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Analysis of Time Determinants Under The Conditions of Application of The Time Driven Activity Based Costing Method Aws

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Abstract. *The studies of J. Lave and L. Silverman, which, with the help of the proximity technique, demonstrated that only through a closeness between time and space can relevant results be obtained to achieve a superior performance under the given conditions of the current health system, in our opinion, outlines the idea that the application of the Time-Driven Activity-Based Costing (TD-ABC) method is the most suitable solution. The complexity of TD-ABC operations is found in the time equations needed to determine the resources consumed by each activity. Using these equations, it is easy to update the model by adding an additional activity. This simplification would allow the multiplication of the activities to be treated without presenting difficulties in the distribution of resources. In fact, what we have here is clearly an "autonomous method of equivalence" that uses working time as a unit of equivalence. The main objective of our concerns is to identify the determinants of the time required to start, perform and complete medical procedures in an ambulatory clinic organized in 15 medical offices. As a reaction to the criticisms of some authors regarding the difficulty of measuring time for establishing the time drivers of the TD-ABC method, in the scientific approach carried out we tried to model the activity times with the help of the multiple regression model. We believe that the values estimated and obtained with the help of the Automatic Linear Modeling factor analysis model eliminate the imperfection of the TD-ABC method highlighted by the authors S. Hoozée et al (2009) regarding subjectivity and instability in the measurement of activity times.*

Keywords: *Activity, Resources, Time, Driver, Time Equations, Cost.*

1. INTRODUCTION

The evolution of the competitive environment has proliferated the appearance in the specialized literature and practice of new theories and concepts based on a connection between the fields of accounting, management, marketing, etc. generating a real revolution in the methodology of cost calculation systems.

In the incursion that we propose to go through, we have in mind the contemporary developments that we can stage taking into account the opinions of the authors Y. Levant and H. Zimovitch.

The period 1950-1960 is characterized by the application of the standard cost method alongside the methods based on the principle of homogeneous sections, which, although it was an evolution in managerial thinking, was subjected to harsh criticism regarding the methods that characterized it on the grounds that it is expensive and complex, and, on the other hand, it does not respond to periods of increased inflation, which has determined new searches.

The period 1960-1980 is characterized by the decrease of interest regarding the allocation and control of general expenses on homogeneous sections, interest that goes

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towards the decrease of costs by increasing the volume of production and the marginal profit. From this perspective, the penetration in Europe of the direct cost method, an extremely simple method, has overshadowed the methods based on the principle of equivalence considered to be outdated for the same reasons that previously put them in the spotlight.

Based on the separation of costs into fixed and variable costs, the problem of making a distinction between direct costs and variable costs, between indirect costs and fixed costs, which was not clearly established, was raised.

The question that arises is why was the term direct costs used at that time? The success of the direct costing method was instilled by the ease with which costs, production volume and profit were linked in order to detect unprofitable businesses or to adjust prices, without negative effects on the market. On the other hand, the advantage of the direct cost method is given by the simplicity regarding the use and presentation of the method, avoiding the complications involved in the rational allocation of costs.

Of course, although the advantage of the direct cost method was that it eliminates fixed costs, it does not mean that it completely eliminates the indirect costs outlined by the equivalence methods, but in practice, the two types of costs overlapped widely, one on top of the other, especially half a century ago.

The period 1960-1980 is also characterized by the discovery of management control, the method of direct costs being of real support through its concept of separating variable costs from fixed ones.

The period 1980-2010 is distinguished by a return to equivalence methods alongside a new concept brought by the ABC method. Practically, the period 1980-2010 is defined by the American interest in countering the Japanese models that were gaining ground in the car industry.

The creation of value for the customer and shareholder became a priority in the concept of cost calculation and which highlighted that the crisis in American industry was caused by the neglect of monitoring indirect costs that were arbitrarily distributed being prioritized to reduce labor costs. To restore the relevance of expenses, a new approach known as Activity-Based Costing (ABC) was launched, proposed by Kaplan, Johnson and Cooper within the Computer Aided Manufacturing-International (CAM-I) working group.

The principle of this method is familiar; this involves logically considering the process of resource consumption, eliminating those that do not contribute to value-creating activities, and highlighting the costs of those that generate value. For this, it is necessary to adopt a transversal perspective of the company, rather than a functional vision of it.

Unlike methods based on the principle of homogeneous sections, where indirect costs are allocated to cost centers and then shared between products by means of arbitrary coefficients, the ABC method follows a logic whereby activities consume resources at the process level and products consume activities according to how much cost factors are used.

According to proponents of the ABC method, an activity must distinguish between a "classic" cost center, which is often associated with a function or department of a firm ... and must not confuse a cost driver with a simple allocation of indirect costs. If a unit of measure simply corresponds to a correlation, a cost driver must be correlated with the costs of the activity, but must also correspond to the factor that generated the cost, the principle of homogeneity must be respected in that regarding the activity.

The ABC method can be considered as an American "reinvention" of the method on homogeneous sections where its technical qualities are not better, but it places it above the other methods by the fact that it can be integrated with the EVA indicator.

Harshly criticized, the ABC method follows the Gaussian curve and begins to lose interest, especially at the level of specialized literature, giving way to a simpler method known as Time Driven Activity Based Costing (TDABC), the foundation of the entire scaffold being represented by time, the most valuable resource of any organization and which is difficult to replace.

2. LITERATURE REVIEW

Considering the criticism of the ABC method and the gradual loss of interest in its application, the method's promoters, R.Kaplan and S.R.Anderson sought to offer new cost allocation solutions that would produce strategic information faster and less expensively.

While several articles advocated the use of the ABC method by organizations, in general and the health system in particular, a certain degree of caution was felt. Thus, Y. Lievens et al., as well as King et al., argue that the potential disadvantage of ABC systems consists in the consumption of time and resources associated with the development and management of these systems.

In November 2004, in the journal Harwaed Business Review, Kaplan and Anderson present in the article published for the first time a new independent method called TD ABC.

A book followed in 2007 in which its authors (Kaplan and Anderson, 2007/2008, p. 6), deny any connection with any resumption of existing practices in the use of the ABC method. A paragraph entitled "ABC of Time: Old Wine (Enduring Leaders) in New Bottles?" (Kaplan and Anderson, 2007/2008, p. 17-18) is even devoted to the refusal of any ABC author to use time inducers. This disclaimer makes a direct reference to Cooper's (1997) article, but there is no further reference to Chapter 14 of Cost & Effect by Kaplan and Cooper (1998, Chapter 14, pp. 292-296), so these two references were considered by Kaplan and Anderson (2003, p. 4) to be the origin of the TD-ABC method.

The main advantages of TD-ABC derive from the elimination of the disadvantages related to the ABC method: long information collection times, the need to repeat the calculations regarding the distribution of time between activities, multiplying the number of activities as the only way to capture the complexity, significant information processing capabilities and declared times that never show unused capacities. In addition, it would be the natural complement, as a costing method for the simple and quick determination of the customer profitability curve, from the balanced scorecard (Kaplan and Anderson, 2007/2008, p. 4-6).

Although little has been written about this costing method, the TD-ABC method has been implemented in over 200 orders ((Kaplan et Anderson, 2007/2008, p. 3).

However, the concept of TD-ABC is relatively new and unexplored in the field of academic research. Few studies have addressed TD-ABCs other than presentations by their designers. We can only cite a few articles, such as those by Bruggeman and Everaert P. (2007) and De la Villarmois and Levant (2007a, b). There are even fewer case studies, apart from Bruggeman et al (2008) dealing with a Belgian logistics company and Mc Donach and Mattimore (2008) dealing with a service SME in Ireland. The purpose of this article is to contribute to measuring the relevance of this method through a case study of one of the few companies in Europe that has been using TD-ABC for several years and to propose an answer to the question: is TD-ABC actually a "new wine" or an "old wine in new bottles".

TD-ABC is an equivalence-based costing method (Villarmois and Levant, 2007a; Levant and Zimnovich, 2008). As the name of the method indicates, equivalences within a "resource pool" are established using a single inductor, the time required to execute them. A "resource pool" is, according to Kaplan and Anderson (2007/2008, p. 76-81) an organizational unit or service.

Not only does it become unnecessary, most of the time, to determine the different activities, but the "resource groups" being a priori well-defined and fewer in number than the activities, this simplifies the implementation of the method and reduces measurement errors. Another advantage of TD-ABC is that it is no longer necessary to perform regular surveys to determine the possible distribution of work time among several activities, which further reduces the maintenance of the method. Indeed, time standards are used. It's just a matter of making sure these standards are consistent with practice and updated regularly. The complexity of operations is taken into account using time equations to determine the resource demand of an activity. Thanks to these time equations, it is also possible to easily update the model: adding an additional activity (if performed by the resource group), adding explanatory variables of elapsed time, productivity changes, etc.

TD-ABC is presented as a method that allows the calculation of a unit cost of capacity defined as:

Unit cost of capacity = full cost of capacity exercised by consumed resources

It is thus possible to compare the value of the used capacities with the available capacities. In fact, Kaplan and Anderson present TD-ABC as a method of rational imputation, allowing the measurement and evaluation of differences in activity.

Most of the literature comes from the originators of the method. Also, this mainly focuses on the advantages of TD-ABC. Furthermore, there are only a few case studies that provide insight into the use of the method. However, four issues seem to be developing: at a practical level, there seems to be hesitation between using standard costs and using actual costs to determine the unit cost of resource groups; assessing the cost of the subactivity is not necessarily straightforward; respect for the principle of homogeneity remains in this method; Finally, measuring time is certainly not easy.

Bagian ini menguraikan teori-teori relevan yang mendasari topik penelitian dan memberikan ulasan tentang beberapa penelitian sebelumnya yang relevan dan memberikan acuan serta landasan bagi penelitian ini dilakukan. Jika ada hipotesis, bisa dinyatakan tidak tersurat dan tidak harus dalam kalimat tanya.

3. OBJECTIVES AND HYPOTHESES

The main objective of our concerns is to identify the determinants of the time required to start, perform and complete medical procedures in an ambulatory clinic organized in 15 medical offices. Even if each activity has its specifics (ophthalmology, endocrinology, ENT, cardiology, etc.), and the patients are not all the same, there is a common note specific to the medical act, according to which the necessary times can be established, the fundamental element of the TD method -ABC and which is the basis for establishing the equations of time.

Starting from this finding, we considered two categories of times that can be measured at the level of each patient, namely the standard times and the additional times that are added to the standard time of the event.

Beyond the size of the numbers that express the times required to realize an event, we must present the following aspects that we have in mind for all the specializations subject to research:

a. First of all, patients, regardless of whether they are old or new, make an appointment for a consultation at the office, usually in the standard form by presenting at the office of the Medical Center or, more recently, by phone. This step is necessary to start the administrative procedure (registering the patient's name, opening a medical record...);
b. Secondly, the patient is received, when he is scheduled, either for treatment or for consultation;
c. Thirdly, patients are subject to medical consultation which may be standard, or which may involve additional actions, such as for example in the case of ophthalmology, extracting a foreign body from the eye, special treatment in case of conjunctivitis, performing some measurements with the apparition special);
d. Fourthly, after the consultation, while some patients pay, others make a new appointment at the same or another office; some patients request additional information, either after the medical consultation or later by phone; in some well-defined situations requiring outpatient treatment, a medical letter (prescription) is required to benefit from the necessary medication; a last step is the archiving of the medical record.

The total time (expressed in minutes), on each main object of activity, will be given by the sum of the standard and additional times taking into account the fact that certain characteristics can influence the presence of various variables in the time equation. For these reasons, certain characteristics such as old patient – new patient, requires treatment – does not require treatment, etc., are represented by dummy (dependent) variables that are equal to one or zero.

The hypothesis we issue is that there are positive links between the variables of the research model, some additional variables (additional times) having a greater influence on the standard variables and which can be optimized in order to increase the efficiency of the TD-ABC method.

4. METHODOLOGY AND DATA

The investigation methodology includes the main research methods, namely qualitative research and quantitative research, by highlighting the particularities of the study from a theoretical perspective, in a descriptive-conceptual way.

As we are talking about complementary relationships between variables, to achieve the proposed goal, we used in particular the ACP method based on the factorial technique, a method that we appreciate as the simplest solution for identifying the factors that determine the correlations between variables, the study being focused on a single medical office, respectively the ophthalmology office. Using the SPSS 26 software, we sought to value all the facilities offered by it in order to fix the conclusions that emerge.

For the data analysis, we used the method of direct observation for 30 days, as well as free discussions with the doctors of the medical offices, respectively we used the timing that we came back to after 6 months to determine the veracity of the data obtained (table 1).

Table 1. Time equations for each activity in the offices of Ophthalmology, Endocrinology, Cardiology, ENT and Internal Medicine (average times in minutes)

	Ophthalmology	Endocrinology	Cardiology	ORL	Internal medicine
Standard activities					
appointment	1.5	1.5	1.5	1.5	1.4
new customer reception	1.75	1.25	1.56	1.85	0.76
HISTORY	6.46	3.47	3.92	2.54	2.87
consultation	20.07	18.8	25.8	18.9	15.65
I use a medical device	17.35	10.2	20.45	18.26	8.94
consultation fee	2.57	2.57	2.57	2.57	2.57
classification sheets	1.67	0.25	1.42	0.86	0.62
Additional activities					
Emergency treatment	1.86	0	0	1.58	0
Send to another office	1.2	1.2	1.2	1.2	1.2
Drawing up a treatment plan	5.06	6.42	6.54	4.25	5.42
medical certificate release	0	0	10.22	0	5.53
additional info request	1.18	1.16	1.25	0.56	0.85

Source: belongs to the author

Considering the data in the table, we can identify the following information flow that will be the basis of the cost calculation, but, especially in the present research, it will serve to optimize the activity times as cost drivers. Paying attention to the activity of ophthalmology, we note the following:

Standard Activities

a. The activity starts with the appointment made at the Medical Center office, by presenting the patient, especially if he is new and lasts 1.50 minutes;
b. The standard procedure for receiving the patient is 1.75 minutes, during which it is possible to draw up a history of the condition;
c. Anamnesis – the standard patient diagnostic procedure that lasts 6.46 minutes;
d. The consultation itself was measured at 20.07 minutes if it does not involve the use of medical equipment and consists only of a patient-doctor discussion;
e. In the situation where the use of medical equipment is necessary, especially in the case of new patients, or with accidents, a time of 17.35 minutes is requested;
f. Once the patient leaves, the payment for the consultation (we are talking about a private clinic) stops and lasts 5.57 minutes, after which the medical file is archived

Additional Activities

a. Additional activities consist primarily of emergency treatment that requires a minimum time of 1.86 minutes;
b. Sometimes it is necessary to refer to another medical office and the issuing of the referral ticket takes 1.20 minutes;
c. The standard activity is completed by additional activities related to drawing up the treatment scheme (5.06 minutes), issuing a medical letter (prescription), time given to the patient for additional explanations and return to control (1.18 minutes).

The times required for the activities of any office can be interpreted in a similar way.

5. RESULTS AND DISCUSSION

Strictly referring to the activities involved in the ophthalmology office, in table no. 1 we show the descriptive statistics of the items corresponding to the standard activities (1-7) and additional activities (8-11), activities that we submit to the analysis as.

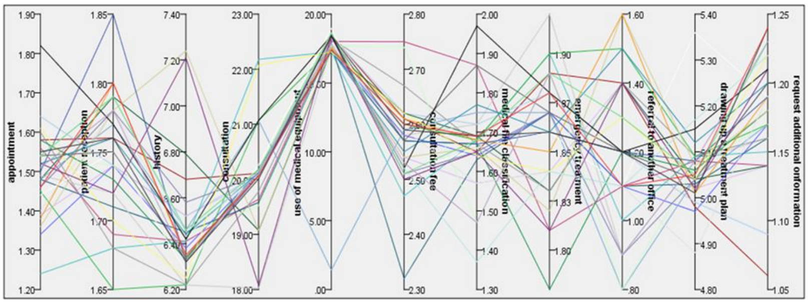
Table 2. Descriptive statistics of items 11-17

Descriptive Statistics							
	ITEM	Variable symbol	N	Minimum	Maximum	Mean	Std. Deviation
Standard activities							
appointment	1	V11	30	1.24	1.82	1.5000	.10671

patient reception	2	V12	30	1.65	1.85	1.7500	.04339
history	3	V13	30	6.22	7.24	6.4600	.24429
consultation	4	V14	30	18.02	22.18	20.0700	.88203
use of medical equipment	5	V15	30	1.41	18.98	17.3500	3.05203
consultation fee	6	V16	30	2.32	2.75	2.5700	.07926
medical file classification	7	V17	30	1.37	1.97	1.6700	.11564
Additional activities							
emergency treatment	8	V21	30	1.78	1.92	1.8600	.03140
referral to another office	9	V22	30	.80	1.60	1.2000	.22128
drawing up a treatment plan	10	V23	30	4.88	5.36	5.0600	.07909
request additional onformation	11	V24	30	1.06	1.24	1.1800	.04094
Valid N (listwise)			30				

Source: made by the author with SPSS 26

The graphic representation of the dynamics of the 11 variables, in the calendar interval of 30 days under analysis, makes it difficult to identify the correlations, even if with the help of SPSS we proceeded to normalize the input data (Figure 1).



Source: made by the author with SPSS 26

Figure 1. Correlations between variables following their normalization

In order to be convinced of the existence of correlations between the variables, based on the descriptive data (Table 1), we applied Bartlett's Test of Sphericity, the results of which are shown in Table 3.

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.449
Bartlett's Test of Sphericity	Approx. Chi-Square	43.921
	df	55
	Sig.	.858

Source: made by the author with SPSS 26

The values of the KMO and Bartlett test indicate that there are one or more common factors that motivate the application of procedures specific to the ACP method.

The first information generated by the ACP method, we extract from the table of total variance (Table 4) from which we observe the existence of a number of five factors that meet the selection criterion (eigenvalues >1) after applying the rotation procedure and which, cumulatively explains 67.615% of the analyzed variance value.

Table 4. Table of total variation

Total Variance Explained									
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
V11	2.097	19.063	19.063	2.097	19.063	19.063	1.870	16.997	16.997
V12	1.656	15.055	34.118	1.656	15.055	34.118	1.461	13.282	30.279
V13	1.436	13.051	47.169	1.436	13.051	47.169	1.432	13.016	43.295
V14	1.191	10.829	57.998	1.191	10.829	57.998	1.383	12.571	55.866
V15	1.058	9.617	67.615	1.058	9.617	67.615	1.292	11.749	67.615
V16	.933	8.486	76.101						
V17	.831	7.555	83.655						
V21	.612	5.562	89.217						
V22	.542	4.928	94.146						
V23	.348	3.160	97.305						
V24	.296	2.695	100.000						
Extraction Method: Principal Component Analysis.									

Source: made by the author with SPSS 26

The existence of the five factors is also suggested by the graphic representation of the principal components identified with the help of ACP (Figure 2). and showing a linear descending sequence.

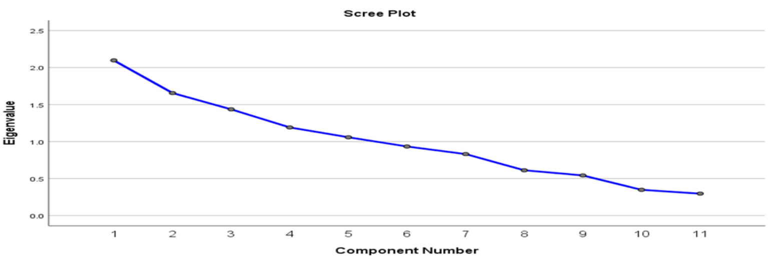


Figure 2. Graphic representation of principal components according to the ACP method

Source: made by the author using SPSS

The component matrix obtained after applying the rotation procedure (Table 5) allows us to identify the factor structure in the case of the analyzed variables.

Table 5. Matrix of components obtained after the rotation procedure

Component Matrix[a]						
	Variable symbol	Component 1	2	3	4	5
Standard activities						
appointment	V11	.068	.255	.793	.084	.084
patient reception	V12	.072	-.063	-.013	.827	-.073
history	V13	.716	-.326	-.270	.185	-.133
consultation	V14	-.363	.267	-.113	-.211	.611
use of medical equipment	V15	.220	.456	.086	-.271	-.698
consultation fee	V16	-.114	-.416	.709	-.146	-.106
medical file classification	V17	.277	.129	.423	-.184	.622
Additional activities						
emergency treatment	V21	-.670	.067	-.153	-.131	.056
referral to another office	V22	.782	.129	-.008	-.268	-.019
drawing up a treatment plan	V23	-.104	.709	.045	.010	.027
request additional onformation	V24	-.075	.541	-.049	.629	.011
Extraction Method: Principal Component Analysis.						
a. 5 components extracted.						

Source: made by the author using SPSS

The structure of the factors is given by the components with positive values of the variables, as we can see from Table 4. In order to make a comparability regarding the action of the factors, we chose as dependent variable V14 "consultation" and as predictors the components of factors no. 2 (variables V11, V15, V17, V21, V22, V23, V24) and no. 5 (variables V11, V17, V21, V23 V24), factor 5 involving a smaller number of activities.

The first information provided by data processing with SPSS software, the Regression function, the Automatic Linear Modeling command refers to a summary of the results (figure no. 4), their accuracy being greater in the first case (Adjusted R squared 0.938 or 93.7%), compared to the second case (Adjusted R squared 0.8 or 80.0%), an aspect also supported by the Akaike criterion whose value is lower in the first case (-64.120) compared to that of the second case (-36,443).

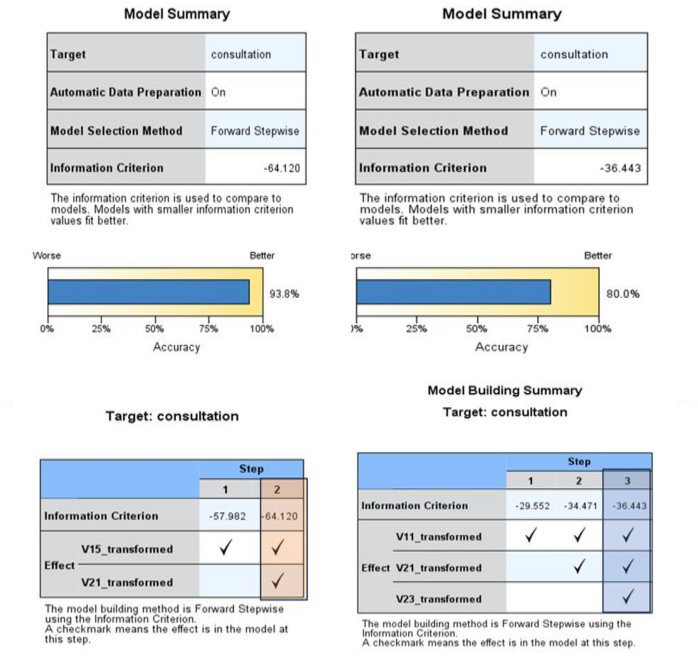
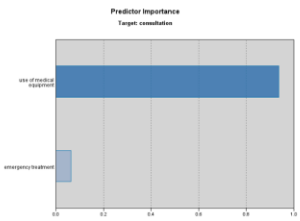


Figure 3. Model Summary case 1 and case 2

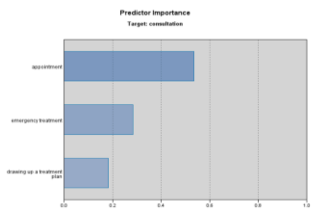
Source: made by the author using SPSS

The second piece of information considers the importance of the predictors (Figure 4). In the first case, the predictor "use of medical equipment" (0.94) and of low importance "emergency treatment" (0.06) appear of particular importance, on the other hand, in the second case which refers to a simple informational flow, we notice a close proximity of the importance of the predictors "appointment" (0.53) to "emergency treatment" (0.28) and to "drawing up a treatment5 plan" (0.18). Although we are talking about a restorative importance, the obtained picture is a starting point in the analysis of the optimization of times on activities.



Nodes	Importance	Importance	V4	V5
V21_transformed	0.0625	0.0625	emergency treatment	0.0625
V15_transformed	0.9375	0.9375	use of medical equipment	0.9375

a) case 1



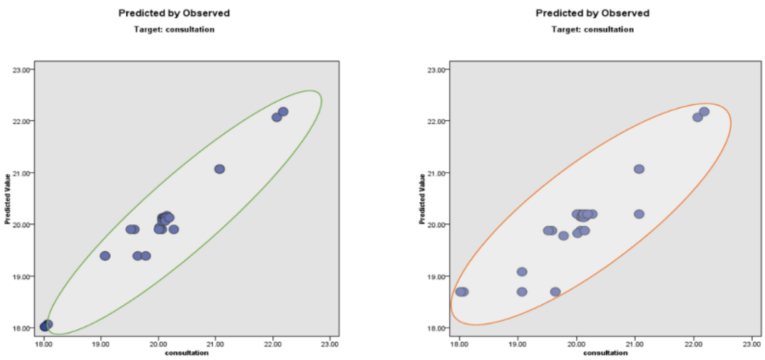
Nodes	Importance	Importance	V4	V5
V23_transformed	0.1815	0.1815	drawing up a treatment plan	0.1815
V21_transformed	0.2839	0.2839	emergency treatment	0.2839
V11_transformed	0.5346	0.5346	appointment	0.5346

b) case 2

Figure 4. Importance of predictors

Source: made by the author using SPSS

Although there are slight differences between the observed values and the predicted values of the regression model (Figure 5), it can be seen that the relationship between the variables is positive, but less perfect in the second case where there are more points further away of the imaginary right.

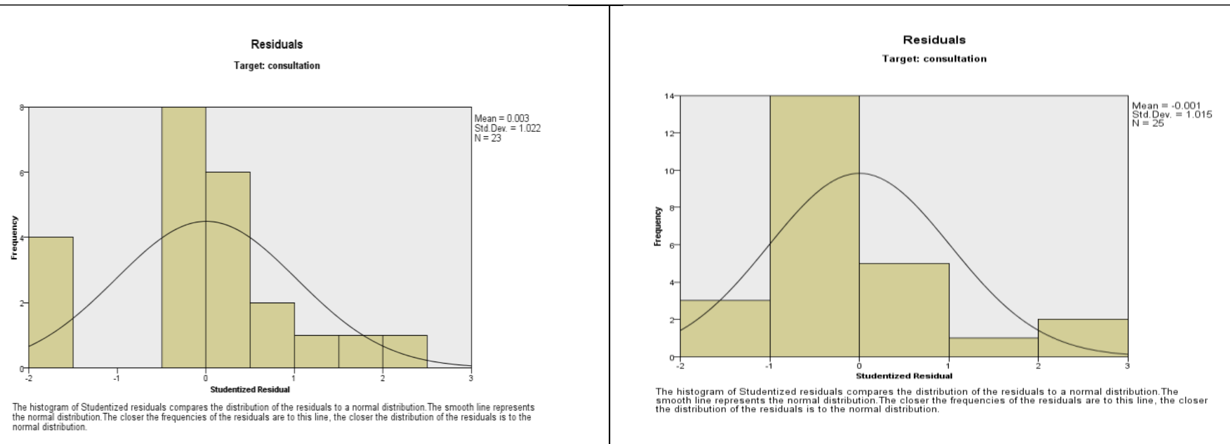


a) case 1 **b) case 2**

Figure 5. Correlation between observed values and predicted values

Source: made by the author using SPSS

The correlation between the observed values and the values predicted by the model is associated with the **histogram of standardized residuals** (errors or deviations of the model from reality) to see their normality. The histogram of the standardized residuals presented in Figure 6 shows us that they are normally distributed in both cases, they are symmetrical with the shape of a bell, slightly flattened in the first case, but the normal curve is not respected, especially for the very low values.

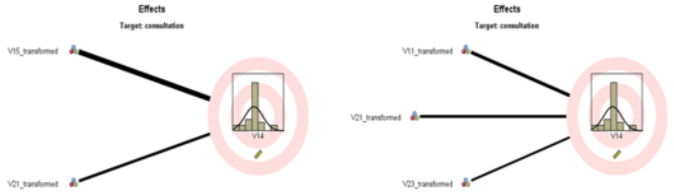


a) case 1	**b) case 2**

Figure 6. Histogram of residuals, target variable "consultation"

Source: made by the author using SPSS

The penultimate step offered by the factor analysis is the graphic summary of the model (Figure 7) completed by the summary of the coefficients in the model.



Effects
Target: consultation

Source	Sum of Squares	df	Mean Square	F	Sig.	Importance
Corrected Model ▼	21.699	11	1.973	41.166	.000	
V15_transformed	9.793	9	1.088	22.708	.000	0.937
V21_transformed	0.653	2	0.327	6.815	.006	0.063
Residual	0.863	18	0.048			
Corrected Total	22.561	29				

Effects
Target: consultation

Source	Sum of Squares	df	Mean Square	F	Sig.	Importance
Corrected Model ▼	19.454	9	2.162	13.912	.000	
V11_transformed	3.921	5	0.784	5.047	.004	0.535
V21_transformed	2.082	2	1.041	6.699	.006	0.284
V23_transformed	1.331	2	0.665	4.283	.028	0.181
Residual	3.107	20	0.155			
Corrected Total	22.561	29				

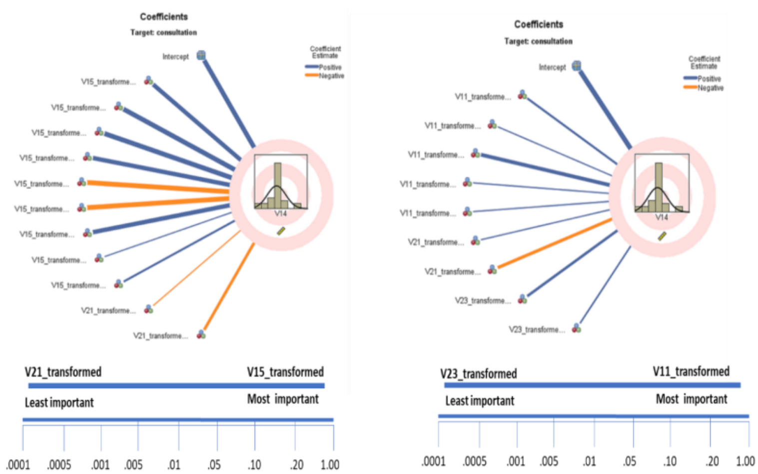
a) case 1 **b) case 2**

Figure 7. Graphical summary of the ACP model

Source: made by the author using SPSS

In the summary graph presented in figure no. 8 we notice that in the first case the independent variable V15 ("use of medical equipment") and the independent variable V21 ("emergency treatment") produce an effect on the dependent variable "consultation", while in the second case, the independent variables V11 "appointment", V21 "emergency treatment" and V23 "drawing up a treatment plan" have an effect on the dependent variable "consultation".

Complementarily, the regression analysis performed provides a summary of the coefficients in the model in which the negative coefficients are represented by orange lines, and the positive coefficients are represented by blue lines (Figure 8).



a) case 1 **b) case 2**

Figure 8. Plot of coefficients

Source: made by the author using SPSS

Linear regression coefficients describe the mathematical relationship between each independent variable and the dependent variable, with the p-values of the coefficients indicating whether these relationships are statistically significant.

A positive coefficient indicates that as the value of the independent variable increases, the mean of the dependent variable also tends to increase. A negative coefficient suggests that as the independent variable increases, the dependent variable tends to decrease. In the case of the performed analysis, we opted for $p < 0.05$ and the results obtained allow us to state that we have coefficients statistically significantly different from zero, which is why we reject the null hypothesis.

The influence that an independent variable (predictor) exerts on the dependent variable depends on how the variables correlate with each other and which determines the structure of the factors obtained by the ACP method and reproduced with the help of the matrix of components (Table 4).

Figure no. 10 confirms that, where the dependent variable is influenced by one or more predictors, the relationship between the two types of variables is directly proportional. The Automatic Linear Modeling factorial analysis model being a model for predicting the fact values for which the averages for the first 10 significant effects can be estimated, for example, we took the results of the first case (factor no. 2) where the "consultation" activity is influenced by the variable V15 "use of medical equipment".

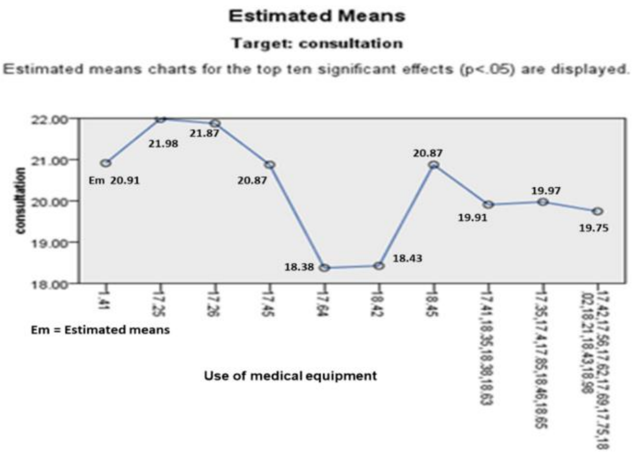


Figure 9. Graph of estimated means for the first 10 significant effects, case 1 dependent variable "consultation", predictor "use of medical equipment"

Source: made by the author using SPSS

As can be seen, as the times of use of medical devices decreases, the times allocated to the standard consultation will also decrease, and vice versa.

6. CONCLUSIONS

Unlike the ABC method from which the approach of the TD-ABC method was based, the allocation of resources to the cost objects takes place through a single driver, namely the time required to execute the various operations.

The TD-ABC method is based on time equations that describe the basic activity of a group of resources and all major variations related to it. The resource group is an organizational unit (a department or an aggregation of activities, such as a medical practice) that combines its resources in approximately identical proportions to implement the various processes it performs. The time equation includes the elements (or modalities) that create major variations of duration in the performance of the core activity. These elements constitute the explanatory variables of time spent and are called time drivers or time inducers. Thus, for example, requesting a new patient (time variation source element) is an action that increases the execution time of the standard activity and also creates additional times.

Since work time is difficult to measure, Kaplan and Anderson (2003, 2004, 2007/2008) criticize a common practice in which employees are asked to estimate the percentage of time spent on different activities. The total of these percentages is often equal to or even greater than 100% or at least exceeds their total working capacity. Knowing that there is often unused capacity, this implies that driver costs are often overestimated. However, in relation to TD-ABC, Kaplan and Anderson (2003, 2004, 2007/2008) propose a solution that consists in estimating elementary tasks using procedures such as interviews or direct observation (timing), although the results are rather vague and unstable leading to amplified measurement difficulties if stated times are considered.

W. Bruggeman and P. Everaert (2007), assume that in the equation of time, an important role is played by time drivers. For the same authors, determining the time required to carry out an activity is defined by its characteristics. According to its founders, the process is always modeled with a single equation, regardless of the type and complexity of the processes.

A time factor "can be a continuous variable, a discrete variable or a dichotomous variable, i.e. a variable that will take the value 0 or 1 (new type or old customer, for example)" (O. De La Villarmois and Y. Levant, 2007).

The results provided by the TD-ABC method are appreciable but, despite its advantages, there remain points that require special attention, especially regarding the elimination of time measurement difficulties, the elimination of subjectivity regarding the measured times, the need for a large amount of data to estimate satisfactory equation of time, difficulty estimating time for non-continuous or unpredictable activities.

Starting from the findings of the authors S. Hoozée et al (2009) regarding the fact that the duration of an activity is not constant, in the scientific approach carried out we tried to model activity times with the help of the multiple regression model. The main objective of the study is to identify the determining factors of the times that have an impact on the determining variable (the consultation) that represents the essence of the activity of a medical office. For each of the 7 medical offices of the Medical Center subject to accreditation. 11 variables were established (taking into account the specifics of each office) and which were grouped into two activities, namely standard activities and additional activities taking into account the information flow generated by the office's activity. Since we only looked at the time optimization part as a cost driver, we only focused on the ophthalmology office.

In order to identify the correlations between the variables, we performed Bartlett's Test of Sphericity, which indicated the existence of at least one common factor that motivates the application of the procedures specific to the ACP method. In this context, the Table of total variation revealed the existence of 5 factors that meet the selection criterion (eigenvalues >1) after applying the rotation procedure and which, cumulatively, explain 67.615% of the analyzed variance value.

The matrix of the components obtained after the rotation procedure provides the structure of 5 factors in the case of the analyzed variables, given by the components with positive values, but following their processing we note that only two factors present accuracy for the intended purpose (factor 2 with an accuracy of 93.8% and factor 5 with an accuracy of 80.0%), an aspect also supported by the Akaike criterion whose value is lower in the first case (-64.120) compared to the second case (-36.443), which other factors are devoid of accuracy and therefore ignored in the analysis performed (between 0% and 8.4%).

In determining the importance of the predictors, we note that it is dependent on how the standard variables are combined with the additional variables. Thus, if we are faced with a more complex case in which a patient goes through several steps (registration for reception, consultation and use of the medical equipment provided, emergency treatment, referral to another specialized medical office, development of a treatment plan and the provision of additional information) on consultation produces a strong effect using medical equipment (0.94), while performing emergency treatment has a weaker effect (0.06). On the other hand, in the case of some routine activities (registration for reception, simple consultation, filing medical record, treatment, drawing up a treatment plan and providing additional information), although there are several variables that exert their effect, their intensity is close. However, the model indicates that the greatest intensity is produced by presenting the patient to the office (0.53) and less by establishing a treatment plan (0.18).

Complementarily, the regression analysis performed provides a summary of the coefficients that describe the mathematical relationship between each independent variable and the dependent variable, with the p-values of the coefficients indicating whether these relationships are statistically significant.

A positive coefficient indicates that as the value of the independent variable increases, the mean of the dependent variable also tends to increase. A negative coefficient suggests that as the independent variable increases, the dependent variable tends to decrease. In the case of the performed analysis, we opted for $p < 0.05$ and the results obtained allow us to state that we have coefficients statistically significantly different from zero, which is why we reject the null hypothesis.

The influence that an independent variable (predictor) exerts on the dependent variable depends on how the variables correlate with each other and that determines the structure of the factors obtained by the ACP method and rendered using the component matrix.

In this sense, as an example, we created the prediction model (graphic) for the values of the first 10 significant effects whose average values can be estimated, specific to the second factor (the first case) and where $p<0.5$.

We believe that the values estimated and obtained with the help of the Automatic Linear Modeling factor analysis model eliminate the imperfection of the TD-ABC method highlighted by the authors S. Hoozée et al (2009) regarding subjectivity and instability in the measurement of activity times.

The advantages of the TD-ABC method are notable, starting from the possibility of calculating the cost for the entire office, for each activity, but also for the unit of time. Moreover, the separate activities specific to the ABC method are integrated into a single time equation in the case of the TD-ABC method, the resource groups are fewer than the activities, the ease with which the model can be updated by adding past period explanatory variables, the time forecasts they can play the role of standards that can be accurately updated.

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