

Santana, Alex; Afonso, Paulo

**Article**

## Analysis of studies on Time-Driven Activity Based Costing (TDABC)

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## **ANALYSIS OF STUDIES ON TIME-DRIVEN ACTIVITY BASED COSTING (TDABC)**

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### **ABSTRACT**

The present article is part of a line of research based on the study, development and application of new approaches at the level of Strategic Cost Management (SCM), cost management and costing systems. Time-Driven Activity Based Costing (TDABC) which, in turn, represents the current level more sophisticated in terms of costs management systems and costing. A literature review on TDABC was conducted with the main objective of identifying the studies that have applied this model and check for new theories combined with TDABC. The research can be classified as archival analysis, qualitative and exploratory consisting of articles on TDABC. The results are based on 14 studies that applied the model, and 6 research papers with complementary joint approaches to TDABC.

**KEYWORDS:** Strategic Cost Management; Time-Driven ABC; Archival Research Method.

## **1. INTRODUCTION**

In recent decades the importance of cost accounting and cost management practices have been an important issue for academics and practitioners (Shields, 1997). Cost management is the topic most mentioned in the literature of management accounting, but demand remains high academic contributions (Chenhall, 2003). On the other hand, as Shields (1997) points out, much of the work produced and new contributions have not been adequately supported on theoretical grounds or through models based on rigorous empirical analysis and a proper validation of new concepts and cost management practices and tools suggested.

Management control activities and cost reduction are essential not only to ensure profit margins, but increasingly as an element of competitiveness for modern firms, which tend to operate in the global market under strong competition. Costing systems calculate the cost of different relevant cost objects of a company by assigning and allocating direct and indirect costs. The weight of the latter in product costs has been increasing (Miller & Vollman, 1985; Turney, 1996) thus, the treatment of indirect costs is, nowadays, particularly

demanding. The so-called traditional costing systems did not pay particular attention to overhead focusing mainly on direct costs (materials and direct labor).

Thus, in this context, traditional costing systems become obsolete or inadequate. Kaplan (1990) present several reasons for the obsolescence of traditional costing systems namely, product costs are miscalculated, leading to bad decisions, the information is not analyzed timely for decision making, the information generated does not is the most relevant in terms of control, the results generated are typically financial. Traditional costing systems and cost management failed to make a decisive contribution to the management of modern companies.

This research focuses primarily on a literature review and analysis of selected articles published on TDABC in the major journals namely, Harvard Business Review, Accounting Review, International Journal of Business and Management, Management Accounting Research, among others. The contribution of this research is the presentation of a framework regarding the main forms of applications of the model and contributions to the joint model theories under study.

## **2. STRATEGIC COST MANAGEMENT**

Traditional cost management has been hotly contested three decades ago having been promoted since then new approaches to consolidate new research stream named Strategic Cost Management (SCM) (Cooper, 1988; Cooper & Kaplan, 1988).

In a new market paradigm, characterized by high and increasing competitiveness, complexity and uncertainty, the need for adequate and timely knowledge on costs asked for more sophisticated cost management systems. Indeed, essentially, such systems produce costing information and support decision-making and need to consider the nature and complexity of organizations and their processes, resulting in effective and efficient management tools. Furthermore, strategic cost management goes beyond traditional costing practices. In general, cost accounting includes "ex-post" reporting and cost analysis activities, while cost managing emphasizes conducting planning exercises and cost control from an "ex-ante" perspective (Geigger & Ittner, 1996).

Strategic Cost Management means aligning costs with the goals and strategic direction of the organization and supports decision making, assuming an increasing key role in modern organizations for the reasons abovementioned. Thus, a strategic cost management system should generate information to planning and cost control, performance evaluation of resources and activities, the analysis of the profitability of relevant cost objects, support the definition of strategic objectives and produce reliable and timely relevant information.

## **2.1 Activity Based Costing (ABC)**

Activity Based Costing (ABC) enables detailed analysis of the costs of a product, paying attention to the activities and processes that characterize the organization's business (Swenson, 1995). ABC is a particularly appropriate methodology to deal with production and business process characterized by high levels of complexity and diversity (Afonso & Paisana, 2009), supporting strategic decision making at three different domains: the computation of product prices and margins, the production mix and the design and development of new products (Innes & Mitchell, 1998). Regarding the production mix, ABC allows us to measure the cost and performance of both activities and cost objects. Accordingly, based on three basic premises: Products require activities, activities consume resources and resources cost money (Afonso, 2002). Conceptually, Kaplan (1984) summarizes these assumptions in the following manner: the various activities consume resources and products, in turn, consume activities.

As this methodology assumes that not all costs can be related to production volume or the volume of direct use of resources, these are treated more strictly (Afonso, 2002). Particularly, making the overhead an element more noticeable, ABC makes the overhead chargeable to the products (Tippett, 1993). ABC is assumed as an improved approach in terms of product costing accuracy when compared to traditional systems (Tsai, 1996).

However, ABC systems have been often viewed as systems of high cost of development, relatively complex and difficult to be adapted to new conditions which often leads, in practice, to the non-use of such systems (Stouthuysen et al., 2010). Time-Driven Activity Based Costing (TDABC) emerged in this context in order to respond to these criticisms.

## 2.2 TDABC - Time-Driven Activity Based Costing

Time-Driven Activity Based Costing (TDABC) is a variation of ABC which intends to be simpler and friendlier based on the execution times of the activities necessary to produce the product or provide the service (Dalci, Kosan & Tanis, 2009). A TDABC system is presented in the form of time equations which reflect the costs of different cost objects taking into account the particularities of activity consumption that characterize the production processes of each particular product.

There are several case studies on the implementation of TDABC, having been observed its advantages, namely that it is a model of easy construction, easy integration with software management and a easy approach for obtaining information about the consumption of resources by cost objects (Pernot, Roodhooft & Abbeele, 2007). Through the TDABC, it is possible to study the effectiveness of the processes in terms of available capacity versus effective capacity utilization. The authors of this approach (Kaplan & Anderson, 2007) argue that the use of time equations result in a simpler and less costly computation model than the ABC method. Among other advantages, TDABC allows assessing the value added of each activity, simulating the use of resources and testing processes of capacity rationalization considering the unused capacity. But some limitations were also noted in some case studies in which, for example, the fact that it may be required a huge amount of data for estimating time equations (Varila, Seppanem & Suomala, 2007).

TDABC is supported on two key parameters, the unit cost of supplying capacity and the time required to complete an activity, or in other words, the unit cost of the practical capacity of committed resources and the unit times of consumption of capacity by the activities that the organization performs for products, services and customers (Kaplan, 2007). The TDABC is a simpler, more accessible, economical and powerful system than the ABC system, simplifying the process of costing through the elimination of surveys and interviews which are typical of an ABC system (Kaplan, 2007).

The TDABC model is a model that assigns resource costs directly to cost objects (Kaplan, 2007). So, firstly it calculates the costs of all resources (equipment, personnel, etc.), dividing them by the capacity, being such capacity the time of work effectively executed.

Secondly, the model distributes the resource costs using the cost rate of supplying capacity, estimating resource requirements for each cost object (typically considering time as a measure of this capacity) (Everaert et al., 2008).

To point out that the model requires only estimations of the time to process customer orders, it is not necessary that they be equal, since the model takes into account the specific characteristics of each product using equations and variables dummy.

Mathematically, the TDABC can be explained as follows (Brugemann et al., 2005). The cost of the event  $k$  of activity  $j$  is given by

$$J = t_{j,k} \cdot c_i \quad (1)$$

Where

- $c_i$  - is the cost per unit (minute) of resource pool  $i$ , and
- $t_{j,k}$  - the time consumed by the event  $k$  of activity  $j$ .

By using time equations, the time consumed by the event of an activity ( $t_{j,k}$ ) can be expressed in function of different characteristics, the so-called time drivers.

The following general time equation (2) describes the time needed for an event  $k$  of activity  $j$ , with  $p$  possible time drivers  $X$ , where  $\beta_0$  represents the constant time, independent of the characteristics of the activity and  $\beta_1$  indicates the increase in time for one unit increase in  $X_1$  (when  $X_2, \dots, X_p$  are held constant)

$$t_{j,k} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_p X_p \quad (2)$$

- $t_{j,k}$  - time required to perform event  $k$  of activity  $j$ ;
- $\beta_0$  - is the constant amount of time for activity  $j$ , independent of the characteristics of event  $k$ ;
- $\beta_1, \beta_2, \dots, \beta_p$  - time consumption for one unit of time driver  $1, 2, \dots, p$ ;
- $X_1, X_2, \dots, X_p$  - time driver 1, time driver 2, ..., time driver  $p$ ;
- $p$  - the number of time drivers that determines the time needed to perform activity  $j$ .

Kaplan & Anderson (2004) consider that the practical capacity is equivalent to between 80% and 85% of the theoretical full capacity.

### **3. METHODOLOGY**

This research was divided as follows: the first corresponds to the construction phase of the theoretical framework of the study, the second concerns the analysis of published articles on Time-Driven ABC in the ISI database. The Institute for Scientific Information (ISI) is considered the first of interdisciplinary information industry and was created in 1958 in Philadelphia, USA. Their database has a record of more than 8000 titles of the most renowned journals worldwide, as well as newly published books, "proceedings" and revisions.

The study can be considered as bibliographic and descriptive with qualitative and exploratory approach. According to Cassel & Symon (1994), this approach is especially relevant for cases in which the themes are emerging, in order to discuss matters with a greater degree of intensity.

Descriptive research is concerned to observe facts, register them, analyze them, classify them and interpret them without the interference of the researcher (Andrade, 2002). Qualitative, according to Denzin & Lincoln (2006), "involves the study of the use and collection of a variety of empirical materials that describe routine and problematic moments and the life of the individual meanings." Bibliographical can be conceptualized as a systematic study that is developed with based on materials published in books, magazines, newspapers, electronic databases, ie, materials that are accessible to the general public (Vergara, 2005). The period of data collection will be by 2012.

#### **3.1 collects of data**

Data collection for this study was as follows: (a) was used as a criterion for choosing the studies that presented the term "TDABC" "Time-Driven ABC" and "Time Driven Activity Based Costing" in the title, abstract or the keywords in the ISI data base, (b) after collection of studies, it was determined that only the articles in the English language will be examined. The collection procedure was as follows:

- 1) From Microsoft Word or Acrobat, as the file format all texts containing the word TDABC was identified;
- 2) they were separated in a specific directory and then were examined one by one, those being considered valid where TDABC was addressed;
- 3) the set of files that met this requirement was considered the target population;

#### 4. DATA ANALYSIS

In response to the main research objective, in this section we describe the analysis of published articles on TDABC. According to the "search" the system in the ISI database, 31 articles about the TDABC were available. A more accurate analysis, some articles were excluded, as were studies in languages other than English, reviews and articles lacked thorough research, getting as final sample analyzed 20 studies.

First an analysis of authors who applied the model as Kaplan & Anderson (2004, 2007), as shown in Table 01 will be held

**Table 01: Application of the Model TDABC**

Nº	Year	Authors	Where was applied	Country
1	2007	Oztaysi, B., Baysan, S., & Dursun, P.	Courier	Turkey
2	2007	Pernot, E., Roodhooft, F., & Van den Abbeele, A.	Library-Univers.	Belgium
3	2008	Everaert, P., Bruggeman, W., Sarens, G., Anderson, S. R., & Levant, Y.	Company Wholesaler	Belgium
4	2009	Demeere, N., Stouthuysen K. & Roodhooft, F.	Clinic Medical	Belgium
5	2009	Bank, D. E.	Hospital Children's	EUA
6	2010	Stouthuysen, Swiggers, Reheul, & Roodhooft, F.	Library-Univers.	Belgium
7	2010	Ratnatunga, J., & Waldmann, E.	Universities	Australian
8	2010	Öker, F. & Adigüzel, H.	Company Manufacturing	Turkey
9	2011	Coulter, D., McGrath, G. & Wall, A.	Sector Energy	Ireland
10	2011	Kate-riin, K. & Jantson, S.	Library-Univers.	Estonia
11	2011	Hajiha, Z. & Alishah, S. S.	Hotel industry	Iran
12	2012	Reddy, K., Venter, H. S., & Olivier, M. S.	Company Technology	South Africa
13	2012	Ratnatunga, J., Tse, M. S., & Balachandran, K. R.	Company Manufacturing	Sri Lanka
14	2012	Somapa, S., Cools, M., & Dullaert, W.	Road Transport	Thailand

Source: Research Data

As shown in Table 01, it appears that there are several sectors and authors from different countries performing the application of TDABC model. It is noteworthy that the authors demonstrate through studies detailing the model, showing the necessary variables for your



application. Importantly, as there are several sectors, each model was adapted to the reality of the organization.

According to the data collection, the first published works using TDABC model, the authors were Oztaysi, Baysan & Dursun (2007) and Pernot, Roodhooft & Van Den Abbeele (2007). In the first study, the authors applied a study in a service company - Courier in Turkey. According to the authors, the research provided to the organization's management has a view of identification of its products, the study was applied to a distribution process using radio frequency identification (RFID), managing to manage human error and the ability to store information in the form to allocate resource efficiency. Concluding that the application of the model compared to the real-time system based on barcode with a potential information system based on RFID, which results reduced costs and have the potential to serve more deliveries with the same resources.

Have Pernot, & Roodhooft Abbeele, (2007) used the model in a university library in Belgium, reaching results of its application in lower costs and better delivery of services. Also stressed, that could disaggregate the costs per transaction, based on an analysis of the activities at the end you will see the true cost of different activities for different requests.

Everaert, et., (2008), a very interesting study because it is a real case study on a wholesale company in Belgium. The study is applied to students so they can make decisions through the descriptions of the president of the organization, and the final analysis is to calculate customer profitability. The decision would be between ABC and TDABC. The case requires students to assume the role of a business consultant to decide on the appropriate method of costing. According to the study, students should first analyze the competitive environment and learn about the difficulties experienced in the ABC model. Then students are asked to choose the ideal model for costing this company. After completing the case, students will understand the differences between ABC and TDABC. The case also illustrates the concepts of time-drivers and equations in real time, with examples of logistics operations.

The study Demeere, Stouthuysena & Roodhooft (2009), was performed in an outpatient Belgium. According to the authors, the application of the model had the involvement of managers and heads of departments in analyzing the underlying activities on the issue of costs. Held meetings with them to define how they could distribute these costs. After this step, the model was applied and reaching the conclusion that the method allowed opportunities and future



recommendations. In addition, it introduced a healthy competition and open communication between the different departments about possible operational improvements. Finally, although the interaction between systems of cost accounting and strategy has often been seen as a liability, in this study, information TDABC clearly improved understanding to the department heads and the different organizational processes of health managers.

The author Bank, (2009) applied the TDABC in the emergency department of a hospital in the United States, with the objective of estimating the resource costs of the provider and apply them to three specific clinical scenarios. We conducted a comparison between these scenarios and concluded that the TDABC can be used as an efficient and accurate tool for estimating the true cost of service. Further stressed that for any patient encounter, the costs of services vary widely based on the proportion of time and resources used, but can be used by officers to help determine the allocation of clinical resources and a management tool.

Stouthuysen, et al., (2010) conducted a study in a library of a university in Belgium and limited study on the acquisition of foreign books, books, local newspapers and the rest process category. Found that the current software was inefficient in the management of the library. Concluded that the structure was clear and understandable and the implementation went well, and the library staff welcomed feedback on their performance and the possibility to further improve the process. Based on the cost data, the administration of the library decided to replace the general acquisition software with a new software program adapted to the needs of the library. In addition, the library management took measures on group activities and re-allocation of tasks to staff wages.

In the study of Ratnatunga & Waldmann (2010), the authors applied the model in Australian universities in order to verify the programs that invest in local government educational institutions for future research. According to the authors, the objectives of the SRE program are: (1) help resolve identified a shortfall in funding available to cover the indirect costs associated with ACG research, and (2) to support universities to build and maintain research excellence through implementing structures of best management practices, performance and financial reporting. Concluded that, while the TDABC has an advantage over ABC in service organizations, to work with the equations of time to research activities in the departments of education, revealed erroneous estimates of the research effort over an annual period, and thus

costs of data collection outweigh the benefits (if any). Importantly, no interviews were conducted in the study, so there may be problems regarding the equations and distributions costs.

Oker & Adigüzel (2010) conducted a case study in a manufacturing company, which manufactures high quality plates and plastic parts for companies in the electronics, automotive and telecommunications in Turkey and Europe sectors. Found that the organization uses the Standard Cost-defining percentages to be applied in the distribution of indirect costs and, according to this system all product groups are profitable. However, when implementing TDABC, indirect costs were through the equations of time allocated and it was realized that not all groups are profitable, and which some groups would prejudice. Concluded that the benefits of TDABC system are easier to update the changes of the time equations, simplicity in the processes of allocation of indirect costs and allows analysis of capacity utilization of the company.

Coulter, McGrath & Wall (2011) conducted a study in a branch company in the energy sector in Ireland. TDABC applied the model following the steps according to Kaplan & Anderson (2004, 2007) the authors identified team members and used the interview to define the management process and products. Concluded in application of the model, that managers now have the most accurate cost, a greater understanding of net margin and values to optimize their portfolios. The communication process was simplified because, before the introduction of TDABC, used reports were taking too long to be able to make decisions. The new reports include important information such as the number of accounts, transactions by payment type and number of clients.

Kate-Riin, Kont & Jantson (2001) addressed the research a comparison between ABC and TDABC in university libraries in Estonia. In the study no was performed applications of the model, only theoretical explanations of what method would be most advantageous to the University. They concluded that among the advantages and disadvantages of the methods, the TDABC would be most appropriate for university libraries, because it would be easier, faster time to deployment, real updates, contributes to providing more effective services and lower costs.

The authors Hajiha & Alishah (2011) applied the TDABC in a case study of a Hotel in Iran. According to the authors, were first identified the weaknesses of the existing traditional costing system to further apply the model. They used interviews of employees in different sectors of the Hotel, found the time consumed for the different activities and profitability of different customer groups by TDABC method and the method used in the company. The results

showed that the use of TDABC model, compared with the existing traditional system provides more appropriate data in cost and customer profitability. Moreover, the proposed model distinguishes the activities of non-value-added and shows the actual capacity of each of the hotel. Therefore, managers of service companies, especially in the hotel industry, one can calculate the time required for activities through time equations in TDABC.

Reddy, Olivier & Venter (2012) applied the TDABC in a company technology in South Africa, to determine the cost of implementation and management activities required for the digital forensic readiness (DFR). Concluded that TDABC provides the ability to measure the cost levels of tasks and activities, and allows the management of the same. It is useful in determining the costs, and according to the authors, the research presented here is important, since it was the first work that addresses the cost of DFR measures and also the first to propose the use of a tool management costs as a to manage and verify such costs. A DFR program may involve activities privacy functions of an organization's information security and information as well, the benefits of cost information activity level revert to these functions too.

Ratnatungaa, Tseb & Balachandranc (2012) conducted a study in a manufacturing company in Sri Lanka. The study addressed a comparison between ABC and TDABC and concluded that the model has TDABC complexities similar to ABC implementation, if the conditions are strictly adhered modeling; these complexities are independent of factors specific to each country, and its simplest form, the model generates the same errors of decision information of traditional costing. From the results of comparative gross margin presented based on data from the case study, it appears that ABC is superior to traditional volume-based cost allocation systems. However, the version TDABC does not appear to different ABC, if the time-activity patterns are used as cost drivers.

In the study of Somapa et al., (2012) applied the TDABC at a trucking company in Thailand. The authors have had problems with lack of essential quantitative data to support the construction of equations of time and costing of capacity, and the difficulty in estimating time for certain activities, especially for those that do not run continuously. The last problem is the trial time allocation for consolidated services. Concluded that, despite the problems encountered was the application of the model, but with the limited data and a lack of control of the organization was indefinite case study.

Table 1 summarizes the main advantages and difficulties in applying the TDABC identified in the studies analyzed.

**Board 1: Summary of main advantages and difficulties identified in studies TDABC**

Authors (year)	Principals advantages identified	Principals difficulty Identified
Oztaysi et al., (2007)	- Reduction of costs; - Most deliveries with the same resources.	- No significant difficulties were encountered;
Pernot et al., (2007)	- Easy construction, - Ease of integration with software management, - Ease of obtaining information about the consumption of resources by cost objects	- No significant difficulties were encountered;
Everaert et al., (2008)	- Details of the model in various complex activities;	- No significant difficulties were encountered;
Demeere et al., (2009)	- The model was considered faster and easier to use; - Visualization of the complexity of the actual operations of the organization.	- No significant difficulties were encountered;
Bank, D. E. (2009)	- Effective and accurate method to estimate the true cost of the service tool	- No significant difficulties were encountered;
Kristof et al., (2010)	- Efficiency in processes and greater cost control activities;	- No significant difficulties were encountered;
Ratnatunga et al., (2010)	- Analyses were better than current systems and the ABC	- Especially not have set schedules of the members of the study "teachers and students", change according to the subjectivity of coordination.
Öker et al., (2010)	- Easier for companies to implement than the company's manufacturing services; - Simpler the first process allocation of indirect costs;	- One disadvantage of TDABC model is the need for detailed information to the initial implementation of TDABC model.
Coulter et al., (2011)	- More accurate costs; - Increased understanding of net margin	- Some sectors was difficult to analyze and collecting the information;
Kont et al., (2011)	- Faster and cheaper to deploy System; - Contributing to the provision of better services and more effective	- No significant difficulties were encountered;
Hajiha et al., (2011)	- Provides more adequate data on cost and customer profitability; - Allows managers develop an optimized strategy to increase productivity and improve processes;	- No significant difficulties were encountered;
Reddy et al., (2012)	- Determines the cost of implementation and management activities;	- No significant difficulties were encountered;
Ratnatunga et al., (2012)	- Helps companies solve implementation problems in a way that will not compromise the accuracy; - Help companies solve implementation problems in a way that will not compromise the accuracy;	- Information of decision as wrong as that produced by traditional volume allocations; - Can not find significant differences between the ABC and TDABC
Somapa et al., (2012)	- Use of simplified parameters; - Provides details of the cost of services rendered;	- The lack of quantitative data on cost drivers - Difficulty in assessing the practical capacity because there are irregular working hours of employees; - The trial of allocation of time for some services. - Hard-scale application and on an ongoing basis.

Source: Research Data

#### 4. 1 Discussion of Results

According to Table 01, it is noticed that the authors highlight some advantages and difficulties in applying TDABC model. As Kaplan & Anderson (2004, 2007), the main advantages of applying TDABC model are:

- 1) makes it easier and faster to develop an accurate model;
- 2) effectively takes the data currently offered by integrated systems business management systems and customer relationship;
- 3) directs the costs to the transactions and applications, using specific characteristics of applications, processes, suppliers and customers;
- 4) can be rotated monthly to capture the result recent operations;
- 5) becomes more visible the efficiencies of the processes and capacity utilization;
- 6) provide the resource requirements, allowing companies to obtain resource capacity based on number of estimates and complexity of applications;
- 7) is easily expandable to cover the entire scope of the enterprise, by the applicable software throughout the enterprise and via database technologies;
- 8) allows fast and inexpensive maintenance model;
- 9) provides detailed information to identify root causes of problems;
- 10) is applicable to many industries or businesses that are characterized by complexity in customers, products, channels, segments and processes, for lots of people and high capital costs.

Performing an analysis of the advantages found, Oztaysi et al., (2007) and Pernot et al., (2007) were able to verify a reduction in costs compared to models that organizations used. The first paper described that could more deliveries with the same resources. The second survey, provision of better services and the ability to disaggregate the costs per transaction, based on an activity. These considerations concern the advantages (03), (05) and (09).

According Everaert et al., (2008); Demeere et al., (2009); Oker et al., (2010); Kont et al., (2011) and Somapa et al., (2012) model is easier and faster in its development, this according to this first advantage emphasized by Kaplan & Anderson (2004, 2007).

Were also identified as advantages of TDABC in the case studies analyzed: Detailing the model in various complex activities. View of the complexity of the actual operations of the organization. Effective and accurate method to estimate the true cost of the service tool. Provide more adequate data on cost and customer profitability. Enables managers to develop an optimized to increase productivity and improve processes strategy. Virtually all the advantages presented by Kaplan & Anderson (2004, 2007) in the use of TDABC were observed in practice through research analyzed.

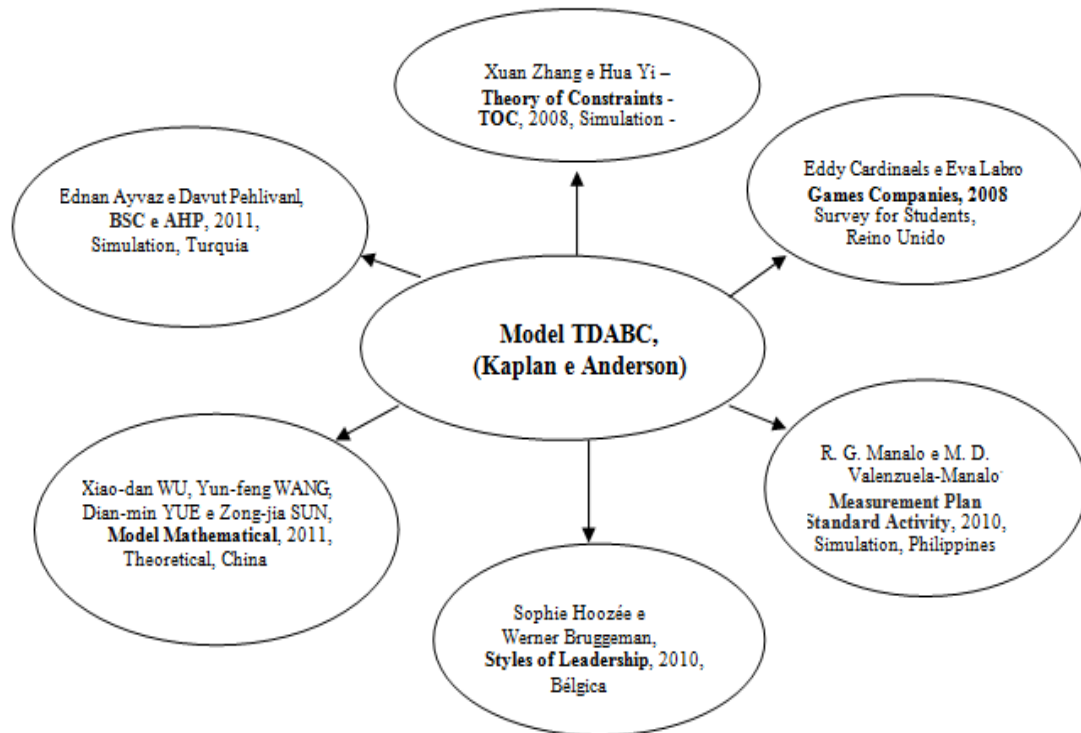
With regard to the difficulties encountered in the analyzed studies, most concerns over the sector (company) than the proper implementation of the model, namely: Ratnatunga et al., (2010), the schedules of the members of the study defined "teachers and students" change according to the subjectivity of coordination. To Somapa et al., (2012), the lack of quantitative data on cost drivers continues to be a problem, the difficulty in assessing the practical capacity because there are irregular working hours of workers and trial time allocation for some services.

Already in the work Ratnatunga et al., (2012) went further, according to the authors, the model provides information for decision as wrong as that produced by traditional volume allocations and also found no significant differences between the ABC and TDABC.

Considering the analysis, it appears that there are some limitations with respect to TDABC model, but it is important to note that despite the problems encountered in some studies, most believe that the model contributes to the management of costs is the actual cost of each product or activity, even in management decision making.

## **4.2 Theories the Joint**

In this section, an analysis of studies that used some theory together with TDABC be performed, ie, what are the contributions achieved by the authors. The works selected here are fundamental for organizations and academia, because these studies contribute to future work that can be implemented and also assist managers with a more comprehensive view of TDABC model.



**Figure 02: the Joint Theories**

In 2008, the authors Xuan Zhang & Hua Yi authors Chinese conducted a study using TDABC by simulating logistics along with the Theory of Constraints-TOC. Examined the rate of use of effective capacity with the principles of the Theory of Constraints to find a new way to solve the existing bottleneck of the case study organizations. According to the analysis, it was found that the activity of boarding verification is the bottleneck of the system. Concluded that by using the simulation logistics, in some ways can "avoid" cost reduction. On the other hand, assists in the coordination of all segments of the global optimization of the entire logistics system.

In search of Xuan Zhang & Hua Yi (2008), contributed to a superficial view of a particular activity, however, future research can apply this same methodology in the organization as a whole, a real case. In the same line of reasoning, Goldratt & Cox (2002) TOC proposes the maxim that "the sum of local optima is not equal to the great overall."

Cardinaels & Labro (2008) took a different form in the application of TDABC, the authors applied a questionnaire to 157 undergraduate students in an academic institution in the UK. It was an application of business games where it was used an experimental design to overcome the difficulty of the measurement of time, which is a prerequisite for the application of



TDABC. (1) the participants perform a series of activities for which, subsequently, provide time estimates, and (2) a media computer accurately the time spent on each activity, providing a benchmark against which real time estimates of participants are compared. The objective was to examine how the measurement error in estimates of time varies according to the parameters used to perform the tasks and projects.

As a conclusion of the research, the authors discuss the findings have direct implications for practice-based costing activity. Service-based economies rely heavily on estimated time on their cost allocations, as in many areas such as billing, bidding and time estimates. Given the extent to which time estimates are used, the decision makers who use the numbers produced by costing systems should be aware of the extent of measurement error that affects the precision of the numbers costing to avoid making wrong decisions. Highlight the need for designers costing systems to find ways to reduce the likelihood of such a mistake in designing a costing system and offer various tools that can be used for this purpose. For instance, as the largest error in estimates of time is incurred when tasks are inconsistent and activities are disaggregated, these cases would most benefit in terms of improved accuracy from an investment in a system for automatic on- line measurement.

The authors R.G. Manalo, M.D. Valenzuela-Manalo (2010), addressed a theoretical study on TDABC with the Standard Measurement Plan Activity. The study was a theoretical, ie, a comparison of ABC and TDABC approach, explaining that TDABC is the best model to meet the cost of goods. Also addressed a structure that combines the complementary features of activity-based costing (ABC) and Time-Driven Activity Based Costing (TDABC). Table or Activity Measurement Standard plan is anchored in the cost of computing unit with the minimum resources required for a particular activity. The unit cost activity is standard and fixed for a certain period, until these variables "time" and change are significant. The default time unit for activity is also used to establish the percentage of time spent. Thus, the ABC data collection is minimized if not totally eliminated.

It was concluded that the two methodologies can reach its calculations from different directions - accounting for the same expenditure - that each has the merit of providing a variety of insight. To understand the issues of ships or unused capacity, the time-driven approach provides more clarity. The authors emphasize that the TDABC is not a substitute for traditional ABC. They should complement each other. Your strengths should be combined to minimize your



weaknesses. So default, the Plan Measurement activity is designed to combine the complementary features of both methods. The amount of resources and the average treatment time (APT) will always be the same, although the cost may be different after a certain period of time. In this situation, a standard activity unit cost can be established that can be used to forecast demand and budget. Similarly, the time to complete or APT can be multiplied by the outputs or completed transactions to arrive at the total time taken for the activity.

Hoozée & Bruggeman (2010) conducted an empirical study to examine the role of worker participation and leadership style in the design of the system TDABC process and understand its effect on operational improvements. More specifically, the goal was to identify how, why and when the design of the system results in TDABC operational improvements. The article shows how the collective and worker participation and leadership style influences the emergence of operational improvements during the design process in an environment TDABC system case study.

According to the authors, was the participation of all members of the organization, especially at lower levels, promoted a dialogue on the input parameters of the cost model. With discussions with the groups on the costing method when guided by a superior with a style oriented leadership thoughtful people, operational improvements appeared. Already with the second group and operational staff were not involved in the design process, because they feared that the new costing system, therefore, thought it would just be a method to ensure compliance, but without operational improvements. Therefore, it appears from this study that this methodology was important since, according to research participation involving leadership styles influence a lot in making decision.

The Chinese author Xiao-Dan Wu et al., (2011) conducted a study using a mathematical model to solve problems on the cost of cost objects and analyze the errors that occurred during the implementation process TDABC. According to the authors, the TDABC model generally assumes that the direct cost of the resources can be allocated directly to cost objects. In the study, the direct costs are measured without error for each cost object, and thus exclude them from the analysis, in that the portion of indirect cost in resources is in use, there are generally three types of errors: errors of aggregation (AE), specification error (SE) and measurement error (ME).

The authors argue that the cause of the error of aggregation is that the resources used in heterogeneous activities are aggregated and collected on cost center resources and shared by the

same unit at the same rate distribution. In TDABC model, measurement errors can cause aggregation. The reason for the emergence of specification error is that the means used to allocate the cost, which is collected and aggregated for products does not reflect the resource requirements of each product, or the ratio of cost. One can say that the specification error stems mainly from a standard for undue cost distribution. In TDABC model, the measurement may cause specification due to an inadequate standard for drivers. This can lead to a measurement error is that there is no standard for measurement, and a technique for accurate measurement of variables method. They concluded that the increase of measurement error increased the cost of all the products, increased measurement errors increased the cost of the product, but the increase of measurement errors have reduced the cost of all products.

The authors Turkey Ayvaz & Pehlivanl (2011) performed a simulation of TDABC with the Balanced Scorecard (BSC) and Analytic Hierarchy Process (AHP). The main objective of the study is to express the need for methods that support the BSC and integrate them in order to practice it correctly in strategic decision. Still, the BSC should be developed in order to determine and organize business strategies according to the four perspectives of the BSC. Planning strategies and improve BSC for strategic decision making. In the study, TDABC is important not only in the full reporting process and time that are intended to serve the customer and cost targets. Moreover, Analytic Hierarchy Process (AHP) is a method of decision making used to evaluate various criteria in order to choose the best to determine critical success criteria. The goal is to create a model to integrate BSC with TDABC and AHP in order to provide a process to support effective strategic decision.

According to the authors, the BSC is a strategic management of vehicles that a company should have in the decision-making process. Concluded that the application of TDABC this management process and helped a lot in making a decision, along with the AHP. Also informed that before putting the BSC in place quickly, its infrastructure must be structured by other processes to support important decisions, such as TDABC and AHP in order to execute it properly.

It is observed that the application of the joint model TDABC theories some cases contributes to the management of costs, however, it is noteworthy that the main objective of the methodology are TDABC unit costs, ie, how to "manage" the organization strategically depend on each other.

## 5. CONCLUSION

This article is the preliminary result (working paper) in a more comprehensive study. In this sense, the results represent a scenario in context of a sample. The proposed goal of this research was to analyze and verify the work they were applying the model or using joint theories with TDABC.

As a final result, we analyzed 20 studies published in the ISI database, and the surveys were implemented in many countries, different sectors and by various authors, an essential contribution in order to have an understanding of this management tool.

The analyzes performed were 14 studies that applied the model and 06 studies that used combined with the theories TDABC model. In studies that applied the model was able to identify the application process, as well as the contributions and limitations. Among the contributions, cost control, and a simple model can be rapidly applied and a tool that provides data for managerial decision making contributions that correspond to Kaplan & Anderson (2004, 2007) present. Regarding the difficulties, the main identified relates to the formulation of the equations of time. It was observed that a large volume of data is required for validation. Moreover, their applicability in unstable environment in which the activities are not routine, is apparently very limited.

In research using other joint theories with TDABC, one can not only analyze the contributions as if they were the TDABC, because there are other forms and applications of the model. What we observed was a diversity of contributions and limitations. In the study by Xuan Zhang & Hua (2008), used the Theory of Constraints applying a simulation and the contribution of this study is interesting for a display in just one step. Importantly it would take a real application and throughout the organization.

Cardinaels & Labro (2008) used questionnaires to students, showing that there are errors in the measurements of time. Although the application is in the student contribution is relevant because it shows us that the decision making depends heavily on the expertise and even experience management. This study can be said that complements and authors Hoozée & Bruggeman (2010) who used the participation of employees in accordance with the styles of

leadership. The results presented demonstrated that yes, the styles of leadership influence on the management of organizations process.

In search of Manalo & Valenzuela-Manalo (2010) conducted a theoretical study applying the ABC, TDABC and APT, and demonstrated that APT and TDABC gives satisfactory results compared to the cost of goods. The authors emphasize that the TDABC is not a substitute for traditional ABC. They should complement each other. Your strengths should be combined to minimize your weaknesses. So default, the Plan Measurement activity is designed to combine the complementary features of both methods.

Regarding the study of Wu Xiao-dan et al., (2011) conducted a study using a mathematical model to solve problems on the cost of cost objects and analyze the errors that occurred during the implementation process TDABC. An important insight, because in none of the studies analyzed, the authors verified the existence of measurement errors. Found that in TDABC model, the measurement may cause specification due to an inadequate standard for drivers.

The Ayvaz & Pehlivanl (2011) authors conducted a simulation of TDABC with the Balanced Scorecard (BSC) and Analytic Hierarchy Process (AHP). This study gives us more comprehensive view, since it is first necessary to verify that the organization's strategic planning, applying the Analytic Hierarchy Process (AHP) and ending with the TDABC. It appears that if there are problems of formulation in any of the steps, you can give unsatisfactory results, ie, the application of model TDABC its unit cost is not real.

The considerations found in the articles published regarding the benefits and difficulties of TDABC model. According to Kaplan and Anderson (2004), of the model presents advantages: a higher level of simplification; ease of implementation and updating of the method; ability to capture the complexities of operations; Comparative offer provided between the capacity and the capacity used; explicit incorporation of resource capacity, especially the capacity unused, providing its management.

Among the studies, the advantages were: - Provides the improvement of decision-making to support information; - The most accurate information possible a view to identify where these resources are effectively consumed; - Relevant management information regarding the estimated practical capacity available, the practical capacity utilization and related idleness; - To facilitate

the implementation of this methodology; - Measure the idle capacity; - Does not require large investments for implementation and - Implementation and maintenance simpler and cheaper.

Regarding the difficulties encountered include: - Difficulty to estimate the execution times; - The existence of possible distortions in the time allocated to activities and degree of subjectivity inherent in the methodology.

Finally, there is the general characterization of how the method is being researched costing TDABC. We notice that this is a much studied under several different optical and some little explored by researchers whose mission is the development of studies that bring relevant news to the method. As a recommendation for future research, we suggest the investigation of other vehicles publishing papers related to the topic discussed.

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