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TDABC METHOD AND PROCESS MANAGEMENT: THE EXPERIENCE INSIDE OF A CERTIFICATION LABORATORY OF A RESEARCH CENTRE

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ABSTRACT

A great challenge for organizations is the continuous necessity to reduce the cost of their products and services. This makes companies seek to adopt appropriated methodologies to obtain information that can assist in the process of decision making. This study aims to contribute, through an empirical research, for the discussion about the methods of costing processes. This article examines a pilot implementation of Time-Driven Activity-Based Costing (TDABC) inside the laboratories of an Electrical Energy Research Center, in the area of Certification (CERT) and the Engines Laboratory (LABEX), through an action research. To achieve the objectives, the research was divided into six distinct phases. From the analysis of the results, it was able to recognize that the method bring out satisfactory results in its implementation, such as providing more accurate costing information for decision making.

KEYWORDS :*Cost Management, Time-Driven Activity-Based Costing, Process Maps.*

SHORT PROFILE

Oliveira, J.R. is Master's Degree in Business Administration.

INTRODUCTION :

Some authors have used the term "Strategic Cost Management" to conceptualize the necessary integration between the cost management process and the company management process. This integration is necessary so the companies can survive in the globalized and competitive environment of the business world (MARTINS, 2001), because global competition and technological innovations that have occurred in recent decades pressured companies to use financial and nonfinancial information to remain active in the market (KAPLAN; NORTON, 1992, 2001; KAPLAN E COPPER, 1998). Consequently, for the survival of businesses in this environment is necessary for them to achieve high levels of quality, efficiency and productivity, as well as eliminating losses and reducing costs (MARTINS, 2001).

With increased competition - and with the efficient use of direct labor and machine ceasing to be the greatest competitive advantage - managers needed more accurate information about the costs of processes, products and customers than they could get in external financial reporting systems. In this context, it was increased the demand of information related to costs and performance of activities, processes, products, services and customers. The most competitive companies are using costing systems optimized for: (a) design products and services that satisfy customers, (b) continuous process improvement, continuous improvement of the workforce, (c) better products, negotiating with customers and (d) efficient processes (KAPLAN; COPPER, 1998).

According to Nakagawa (1995) and Martins (2001), the opening of new markets allied to the emergence of technologies and methodologies in companies as JIT (Just-in-Time), TQM (Total Quality Management), TPM (Total Productive Maintenance), GT (Group Technology), AGV (Automatically Guided Vehicle), FMS (Flexible Manufacturing Systems), CIM (Computer Integrated Manufacturing), CAD (Computer Aided Design), among others, besides causing an increase in spending on production activity, also increased indirect costs (sales activities, transport, distribution, logistics etc.). Consequently, the "traditional systems costing" became disabled with respect to the information generated in this new business environment. These changes in organizational structures over time changed the way of evaluating operating costs which required that the processes involved also needed improvement and monitoring to provide reliable information to management.

Due to technological advancement and complexity of production systems, indirect costs have increased significantly compared to direct costs, arising the need for these indirect costs have appropriate treatment, avoiding distortions occurred with the arbitrariness and subjectivity of traditional apportionments. To meet this need was developed a costing methodology based on activities, or simply ABC Costing (Activity Based Costing), defined by Martins (2001, p. 91) as "a costing methodology that seeks to significantly reduce the distortions caused by the arbitrary allocations of indirect costs".

Despite the recognition of the literature by the relevant contributions of the ABC method in terms of management information, it has received a lot of criticism, especially in relation to the prolonged and costly data collection and the difficulty of updating the model. Based on these critical to the conventional method, Kaplan and Anderson developed a more practical and modern approach to the ABC Costing, the TDABC (EVERAERT et al., 2008; BRUGGEMAN et al. 2005).

This research is part of a larger study that structured a proposal for implementation of TDABC Costing System, from the processes maps of the studied organization, the certification processes of electrical equipment for potentially explosive atmospheres, run by the Certification area (CERT) and the Engines Laboratory (LABEX) of CEPEL. This paper presents the results related to the implementation of this research during the period between January 2012 and January 2013.

This work was divided into six sections, considering this introduction. The second section presents the theoretical framework, which addresses aspects of process management, with emphasis on the process mapping; considerations on the main costing systems, with emphasis on the ABC Costing; and, finally, the TDABC approach. The third section presents the studied company. In the fourth section, the methodological aspects used in this work were showed. In the fifth section, the implementation of the research was presented, containing its results. Then, in the sixth section, were made the conclusions of this work, highlighting the limitations and making proposals for further research.

2 LITERATURE REVIEW

2.1 BUSINESS PROCESS MANAGEMENT WITH A FOCUS ON COSTS

Due to the current global competitiveness, companies need to establish a business vision in order to know the activities of its main business processes and the respective performance of each of these activities (NAKAGAWA, 1994).

For Mendonça and Braconi (2009), the use of Business Process Management is important for the implementation of Activity Based Costing, as it provides greater transparency to define the activities and how resources will be allocated, besides it analyses the performance of processes. Davenport

(1994) states that the Cost is one of the major factors in assessing the performance of processes and the Activity Based Costing would be the ideal tool to measure it because with the allocation of costs to each process activity and the identification of problems in the implementation of activities, appear the opportunities to improve the simplification and rationalization of these activities. To Nakagawa (1994, p. 25), the management-based activities or processes "has in the ABC Costing its backbone". Complementing this line of thought, Smith e Fingar (2003) considers the Activity Based Costing one of the tools that can help companies in implementing the improvement of its business processes. According to the author, the purpose of this tool is to calculate the resources needed to produce a product or provide a service to a specific client.

Despite recognizing the advantages of ABC against the traditional costing systems, Mendonça and Braconi (2009, p. 138) assert that the implementation of ABC Costing has received various criticisms of many professionals and authors. The empirical study by Machado (2009) that sought to observe the ABC utilization rate in some countries in Europe and Asia found that although the articles analyzed recognize the theoretical benefits of the implementation of ABC Costing, the results also noted the limited use of ABC method in companies. Kaplan and Anderson (2007a) agree that many companies stopped using the ABC method due to several factors such as the high cost of development, the maintenance complexity and the difficulty of modifications. For Machado (2009), the reason for the limited use of the ABC may be in the difficulties associated with its implementation and presents three main factors for the low adoption of ABC: difficulty to identify the activities and select the cost drivers; difficulty of determining the cost of each activity; resistance to change by workers.

For Kaplan and Anderson (2007a, p.8), in general, the implementation of ABC faced troubles as time consuming data collection processes; the data were subjective and difficult to validate; storage, processing and presentation of data were expensive; most models ABC was local and did not provide an integrated view of profit opportunities across the scope of the company; ABC model was not suffering update nor was adapted easily to changing circumstances; and the model incurred in theoretical error by ignoring the possibility of idle capacity.

2.2 TIME-DRIVEN ACTIVITY-BASED COSTING – TDABC

According to Bruggeman et al. (2005), the original concept of Time-Driven Activity-Based Costing, or Costing Based on Activity and Time, was originally developed by Professor Steven R. Anderson while he implemented the method in your company Acorn Systems, in 1997. However, the TDABC approach was improved in conjunction with Professor Robert Kaplan, from Harvard Business School in the United States, in 2001. This TDABC improved approach was consolidated through the publication of various articles written by several authors.

The TDABC cost is a suitable method for companies characterized by complex activities, as well as those which work by orders. This is due to the use of time equations that allow easy upgrade of TDABC system to the new changes occurred in their products and services. To meet new customers, companies need a model of cost as the TDABC, which is able to adapt easily to these changes, instead of reviewing all the costing system (EVERAERT and BRUGGEMAN, 2007).

The main difference between the TDABC and the ABC is that the more modern approach uses time as the main driver to allocate resource costs directly to the cost objects, such as transactions, orders, products, services and customers. That is, while the ABC uses the criteria of number of transactions to allocate the costs of activities to the products, the main

input of TDABC is the time required to perform the activities (KAPLAN and ANDERSON, 2007a).

The concept of TDABC is a relatively new theme in literature and is still being explored by researchers thus are not currently found many studies on the subject. However, some international scientific articles were identified reporting experiences on case studies about its implementation in some organizations, especially in European countries.

2.3 MAIN CHARACTERISTICS OF TDABC

The main innovation of the TDABC, compared to the ABC, is that it does not hold to the activity of step definition, making unnecessary the costly, time consuming and subjective work of interviews with employees to allocate the costs of the department for the various activities performed (KAPLAN and ANDERSON, 2007a).

Kaplan and Anderson (2007a) proposed a model of deployment project of TDABC through a typical sequence of steps for deployment as is illustrated in Figure 1.

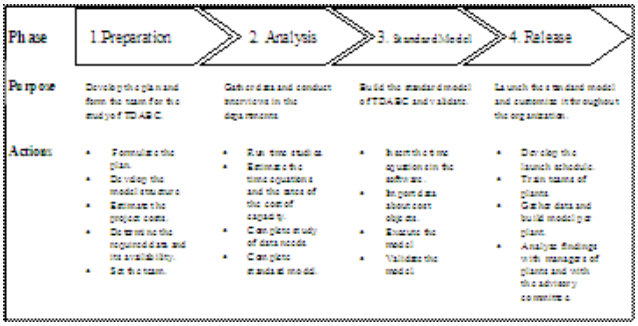

Figure 1. Implementation Model of TDABC
Source: Kaplan & Anderson (2007a).

The organization researched, an Electrical Energy Research Center located in Rio de Janeiro - Brazil, is the largest electrical energy research institution in South America. It recognized since the early 70's as an international renowned laboratory. The Center's mission is to develop and deploy sustainable technology solutions for the generation, transmission and distribution of electricity by means of Research, Development and Innovation activities for the Brazilian electricity sector.

3 METHODOLOGY

This research seeks to generate and to evaluate the knowledge in order to understand the problem of the organization and propose real alternatives of solution. On the above, and considering the participatory nature of one of the researchers, it works with the qualitative approach and is framed as an action research.

As Thiollent (2011, p. 31-32) action research has as "objective to analyze the characteristics of the various available methods, to assess their capabilities, potentials, limitations or distortions and critique the assumptions or the implications of its use." Regarding its practical application, the methodology deals with the evaluation of research techniques and the generation or testing of new methods to effectively solve theoretical and practical problems of research (THIOLLENT, 2011).

According to Thiollent (2009), several areas, such as education, communication, social services are able to use action research. In this sense, the author states that "organizations" can be understood as any entity that adds social groups whose activities are structured in processes with defined objectives. Organizations in which there may be demands as action research are: production or service companies, public administrations, center of scientific and technological research, professional associations or trade unions and other non-profit entities. Therefore, the target organization of this study presents a profile that fits as an organization with demand for the application of action research, since:

a) provides various services to its clients and associates;
b) it is part of the government's environment indirectly, by submitting directly to a state-

owned energy holding company;
c) it is essentially a center of technological research;
d) it is legally structured as a civil non-profit association.

For the research, the project was planned, organized and implemented in four phases and fourteen steps, described in Figure 2.

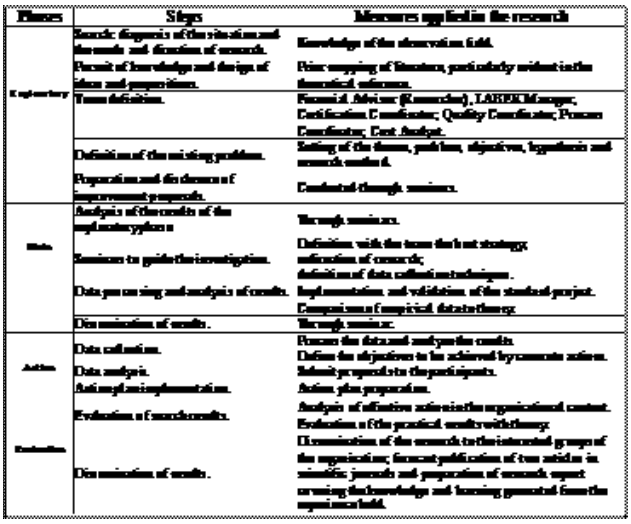

Figure 2. Structure of action research in CEPEL
Source: Adapted from Mello et al. (2012) and Thiollent (2009).

4 TDABC IN A RESEARCH CENTER

The research project structure and the implementation of TDABC method outlined in the Figure 2 in accordance with the methodology of implementation presented by Everaert et al. (2008, p 175) comprise:

1. Identify the activities performed.
2. Estimate the cost of each resource group (activity).
3. Estimate the practical capacity of each resource consumed.
4. Calculate the rate of the cost of capacity.
5. Estimate the time for each transaction (considering the time equations).
6. Multiply the unit cost of each transaction by the time estimate for cost object.

The TDABC costing project applied to the certification request fulfillment process of electrical equipment for potentially explosive atmospheres was developed and implemented during the year 2012. The TDABC methodology used in this study was developed in spreadsheets - specifically in Microsoft Excel, which enabled perform all calculations and modeling needed for validation and deployment of TDABC.

This project is limited to the experimental method TDABC in the certification process of electrical equipment on which certification and testing are performed respectively by CERT and LABEX, two areas of the Department of Laboratories (DL) of CEPEL.

Initially, was made the analysis of the map of the processes "Ensure equipment", performed by CERT, and "Evaluate equipment performance," performed by LABEX, then a consolidated report was prepared of the case studied with the main activities performed in the process of service for certification application of electrical equipment for explosive atmospheres comprising both areas studied and which is illustrated in simplified form in Figure 3.

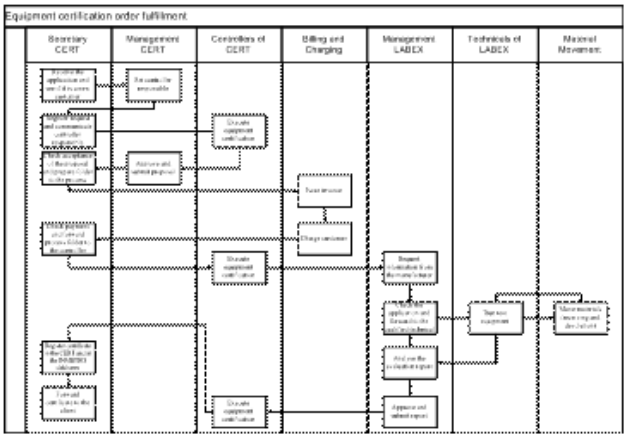

Figure 3: Equipment certification process map.
Source: Prepared by authors

4.1 ESTIMATE OF THE COST OF EACH RESOURCE GROUP

To a further development of research, in this study were collected actual data of the year

2011 to measure the cost of each resource group. Data collection for the present stage was conducted through desk research and had as data source the reports of the accounting system and also the information reports extracted from the organization's cost system.

The annual cost of the resource group related to the activities available to the execution of the services studied is shown in Table 1. The identification step of the resources available for implementation of the activities were conducted through desk research and had as data source the SISCUSTOS (Cost System) and the RDT (Time Allocation System). The values shown are basically composed by personnel expenses, physical space and equipment.

Table 1. Estimate annual cost of available resources.

Available Resources	Annual Cost (R$)
LABEX Management	224.701,44
Certification Management	417.464,51
Certification Secretary	45.696,00
Material Movement	64.315.09
Billing and Charging	276.878.42
Total	1.029.055.46

Source: Prepared by authors

4.2 ESTIMATE OF PRACTICAL CAPACITY

The calculation of the estimate of practical capacity, Table 2, was based on the methodology presented by Kaplan and Porter (2011). To maintain uniformity, the calculation of the practical capacity was also made on an annual basis, in which case the year 2011. Data collection was conducted through desk research technique, with the data source reports of the corporate Time Allocation System (RDT) of CEPEL.

For cost calculation purposes, the time to be considered should be that effectively available for activities. Kaplan and Anderson (2007a, p. 12) state that "not even all paid time is tapped for the job."

Thus, in the first part of the calculation shown in Table 2, the total number of days in the year is decreased of days considered by the organization as non-working days (weekends and holidays). Then, the subtotal receives the decrease of the days when employees were not available for work; in this case, days of vacations taken effectively. In the second part of the calculation of the available hours per day, was subtracted an hour break for lunch, then coming to the amount of hours per day that employees are actually available for performing the tasks.

Table 2. Estimate of practical capacity available

Description	Management LABEX	Management CERT	Secretary CERT	Material Movement	Billing and Charging
(a) Number of employees	1	1	1	1	2
(b) Number of days in the year	365	365	365	365	365
(c) Weekends	105	105	105	105	105
(d) Holidays	11,5	11,5	11,5	11,5	11,5
(e) Subtotal = ((b - c - d) * a)	249,5	249,5	249,5	249,5	499
(f) Unused vacation days	22	26	8,8	13	56
(g) Available days per year (e-f)	227,5	223,5	240,5	236,5	443,0
(h) Available days per month (g/12)	19,0	18,6	20,0	19,7	36,9
(i) Start time of the work day	08:00	08:00	08:00	08:00	08:00
(j) End time of the work day	16:50	16:50	16:50	16:50	16:50
(k) Available hours per day (j-i)	8,5	8,5	8,5	8,5	8,5
(l) Lunch break	1,0	1,0	1,0	1,0	1,0
(m) Hours available for activities execution (k - l)	7,5	7,5	7,5	7,5	7,5
(n) Monthly practical capacity in minutes (h * m * 60)	8.550	8.370	9.000	8.865	17.730
(o) Annual practical capacity in minutes (n x 12)	102.600	100.440	108.000	106.380	212.760

Note. Adapted from Kaplan and Porter (2011).

It is worth mentioning that the results of the calculation of days available per month, item "h" of Table 2, were rounded for better visualization of numbers and understanding of research data.

4.3 CALCULATING THE CAPACITY COST RATE

The next step is the calculation of the capacity cost rate that Everaert et al. (2008) define as the calculation of the capacity cost rate of each resource group, which must be made by dividing the total cost of each resource group for its practical capacity. This concept stems from the interpretation of formula of the capacity cost rate given by Kaplan and Anderson (2007b,

p.10):

Therefore, after the identification of the activities provided with their respective costs and also the calculation of the practical capacity, the next step was to calculate the capacity cost rate, which can also be understood as the unit cost of each resource available to the process of equipment certification service. This calculation is performed by dividing the cost allocated to the resources by the available resource capacity, as shown in Table 3.

Table 3.Calculation of capacity cost rate of resources.

Description	Management LABEX	Management CERT	Secretary CERT	Material Movement	Billing and Charging
(a) Cost assigned to resources (R$)	126.758,46	417.464,53	45.696,00	64.315,00	37.637,42
(b) Available capacity of resources (minutes)	187.680	188.400	112.578	186.528	288.840
(c)=(a)/(b) Capacity cost rate of resources per minute (a ÷ b)	R$ 2,19	R$ 4,16	R$ 1,41	R$ 1,68	R$ 1,31

Note. Adapted from Kaplan and Porter (2011).

4.4 ESTIMATED TIME OF EACH TRANSACTION

In this study, the estimated time required for execution of activities (Table 4) was carried out through semi-structured interviews, in which fifteen activities studied had the average execution time estimated by each activity executor. It was also used participant observation technique for data collection of some activities, in which the researcher timed the run time of some of the activities studied. In the comparison between the two data collection methods (interviews and participant observation) there were no significant differences between the collected time. Thus, the time estimated by each the activity executor of activities for purposes of the calculation of this work were kept.

Table 4. Estimated time of each transaction

Activity	Area	Executor	Time in minutes	Resource class
Receive the application and verify if it is a new customer	CERT	Secretary	20	R
Set controller responsible	CERT	Management	10	R
Register request and communicate controller responsible	CERT	Secretary	15	R
Approve and submit proposal	CERT	Management	10	R
Check acceptance of the proposal and prepare folder to the process	CERT	Secretary	10	R
Issue invoice	FINANCE	Auxiliar	5	B
Charge customer	FINANCE	Auxiliar	15	B
Check payment and forward process folder to the controller	CERT	Secretary	5	R
Request information from the manufacturer	LABEX	Management	20	R
Check the application and forward to the qualified technical	LABEX	Management	50	R
Move materials	LOGISTICS	Technical	15	E
Analyze the evaluation report	LABEX	Management	50	R
Approve and submit report	LABEX	Management	20	R
Register certificate in the CERT and in the INMETRO database	CERT	Secretary	50	R
Forward certificate to the client	CERT	Secretary	10	R
		TOTAL	245	

Note. Label: R: request; B: bill; E: equipment;
Source: Prepared by authors

4.5 CALCULATING THE COST OF EACH TRANSACTION

At this step it was performed the calculation of the unit cost of transactions, also called calculation of the cost driver of TDABC, that in this proposal is based on time. The calculation of the unit cost of the transaction is obtained by multiplying the time required to perform each transaction by the capacity cost rate (Table 5).

Table 5. Cost driver of activities rate.

Activities	Executor	Minutes needed	Cost capacity rate (R$/h)	Cost driver (R$)
Receive the application and verify if it is a new customer	Secretary CERT	20	0,41	8,20
Set controller responsible	Management CERT	10	4,16	41,60
Register request and communicate controller responsible	Secretary CERT	15	0,41	6,15
Approve and submit proposal	Management CERT	10	4,16	41,60
Check acceptance of the proposal and prepare folder to the process	Secretary CERT	10	0,41	4,10
Issue invoice	Auxiliar FINANCE	5	1,31	6,65
Charge customer	Auxiliar FINANCE	15	1,31	19,65
Check payment and forward process folder to the controller	Secretary CERT	5	0,41	2,05
Request information from the manufacturer	Management LABEX	20	3,30	65,70
Check the application and forward to the qualified technical	Management LABEX	10	3,30	43,00
Move materials	Technical LOGISTICS	15	0,00	0,00
Analyze the evaluation report	Management LABEX	20	3,30	65,70
Approve and submit report	Management LABEX	10	3,30	43,00
Register certificate in the CERT and in the INMETRO database	Secretary CERT	20	0,41	11,20
Forward certificate to the client	Secretary CERT	10	0,41	4,10
	TOTAL	245	–	334,70

Source: Prepared by authors

The TDABC model presented by Kaplan and Anderson (2007a) makes possible to replace this step, calculation of transactions, by

the time equation. However, this research did not rule this phase, due to the fact the permanent group of deployment believe that the structured way of calculating the cost drivers rate can be useful to the management of cost with respect to time and cost in monetary values of each available activity.

4.6 TIME EQUATIONS

According to Kaplan and Anderson (2007a, p. 39), any company which has already mapped its processes "[...] is able to directly build its time equations". The time equation is a tool of TDABC that allows the construction of a model that dynamically represents the complexity and variability which are present in organization's business processes.

According to these authors, the acceptance of the time equations by the organization is easier, since they represent the flow of business processes, in addition to having a simple methodology for the data collection needed for its implementation.

The time equations proposed in this study were prepared in order to model each resource available to the execution of target process. The data used in time equations were collected based on interviews with each activity executor (Table 6).

Table 6. Time equations of available resources.

Areas	Time equation
Secretary CERT	$20+15+20X_1+10+5+3X_2+30+10$
Management CERT	$10+20X_3+10$
Management LABEX	$20+30+30+20+15X_4+30X_5+50X_6$
Material Movement ILO	$15X_7+30X_8$
Billing and Charging DVEN	$5X_9+15+20X_{10}$

Note. Prepared by authors

For the development of time equations was necessary to identify the variables that require a different time to the execution of activities. The variables of the time equation of this research were also based on interviews conducted with each activity executor and validated by the permanent group of deployment, as shown in Table 7. According to Kaplan and Anderson (2007a), the use of variables in the equation allows you to allocate just and only the time actually used in the implementation of activities consumed during the product manufacturing process or service delivery, preventing that the measured object becomes misjudged or overvalued.

Table 7. Description of variables of time equations.

Areas	Description	Time consumed
Secretary CERT	X_1=1 if it is a new customer; 0 if not.	20 minutes
	X_2=Amount of payments to consult. 5 minutes increase for each payment to be consulted.	5 minutes
Management CERT	X_3=1 if it is a defaulting customer; 0 if not.	20 minutes
Management LABEX	X_4=1 if bid price up to R$ 107.500,00; 0 if not.	15 minutes
	X_5=1 if bid price over than R$ 107.500,00 and less than R$ 575.000,00; 0 if not.	50 minutes
	X_6=1 if bid price over than R$ 575.000,00; 0 if not.	50 minutes
Material movement ILO	X_7=Number of equipments	15 minutes
	X_8=1 if equipment weight is over than 1.000kg; 0 if not.	50 minutes
Billing and Charging DVEN	X_9=Number of billings	5 minutes
	X_{10}=1 if is the customer closed; 0 if not.	20 minutes

Note. Prepared by authors

It is worth mentioning that the implementation of TDABC from process maps had its drafting stage of time equations facilitated by the fact that the organization already has mapped its main support processes.

4.7 RESULTS ANALYSIS

The TDABC was implemented as a management tool for measuring the cost of the process of Electrical Equipment Certification for Explosive Atmospheres. It should be noted that this method does not replace, nor pretends to replace any existing system in the organization. The aim is to use the TDABC as a management tool to generate useful information for decision-making based on costs.

Regarding the results of the application of TDABC, as analysis carried out together with the deployment team, the TDABC methodology presented the following benefits:

a)Easiness, simplicity and acceptability. These positive characteristics were presented during the deployment process and also on possible

adjustments and maintenance performed in TDABC. In this context, the TDABC presents itself as an excellent management tool for measuring the cost of the studied organization processes. Highlighting the use of the intended time equation in TDABC, which makes the model simple and easy to adapt to the cost objects, to the more complex processes and customers; as affirmation of Kaplan and Anderson (2007a).

b)The TDABC also performed in this empirical experiment as a quick deployment tool, which can be developed in spreadsheets such as Microsoft Excel, and processing of information with speed, even when changes occurred in time estimates, in variables of time equation or in any other element of the tool. Note that the use of spreadsheets cannot be generalized in the case of application in all areas of the studied organization or other organizations, where an information system due to the volume of data will be necessary, as proven by Reddy et al. (2011).

Despite the many benefits presented by TDABC, the methodology also had some limitations:

a)Difficulty with the time estimate of some activities, where the runtime is fickle, and in which were used the average to represent the estimated time of execution of such activities. Hoozée et al. (2010) question the subjectivity of time estimated for implementation of activities and warn of the impact of using these estimates in time equations without a refinement of the driver cost.

b)The TDABC method is a relatively new theme in literature and is still maturing, requiring further empirical studies to theoretical recognition on the same level of other costing methods.

4.8 CONCLUSION

The conclusions of this study focus on the answer to the main research question, which was to investigate and find out if it would be possible to develop a costing method based on activity and time, from maps of existing processes in CERT and LABEX, capable of providing agile and reliable information for making decisions based on cost. Depending on the application demonstrated above, it can be concluded that for the target organization, TDABC can be used as costing method, based on the process maps to generate flexible and secure information to support decision-making based on cost.

It is worth mentioning that this study was not intended to be perceived as applicable to the organization as a whole, due to the complexity of the diverse existing processes and because of the size of the organization. In addition, the applicability of our study should not be generalized to other organizations, mainly because of aspects inherent to the type and size of organization.

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