MixBC Method: a New Approach for Distribution of Indirect Costs and Expenses to Products

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Abstract — **In cost management, the products cost is a valuable and necessary information. Nevertheless, distributing indirect costs and expenses to products may involve several uncertainties, what can lead to imprecise results and decision mistakes. The aim of this paper is to construct a method that would reduce the uncertainties found in current costing processes, by modelling and providing the analytical deduction of the method MixBC – Mix Based Costing. In sequence, there was performed an example of construction projects costing using MixBC. By analysing different production scenarios, this method permits indirect costs and expenses to be distributed among the products without the need of arbitrary apportionment.**

Keyword - Cost Management, Cost Accounting, MixBC - Mix Based Costing, Absence Costing, Inference Costing.

I. Introduction

Costing methods allow costs to be allocated to products. Different methods may result in significantly different interpretations, particularly as regards product profitability [3]. This is a crucial parameter to the production decision process and to business strategies [7].

The costing system should be chosen taking into account the reality of the organization. It should not only be functional, but should also provide a good cost-benefit relation, since the measurement of certain costs can become economically unfeasible [2].

The major drawback of all costing methods is that they end up by including subjective and arbitrary elements in the determination of production costs when dealing with the apportionment of indirect costs.

In the marginal costing system, it can be noticed that the concept of contribution margin does not solve the problem of product profitability, since a product that has a larger contribution margin can also be responsible for a large part of the total fixed expenses, which reduces its attractiveness.

In theory, a product may have a positive contribution margin, but it might not be profitable, or the product may not be as profitable as expected, particularly when fixed expenses represent a large part of the total expenses [4].

Information related to product´s profitability can only be obtained if the total cost of the product is considered. The major problem related to this lies in how to distribute indirect costs to the products, that is liable to subjective and arbitrary elements. Methods such as ABC (Activity Based Costing) try to reduce uncertainty by seeking to track cost formation [1]. However, criticism is raised to the degree of bureaucracy surrounding costing systems that use the ABC method, due to the high amount of information created.

The objective of this work is to obtain a costing method that would reduce the arbitrary and subjective elements resulting from indirect cost apportionment. It must also be simpler than the ABC method, which is considered one of those that provide the more precise results.

The methodology adopted was bibliographical research, followed by the modelling of the product-cost universe, using the set theory. From this modelling, an approach using variation of scenarios was proposed, from which the equations that integrate the method were deduced. Finally it was performed an application of the MixBC (Mix Based Costing) method related to civil construction projects.

The benefits resulting from the present paper include improvement in the quality of management information, especially in the calculation of product profitability and pricing based on costs.

II. MixBC – Mix-Based Costing Method

This proposal was based on the analysis of the products mix (rather than that of products individually) and on the hypothesis that the absence of a particular product in the mix provides clues as to the degree of utilization of

shared costs (costs that are common to one or more products, and that are usually indirect) for the absent product. The method proposed can be called Mix-Based Costing (MixBC), Absence Costing or Inference Costing.

A. Distribution of Fixed Indirect Costs

Fixed costs may be classified as Identifiable Fixed Costs (those related to one or more products) and Non-Identifiable Fixed Costs (those shared by all products). The universe of fixed costs for Alpha, Beta, and Gamma products may be represented as follows:

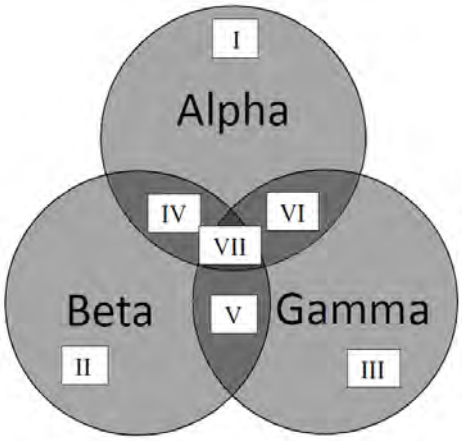

Fig. 1. Graphic representation of the universe of fixed costs for a business which produces products Alpha, Beta and Gamma. Source: authors

Analyzing the regions of the universe of fixed costs for the business, we find: (note that costs refer only to production, therefore, costs are associated only to the products):

- **REGION I**: Fixed costs are typical of only Alpha product; thus costs for this region can be regarded as Fixed Costs Identified for Alpha product.
- **REGION II**: Fixed costs are typical of only Beta product; thus costs for this region can be regarded as Fixed Costs Identified for Beta product.
- **REGION III**: Fixed costs are typical of only Gamma product; thus costs for this region can be regarded as Fixed Costs Identified for Gamma product.
- **REGION IV**: Fixed costs are only shared by products Alpha, and Beta; thus, costs for this region can be regarded as Fixed Costs Identified for the group Alpha+Beta.
- **REGION V**: Fixed costs are shared only by products Beta, and Gamma; thus, costs for this region can be regarded as Fixed Costs Identified for the group Beta+Gamma.
- **REGION VI**: Fixed costs are shared only by products Gamma, and Alpha; thus, costs for this region can be regarded as Fixed Costs Identified for the group Gamma+Alpha.
- **REGION VII**: Fixed costs are shared by all products in the Mix; thus, costs for this region can be regarded as Non-Identified Fixed Costs or costs common to all products.

Thus, the total fixed cost (CF) of the Product Mix (Alpha, Beta, and Gamma) can be written as:

$$CF_{ALPHA,\ BETA,\ GAMMA}=CF_{MIX}= CF_{I}+CF_{II}+CF_{III}+CF_{IV}+CF_{V}+CF_{VI}+CF_{VII} \quad \text{(Eq. v)}$$

Bearing this in mind, the following situation is proposed: Alpha product is discontinued by the business and its production is not substituted by any other product. The new distribution of fixed costs would be:

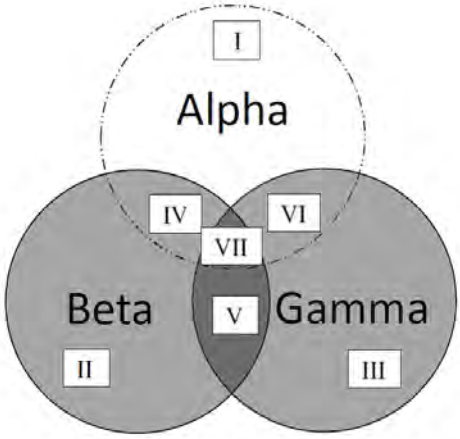

Fig.2. Graphic representation of the universe of fixed costs for a business which produces products Beta, and Gamma. Source: authors

It should be noticed that only region I -- that is, the fixed costs that were exclusive of product Alpha -- has actually stopped existing because of the absence of Alpha. The fixed costs that Alpha somehow shared with other products continue to exist in the manufacturing of Beta and Gamma products (regions IV, VI, and VII), as well as the fixed costs identified with the remaining products, either individually (regions II and III) or in group (region V).

The new total fixed cost for the new Product Mix (only Beta and Gamma, without the participation of Alpha) can be written as:

$$CF_{MIX\text{-}ALPHA}=CF_{II}+CF_{III}+CF_{IV}+CF_{V}+CF_{VI}+CF_{VII}$$
(Eq. vi)

Substituting Eq. vi in Eq. v, we find:

$$CF_{MIX}=CF_{I}+CF_{MIX\text{-}ALPHA}$$
(Eq. vii)

Contrariwise,

$$CF_{I}=CF_{MIX}-CF_{MIX\text{-}ALPHA}$$
(Eq. viii)

That is, the identified fixed cost for a particular product (fixed cost exclusive of a product, in this particular case, product Alfa, CF_I) does not require any kind of tracking to be identified, but rather can be obtained from a cost scenario in which the product under discussion is absent, subtracted from the cost scenario of the present situation (mix costs, CF_{MIX}). This can also be considered as the ***Minimum Fixed Cost*** that can be ascribed to product Alpha ($CF_{ALPHA,\ MIN}$).

$$CF_{ALPHA,\ MIN}=CF_{I}$$
(Eq. ix)

On the other hand, if there was only product Alpha (without the other mix products), the fixed costs related to it would be maximum and would be calculated by:

$$CF_{ALPHA,\ MAX}=CF_{ALPHA}=CF_{I}+CF_{IV}+CF_{VI}+CF_{VII}$$
(Eq. x)

Therefore, it can be said that the fixed costs related to product Alpha necessarily fall between the Minimum Fixed Cost and the Maximum Fixed Cost for this product, obtained by comparing the present structure with the scenarios of ABSENCE OF PRODUCTION of Alpha (excludent production) and EXCLUSIVITY OF PRODUCTION of Alpha (exclusive production), respectively.

Substituting Eq. ix in Eq. x, we find:

$\Delta CF_{ALPHA}=CF_{ALPHA,\ MAX}-CF_{ALPHA,MIN}=CF_{IV}+CF_{VI}+CF_{VII}$
(Eq. xi)

In which the term $\Delta CF_{ALPHA}=CF_{IV}+CF_{VI}+CF_{VII}$ could be considered as the range of variation of fixed costs for product Alpha and it represents the extent of use of the Mix structure by product Alpha, or the extent to which product Alpha depends on the Mix structure.

If the same reasoning is applied to the fixed costs for the remaining products, we find:

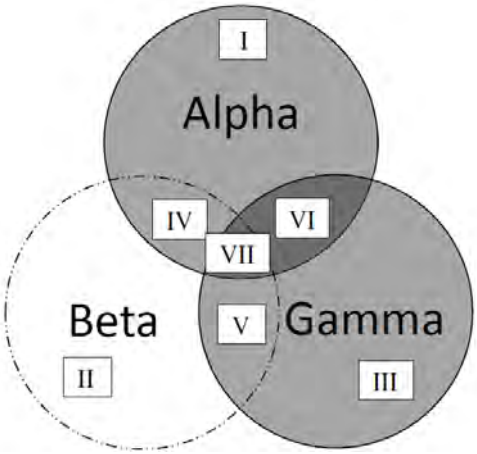

Fig. 3. Graphic representation of the universe of fixed costs for a business which produces products Alpha, and Gamma. Source: authors

$CF_{BETA,\ MIN}=CF_{II}=CF_{MIX}-CF_{MIX\text{-}BETA}$
(Eq. xii)

$CF_{BETA,\ MAX}=CF_{BETA}=CF_{II}+CF_{IV}+CF_{V}+CF_{VII}$
(Eq. xiii)

$\Delta CF_{BETA}=CF_{BETA,\ MAX}-CF_{BETA,MIN}=CF_{IV}+CF_{V}+CF_{VII}$
(Eq. xiv)

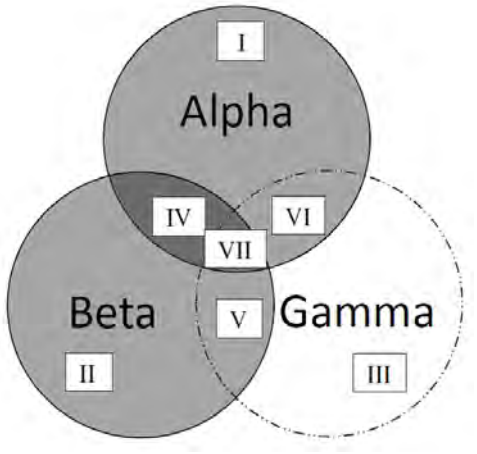

Fig. 4. Graphic representation of the universe of fixed costs for a business which produces products Alpha, and Beta. Source: authors

$CF_{GAMMA,MIN}=CF_{III}=CF_{MIX}-CF_{MIX\text{-}GAMMA}$
(Eq. xv)

$CF_{GAMMA,\ MAX}=CF_{GAMMA}=CF_{III}+CF_{V}+CF_{VI}+CF_{VII}$
(Eq. xvi)

$\Delta CF_{GAMMA}=CF_{GAMMA,\ MAX}-CF_{GAMMA,MIN}=CF_V+CF_{VI}+CF_{VII}$ (Eq. xvii)
(Eq. xvii)

The fixed cost of the structure shared by the product Mix can be defined by:

$CF_{\ COMP}=CF_{IV}+CF_V+CF_{VI}+CF_{VII}$
(Eq. xviii)

Substituting equations ix, xii, xv, and xviii in Eq. v, we find:

$CF_{MIX}=CF_{ALPHA,MIN}+CF_{BETA,MIN}+CF_{GAMMA,MIN}+CF_{COMP}$
(Eq. xix)

That is, the fixed cost of the structure shared by the Mix can be determined by subtracting from the present situation the minimum fixed costs for each product (determined by the scenarios of absence of each one, sequentially). This can be proved by substituting equations ix, xii, and xv in equation xix:

$CF_{COMP}=CF_{MIX}-(CF_{MIX}-CF_{MIX\text{-}ALPHA})-(CF_{MIX}-CF_{MIX\text{-}BETA})-(CF_{MIX}-CF_{MIX\text{-}GAMMA})$(Eq. xx)

Thus,

$CF_{COMP}=CF_{MIX\text{-}ALPHA}+CF_{MIX\text{-}BETA}+CF_{MIX\text{-}GAMMA}-2CF_{MIX}$
(Eq. xx-a)

As the result depends only on the terms that are independent from cost sharing, it can be generalized for a Mix of "N" products:

$CF_{COMP}=CF_{MIX\text{-}1}+CF_{MIX\text{-}2}+\ldots+CF_{MIX\text{-}N}-(N-1)CF_{MIX}$
(Eq. xxi)

As previously seen, the ranges of fixed costs for each product (ΔCF_i) show the utilization of the mix for each product, respectively. Thus, to define the degree of use of the Mix for product I based on costs (UC%), we find:

$$UC\%_i=\frac{\Delta CF_i}{CF_{COMP}}x100$$
(Eq. xxii)

Therefore, for products Alpha, Beta, and Gamma in our example, we would find respectively:

$$UC\%_{ALPHA}=\frac{\Delta CF_{ALPHA}}{CF_{COMP}}x100$$
(Eq. xxiii)

$$UC\%_{BETA}=\frac{\Delta CF_{BETA}}{CF_{COMP}}x100$$
(Eq. xxiv)

$$UC\%_{GAMMA}=\frac{\Delta CF_{GAMMA}}{CF_{COMP}}x100$$
(Eq. xxv)

As the fixed cost structure of the mix is shared, if the degrees of use of the Mix (UC%) for all the products are added, we will find a number greater than the unit. Thus, in order to define the participation of each product in the Fixed Cost of the Mix (the amount each of them absorbs from the mix, when compared with the remaining products), it is necessary to normalize the UC% parameter, obtaining what was called FACTORS OF COST PARTICIPATION (FPCs)

$$FPC_i=\frac{UC\%_i}{\sum_1^N UC\%_j}=\frac{\Delta CF_i}{\sum_1^N \Delta CF_j}$$

(Eq. xxvi)

The parameter FPC is crucial to determine the total fixed costs for each product. It determines how much of the shared fixed costs shall be allocated to each one. In order to obtain the percentage participation factor (FPC%), simply multiply FPC by 100.

Thus, for products Alpha, Beta, and Gamma in the example, we find, respectively:

$$FPC_{ALPHA} = \frac{UC\%_{ALPHA}}{\sum UC\%} = \frac{\Delta CF_{ALPHA}}{\sum \Delta CF}$$

(Eq. xxvii)

$$FPC_{BETA} = \frac{UC\%_{BETA}}{\sum UC\%} = \frac{\Delta CF_{BETA}}{\sum \Delta CF}$$

(Eq. xxviii)

$$FPC_{GAMMA} = \frac{UC\%_{GAMMA}}{\sum UC\%} = \frac{\Delta CF_{GAMMA}}{\sum \Delta CF}$$

(Eq. xxix)

Finally, the total fixed cost for a particular product in terms of its shared structure in the Mix can be written as:

$$CF_i = CF_{i,\,MIN} + FPC_i * CF_{COMP} \qquad \text{(Eq. xxx)}$$

To proceed with the example, for products Alpha, Beta, and Gamma, we would find, respectively:

$$CF_{ALPHA} = CF_{ALPHA,\,MIN} + FPC_{ALPHA} * CF_{COMP}$$

(Eq. xxxi)

$$CF_{BETA} = CF_{BETA,\,MIN} + FPC_{BETA} * CF_{COMP}$$

(Eq. xxxii)

$$CF_{GAMMA} = CF_{GAMMA,\,MIN} + FPC_{GAMMA} * CF_{COMP}$$

(Eq. xxxiii)

It can be observed that the method deduced above reduces significantly the arbitrary and subjective elements caused by traditional apportionment, yet it does not need a sophisticated structure of cost tracking, as does the ABC method. However, the method proposed in this work requires knowledge of project analysis and processes, in order that the scenarios required can be evaluated coherently.

B. Applying MixBC to Expenses

Fixed expenses can also be analyzed using MixBC, that is, by applying the same sequence of reasoning used to solve the problem of fixed costs.

In managerial terms, applying MixBC to fixed expenses is extremely reasonable, since in a business, every expenditure (cost or expense) exists (or should exist) to somehow make possible the production and commercialization of one or more products. From this point of view, it is reasonable to associate expenses to products, which is possible with the MIXBC method.

Applying the MIXBC to fixed expenses (DFs), the following equations for product “i” of a Mix of “N” products is to be found:

$$DF_{i,MIN} = DF_{MIX} - DF_{MIX\text{-}"i"}$$

(Eq. xxxiv)

$$DF_{i,\,MAX} = DF_i$$

(Eq. xxxv)

$$\Delta DF_i = DF_{i,\,MAX} - DF_{i,MIN}$$

(Eq. xxxvi)

$$DF_{COMP}=DF_{MIX-1}+DF_{MIX-2}+\ldots+DF_{MIX-N}-(N-1)DF_{MIX}$$
(Eq. xxxvii)

Likewise, the degree of use of the structure (U%) and the participation factor (FP) must be calculated using the parameter "Fixed Expenses", expressed as:

$$UD\%_i=\frac{\Delta DF_i}{DF_{COMP}}x100$$
(Eq. xxxviii)

$$FPD_i=\frac{UD\%_i}{\sum_1^N UD\%_j}=\frac{\Delta DF_i}{\sum_1^N \Delta DF_j}$$
(Eq. xxxix)

$$DF_i=DF_{i,\,MIN}+FPD_i*DF_{COMP} \qquad \text{(Eq. xl)}$$

It must be pointed out that the MixBC could have been applied to the fixed costs + fixed expenses set (and in that case participation factors corresponding to the whole set would be obtained, FPCDs – factors of costs and expenses participation) or it could have been applied separately to the fixed costs (with cost-specific FPs, FPCs) and then to the fixed expenses (with expense-specific FPs, FPDs). It is clear then that the method does not even require the separation of expenditures as costs and expenses to be applied. Users should choose the best option at their discretion.

C. Checking Coherence

The MixBC method is based on a mathematical algorithm which, as expected, has values for which the equations deduced lose their meaning. This happens when the logic of the model is broken, as for example, when the fixed cost obtained by analyses of a scenario of exclusive production (CF_{MAX}) is lesser than CF_{MIN}; or when the amount of resources in a scenario exceeds the amount of resources available in the mix, and in other cases.

The situations in which the model loses its coherence may be due to misevaluation by the cost analyst, or due to a degree of coherence that is not easily perceived by the analyst, thus inducing to error.

Coherence conditions were thus identified to guide analysts and so assure the logic of the algorithm. These conditions should preferably be computer-checked. There are four conditions that should be followed, as exemplified below for the parameter CF – Fixed Cost.

- *Individual conditions* – Applied individually to the scenarios, that is, the four coherence equations should be followed by all scenarios:
  - $CF_i \leq CF_{MIX}$. That is, in the exclusive production scenario for product "i", resources should not exceed amounts available in the mix;
  - $CF_i+CF_{MIX-i} \geq CF_{MIX}$. That is, in the exclusive and excludent production scenarios for product "i", resources cannot be lesser than the amount available in the mix;
  - $CF_{i,MAX}=CF_i \geq CF_{i,MIN}$ That is, for a certain product, the maximum resources should be greater than the minimum resources defined from the mix;
- *Collective condition* – It is applied to the whole set of the scenarios, which should follow the equation:
  - $\Sigma CF_{MIX-i} \geq (N-1)CF_{MIX}$. Or, similarly, $CF_{COMP} \geq 0$, which symbolizes that resources shared in the production mix cannot be negative.

III. Results and Discussion

As regards civil construction ISATTO [5] points out that the information provided by traditional accounting systems contributes little to process management. Because of that managers adopt alternative control systems, especially those based on unit production standard costs.

It becomes evident that an adequate cost management is directly associated to the understanding and controlling of the production process of a particular building construction. It allows a vision of the flow aligned with project management, which is derived from an activity-centered approach [6].

ROCHA [8], analyzing seven building companies, adopted an ABC approach, in which costs were assigned according to the type of construction work being undertaken: paving, sanitation and buildings. This classification may have tried to create a *symbolic product having an annual cycle*, understood as the set of

works of the same type, whether finished or unfinished, which fall into a certain period of time, to which direct costs, indirect costs and expenses are assigned, and which constitute a cost object analogous to a "project".

As an example, MIXBC will be applied to indirect costs and expenses of civil construction projects (Paving, Sanitation and Buildings), using activities typical of departments responsible for indirect costs (Engineering, Supplies, Human Resources, Accounting and Financial).

To illustrate the application of the method, it will be detailed the analysis of the resource "Budget Analyst", that is part of the "Engineering Department". This analysis must be performed by a multidisciplinary team, in order to considerer different aspects of the allocation of the resources (Table I). Extending the same type of analysis to other resources from the "Engineering Department", it was obtained Table II. After this analysis, there were calculated the MIXBC method´s parameters (Table III).

TABLE I

Scenario analysis of the resource "Budget Analyst" according to the MIXBC method. Source: authors

EXCLUSIVE AND EXCLUDENT EQUIVALENT AMOUNTS PER ANNUM (analysis performed by a multidisciplinary team)
ENGINEERING DEPARTMENT **Resource: Budget analyst *** **Unit: Worker-month**
Scenario analyses: • In **exclusive production** scenarios for each project: o Only Paving works: A 1.0 budget analyst is deemed necessary for one year plus 1.0 budget analyst working part time (low use of resource), that is, 1.0 x 1.0 + 1.0 x 0.5 = 1.5 Worker annum. o Only Sanitation works: Analysis shows that sanitation works consume on average 1 budget analyst for one year. o Only Building Construction works. The figure to be used is 1.0 Worker-annum. • In **excludent production** scenarios for each project: o Absence of Paving works: In case no paving works are undertaken, the figure to be used is 2.0 Worker-annum. o Absence of Sanitation Works: In case no sanitation works are undertaken, it signals the need of 2 budget analysts for a year. This amount will be used to make up the team. o Absence of Building Construction Works: In case no building construction works are undertaken, there is a seasonal need for this resource at the end of the year (months of October, November and December). It is necessary to hire temporarily more 1.0 budget analyst, that is, 2.0 workers x 1.0 annum + 1.0 worker x 3/12 annum = 2.25 Worker annum. • New distribution of amounts for resource "Budget analyst": PAV. SAN. BUILD. MIX MIX-PAV MIX-SAN MIX-BUILD 1,5 1,0 1,0 3,0 2,0 2,0 2,25 • It should also be noticed that the amount of resources available should not be exceeded in any situation (any amount ≤ MIX amount).

TABLE II

Scenario analysis of all resources from the "Engineering Department", according to the MIXBC method. Source: authors

RESOURCES	**EXCLUSIVE AND EXCLUDENT EQUIVALENT AMOUNTS PER ANNUM (result of the multidisciplinary team analysis)**						
Engineering Department	**PAV.**	**SAN.**	**BUILD.**	**MIX**	**MIX-PAV**	**MIX-SAN**	**MIX-BUILD**
Budget analyst *	1.50	1.00	1.00	3.00	2.00	2.00	2.25
Civil engineer	1.00	0.50	1.00	2.00	1.50	1.50	1.50
Outsourced project designer	0.20	0.40	0.65	1.00	0.90	0.75	0.50
Architect	0.17	0.17	0.50	0.58	0.58	0.58	0.58
Draftsman	0.50	1.00	1.50	2.00	2.00	1.50	1.00
Building technician	1.00	0.50	1.00	2.00	1.50	1.50	1.50

TABLE III

MIXBC method´s parameters of all resources from the "Engineering Department". Source: authors

RESOURCES	MIXBC PARAMETERS (calculated from the results of the team analysis)									
Engineering Department	PAVING			SANITATION			BUILDINGS			
	CFmin	ΔCF	FPC	CFmin	ΔCF	FPC	CFmin	ΔCF	FPC	CFcomp
Budget analyst *	1.00	0.50	0.67	1.00	0.00	0.00	0.75	0.25	0.33	0.25
Civil engineer	0.50	0.50	0.50	0.50	0.00	0.00	0.50	0.50	0.50	0.50
Outsourced project designer	0.10	0.10	0.25	0.25	0.15	0.38	0.50	0.15	0.38	0.15
Architect	0.00	0.17	0.20	0.00	0.17	0.20	0.00	0.50	0.60	0.58
Draftsman	0.00	0.50	0.33	0.50	0.50	0.33	1.00	0.50	0.33	0.50
Building technician	0.50	0.50	0.50	0.50	0.00	0.00	0.50	0.50	0.50	0.50

Finally, applying the parameters calculated above at Eq. xxx and Eq. xl, there were allocated the costs and expenses to the "products" Paving, Sanitation and Buildings, according to the MixBC method. The annual expenses with the resources are all known from simple accounting reports (the real mix of "Budget Analyst" is composed of three units of this resource and cost about $ 93,177.00 per annum) and the total annual amount of costs and expenses are about $ 882,000.00 (Table IV).

These results can be compared with the ones obtained by ROCHA [8], after applying ABC method using two criteria of arbitrary apportionment: revenue and hours worked (Table V).

TABLE IV

Final allocation of costs and expenses to products according to the MIXBC method. Source: authors

RESOURCES	COSTS AND EXPENSES SEPARATED BY MIXBC			
Engineering Department	**CFpav**	**CFsan**	**CFbuild**	**CFtotal**
Budget analyst *	36,235.50	31,059.00	25,882.50	93,177.00
Civil engineer	99,450.00	66,300.00	99,450.00	265,200.00
Outsourced Project designer	5,574.94	12,416.91	22,553.16	40,545.00
Architect	10,837.50	10,837.50	31,875.00	53,550.00
Draftsman	5,100.00	20,400.00	35,700.00	61,200.00
Building technician	40,315.50	26,877.00	40,315.50	107,508.00
	197,513.44	**167,890.41**	**255,776.16**	**621,180.00**
Supplies Department				
Storekeeper	7,857.78	14,204.44	24,177.78	46,240.00
Purchaser	8,899.30	8,899.30	21,221.40	39,020.00
	16,757.08	**23,103.74**	**45,399.18**	**85,260.00**
Human Resources Department				
Office assistant	3,400.00	13,600.00	13,600.00	30,600.00
Human resources assistant	56,000.00	156,800.00	89,600.00	302,400.00
Human resources manager	17,235.00	34,470.00	17,235.00	68,940.00
	76,635.00	**204,870.00**	**120,435.00**	**401,940.00**
Accounting Department				
Outsourced accounting services	7,308.00	20,097.00	9,135.00	36,540.00
	7,308.00	**20,097.00**	**9,135.00**	**36,540.00**
Financial Department				
Administrative assistant	9,180.00	9,180.00	18,360.00	36,720.00
Financial assistant	12,120.00	12,120.00	12,120.00	36,360.00
	21,300.00	**21,300.00**	**30,480.00**	**73,080.00**
Expenses	**DFpav**	**DFsan**	**DFbuild**	**DFtotal**
Compensation for services rendered	80,000.00	80,000.00	80,000.00	240,000.00
Managers	122,400.00	122,400.00	122,400.00	367,200.00
Maintenance and office supplies	14,536.00	24,950.40	26,753.60	66,240.00
Computer support	5,676.92	6,646.15	5,676.92	18,000.00
Expenses related to use of facilities	27,041.94	45,652.00	48,506.06	121,200.00
Office maintenance services	17,340.00	26,010.00	26,010.00	69,360.00
	266,994.86	**305,658.55**	**309,346.59**	**882,000.00**

TABLE V

Apportionment of expenses, per Revenue and per Hours worked. Source: [8]

TYPE OF EXPENSE	Total	Paving	Sanitation	Buildings
Apportionable costs and expenses (Revenue)	**882,000.00**	504,000.00	252,000.00	126,000.00
Apportionable costs and expenses (Hours worked)	**882,000.00**	164,093.02	492,279.07	225,627.91

As expected, the MixBC results point in the direction that the “hours worked” arbitrary apportionment criteria is less arbitrary than “revenue” arbitrary apportionment criteria. Nevertheless, it is clear that the apportionment criterion provided by MixBC method is quite more coherent than the arbitrary criteria used in [8], and should lead to more precise information for cost management purposes.

IV. CONCLUSION

The Mix-Based Costing method was built on the analyses of the product mix (rather than on that of products individually), and also on the hypothesis that the absence of a certain product in the mix provides clues as to the degree of utilization of shared costs (costs shared by one or more products, usually indirect) by that particular absent product.

The major advantage of the method may lie in allowing costs and indirect shared expenses -- which cannot be actually separated for each product -- to be treated in a mathematical and coherent way. This contrasts with the other methods, which usually apportion or track of expenses. In this sense, the uncertainties are calculated by a process of cost inference, based on the exclusive production (only the product analyzed is produced) and excludent production (only the product analyzed is not produced) scenarios.

It should be pointed out that MixBC is a method strongly dependent on the experience and on the systemic vision of cost analysts, who should have an in-depth knowledge of the reality of the business operations. The good foresight of these professionals shall be responsible for building coherent scenarios of resource consumption, and the application of the method shall lead to the safe completion of the cost distribution task. It is recommended that the scenario analyses be performed by a multidisciplinary team, comprising professionals from human resources, production and administrative managerial level.

It was also observed that the MixBC method presents levels of bureaucracy and detailing that are significantly lower than that of the ABC method. It is thus a valuable tool for the distribution of costs to the products, reducing the arbitrariness caused by apportionment and contributing to more profitable production strategies.

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