of scientific methodology. 7. ed. São Paulo: Atlas, 2010
- [3]. BEUREN, Ilse Maria (org.). How to elaborate monographic works in accounting: theory and practice. 3. ed. São Paulo: Atlas, 2008.
- [4]. HORNGREN, Charles Thomaz. Cost Accounting: an administrative approach. São Paulo: Atlas, 1978.
- [5]. SOUZA, Celia de; SOUZA, José Carlos de; FARIA, Ana Cristina de. Methods of joint cost allocation applied to rabbit activity: a case study. Available at: <<http://revista.dae.ufla.br/index.php/ora/article/viewArticle/152>>. Accessed on: 25 Aug. 2012.
- [6]. BORNIA, Antonio Cezar. Managerial cost analysis in modern companies. Porto Alegre: Bookman, 2002.

- [7]. PEREZ JUNIOR, José Hernandez; OLIVEIRA, Luís Martins de; COSTA, Rogério Guedes. Strategic cost management. 5. ed. São Paulo: Atlas, 2008.
- [8]. MARTINS, Elisha. Cost accounting. 9. ed. São Paulo: Atlas, 2003.
- [9]. BENDLIN, Luciano.; SOUZA Alceu. A relação entre o custo e preço de venda prestação de serviço. Um estudo de caso em terceirizada da ALL. Anais do Congresso Brasileiro de Custos, 2011, anaiscbc.emnuvens.com.br

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