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The use of Time-Driven Activity-Based Costing (TDABC) for calculating the costs of information processes[1]

Adam CZERWIŃSKI

Opole University, Poland

Abstract: The purpose of the paper is to present ways of applying Time-Driven Activity-Based Costing (TDABC) as an effective tool for evaluating the efficiency of information activities and processes. Measuring the costs of information and of information activities is difficult for a number of reasons. Therefore, information economics does not offer a separate concept or methodology for this type of costing. There is also a lack of suitable tools for assessing the value not only of information but also of information products. Time-driven activity-based costing may be used for measuring the costs of information processes. The paper demonstrates the above on the example of an "Request for Proposal (RFP) - offer" process that has been modelled as a network of activities. Then, time and labour resources required for the execution of the activities forming part of the process, as well as their drivers, have been identified. The above enabled to build time equations and cost formulas for the process. Using the above formulas, time and cost efficiency of the above information process for various customers were analysed. Then, it was possible to further study the impact of the cost structure of the labour resource on process efficiency.

Keywords: Time-driven activity-based costing, TDABC, cost of information, cost of information process, information process efficiency analysis

1. Introduction

In modern economy, the costs of information activities incurred by various entities (businesses, non-commercial institutions and households) has been rapidly growing. Therefore, the knowledge of these costs and of their measurement methods is necessary to properly design and manage processes and information

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Correspondence Address: Adam Czerwiński, Opole University, Faculty of Economics, ul. Ozimska 46a, 45-058 Opole, Poland. E-mail: adam.czerwinski@uni.opole.pl.

systems. It is also a condition for the analysis, development, selection and implementation of more effective solutions for these processes and systems.

The problems with the definition and measurement of costs of information have the following causes (Oleński, 2010).:

- the information process is semiotic in nature and therefore it is difficult to evaluate the costs of individual messages,
- a lack of a systematized specification of elements forming part of costs of information in the economy, as well as in social and economic processes. Additionally, these costs are dispersed in various production and management processes, as a result of which their recording is fragmentary,
- information may be reproduced easily and cheaply; therefore the marginal cost of producing a specified information product is zero,
- there exist significant differences in costs between processes and information systems generating the same information or the same information services.

Oleński (2003: 211-212) has distinguished two approaches to the definition and measurement of the cost of information: technological-subjective and holistic. Under the technological–subjective approach, the cost of information is defined as the cost of producing the information in the IT system which is a production information process. The above approach is adopted in informatics, especially in business informatics. Within its framework, the information process is treated like any other production process. Attempts are made to isolate within a company's cost records these cost elements which may be regarded as the cost of information itself. From the above it follows that this approach may be used only when the analysis is restricted to certain costs of information incurred by a given social or economic entity and not to the total cost of information.

Under the holistic approach on the other hand, the cost of information is defined as the cost of implementation of the entire information process or of a complex of information processes forming a certain information system. Thus, the information process is viewed as a semiotic process. Hence, in terms of methodology, it is a more difficult approach than the technological-subjective approach. It relies on a good definition and precise identification of the information system and information processes together forming a given information system.

The information process may be composed of eight phases: generation, gathering, storing, processing, transmitting, sharing, interpretation and using of information. In each of them, costs are incurred the total of which constitutes the cost of the process. This type of identification and measurement of costs is

then fully in line with the concept of Activity-Based Costing (ABC). However, in this case the measurement covers only the resources used for the activities, i.e. information operations which may be classified into one of the above-mentioned phases of the information process.

Time-Driven Activity-Based Costing (Time-Driven ABC or TDABC) is a modified version of the activity-based costing proposed by Robert S. Kaplan and Robin Cooper together with Steven R. Anderson in 2001 (Kaplan and Anderson, 2008)..

Among the deficiencies of the classical concept of activity-based costing are the growing complexity of cost accounting models resulting from the need to reflect the growing complexity of the economic reality and a high variability of the environment which calls for a continuous updating of both the data in the model and of the model itself (Kaplan and Anderson, 2008: 31-32).

What differentiates the approach used in time-driven activity-based costing from the classical approach is the use of only one type of resource driver – the time of execution of an activity. If the range of activities forming the process is known, it is possible to estimate their total time-intensiveness, i.e. the time of execution of the process. After having identified the above time and the standard cost of a time unit, we can estimate the cost of the process. It results from process demands regarding the services of various resources such as work performed by people as well as real and financial capital. Thus, time is the unit being the common denominator for the evaluation and costing of various activities.

Among the significant advantages offered by Time-Driven ABC is the possibility to measure the differences resulting from variations in activities under a process and to express them as time and cost. Such information makes it possible to evaluate and analyse multiple variants of the process in terms of time and cost and to take decisions to improve the efficiency of their execution.

The literature on the subject mentions the following advantages of time-driven ABC as compared with its classical version (see: Kaplan and Anderson, 2008: 11-12):

- easier and faster preparation and implementation of the model,
- ease of integration with the ERP systems in place at the company used to input data for the model,
- low costs and easier and faster updating of the model,
- ease of extension (greater scaleability) of the model to suit the company's requirements,
- greater precision of generated information,
- possibility to precisely calculate the efficiency and effectiveness of processes and to focus on improving them,
- ensuring of transparency in terms of processing effectiveness and production capacity utlization,

- possibility to implement a single model in various departments (units) of an organisation involved in similar operations and to compare their performance,
- better forecasting (budgeting) capabilities,
- possibility to use in benchmarking.

The paper presents the possibilities of using TDABC in the evaluation and analysis of the costs of an information process on a practical example.

2. Process model

The information process under analysis is the process tentatively called "Request for Proposal (RFP) - offer" whose aim is to generate an offer (product, service) in reply to a customer's inquiry. The following assumptions have been adopted:

- the RFP includes product specification sufficient to determine whether preparation of an offer is possible,
- the offer may be prepared in various options and should include the price,
- processing of the offer is subject to internal limitations which need to be taken into account before the offer is presented to the customer.

It is also assumed that the analysed process will include all of the above-mentioned phases: generation, gathering, storing, processing, transmission, sharing, interpretation and using of information. They take the form of information activities which are aggregated complexes of operations (i.e. they may be decomposed). An example of such an activity would be "checking the conditions in the specification of the request". It will include a phase of interpretation of the conditions and the phase of using the interpreted messages included in the specification for the evaluation of the possibility of delivering a product or service being the subject of the request. An assumption was made that the described activities are sufficient for a correct execution of the process by its executor and do not need to be decomposed further. Thus, they may be shown as an algorithm. The algorithm in turn will be shown as an activity network (Fig. 1).

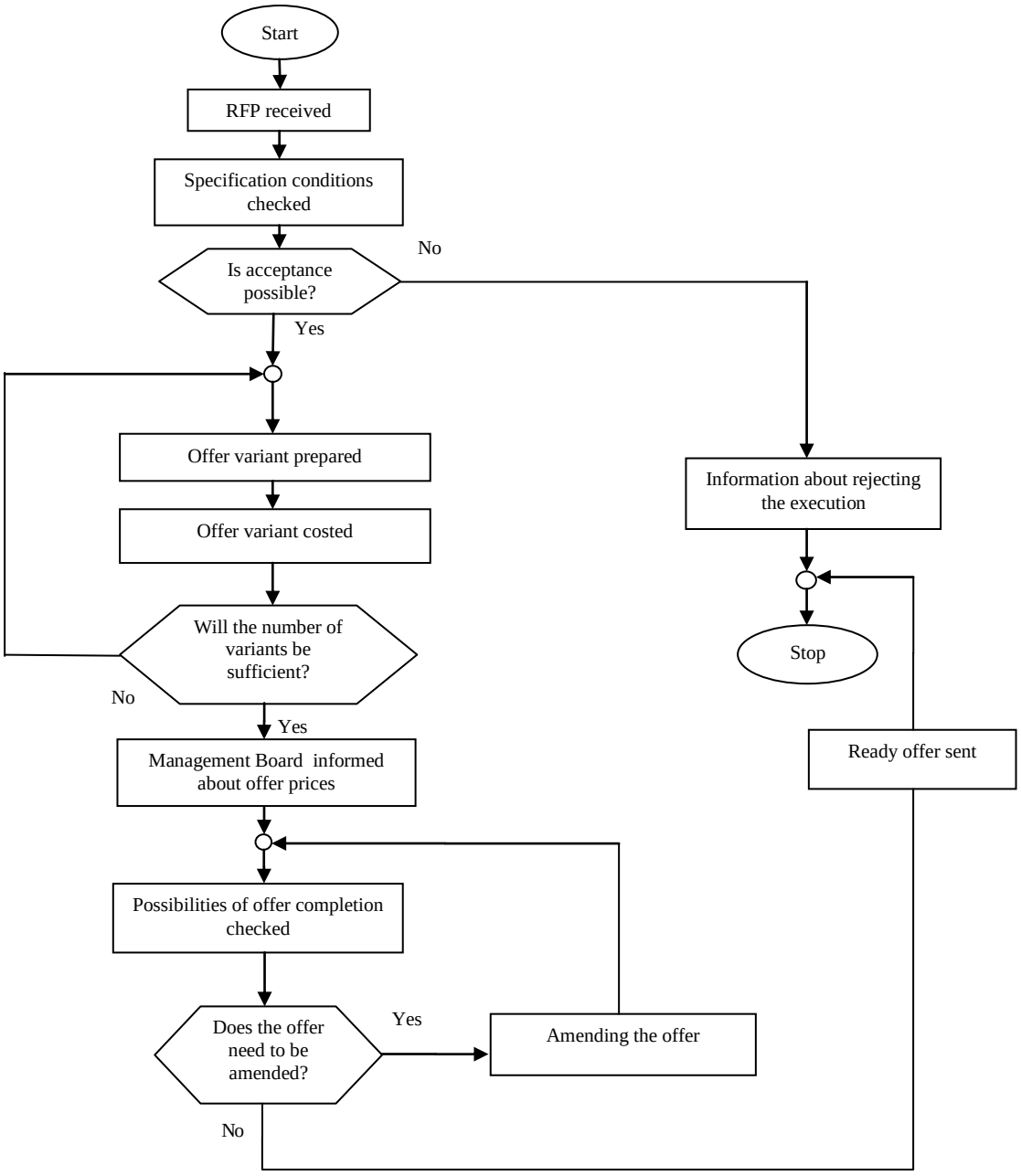

Figure 1. Network of activities of the "RFP - offer" process.

Source: author's own elaboration

3. Determination of resources, time equations and cost formulas

The following assumptions have been made to determine the efficiency of this process executed for various customers:

- individual activities are performed by four organisational units: Administrative Office, Technical Department, Finance Department and Management Board,
- the above entities have various amount of labour resources expressed as full-time equivalents which are paid differently. Table 1 shows the number of resources used for further analysis as well as their gross monthly salary in PLN,
- monthly working time of a single resource is 170 hours and its utilization is 85% (15% losses are allowable).

The adopted assumptions made it possible to determine unit costs of labour resources in the organisational units in question expressed in PLN/minute. From Table 1 it follows that e.g. a unit cost of labour in the Management Board unit is four times the cost of the Administrative Office unit.

Table 1. Sample pool of labour resources and their unit costs

Unit	Number of resources (full-time equivalent)	Pool of labour resources (min/month)	Cost of a single resource (PLN/month)	Cost of the resource pool (PLN/month)	Unit cost marking	Unit cost (PLN/min)
Administrative Office	1	8 670	2 800	2 800	c_{AO}	0.32
Technical Department	4	34 680	4 600	18 400	c_{TD}	0.53
Finance Department	3	26 010	4 200	12 600	c_{FD}	0.48
Management Board	2	17 340	10 500	21 000	c_{MB}	1.21

Source: author's own elaboration.

The network of activities presented in Fig. 1 makes it possible to allocate individual activities under the process to their executors (organisational units). Besides, for each of them, time driver must be determined in a single "RFP – offer" process. The underlying time driver is the number of requests that generates a multiple execution of a single "RFP – offer" process. Table 2 presents drivers of individual

activities and sample times of their execution (expressed in minutes) as well as costs. Activity drivers are interpreted as follows:

- execution type (Xl) – assumes the value of 1 if it is not possible to fulfil an order for a product with a specification given in the RFP and it assumes the value of 0 if such possibility exists,
- number of variants (X2) – describes the offer horizontally and indicates how many products may match the specification,
- number of amendments (X3) – is a result of subject-matter check of the offer and indicates that resource limitations appearing on an ongoing basis have been taken into account
- status (X4) – assumes the value of l if an offer has been prepared in reply to the RFP and the value of 0if no offer has been prepared.

Table 2. Specification of information activities executed in a single "RFP – offer" process together with time drivers, times of execution of the activities and their costs

No.	Activity	Executor	Time driver	Variable	Time (min)	Cost
1	RFP received	Administrative Office	none		5	5 c_s
2	Specification conditions checked	Technical Department	none		5	5 c_{TD}
3	Customer informed about rejecting the execution	Administrative Office	execution type	X_1	12	12 c_{AO}
4	Preparation of a variant of the offer	Technical Department	Number of variants	X_2	100	100 c_{TD}
5	Offer variant costed	Finance Department	Number of variants	X_2	20	20 c_{FD}
6	Management Board informed about offer prices	Finance Department	status	X_4	5	5 c_{FD}
7	Possibilities of executing the order checked	Management Board	Status or number of amendments	$X_3 + X_4$	10	10 c_{MB}
8	Offer terms amended	Technical Department	Number of amendments	X_3	15	15 c_{TD}
9	Ready offer sent	Administrative Office	status	X_4	5	5 c_{AO}

Source: author's own elaboration.

The data included in Table 2 enable the preparation of time equations and cost formulas of a labour resource for any course of the "RFP – offer" process. The time equation is as follows:

$$t = 10 + 12X_1 + 120X_2 + 25X_3 + 20X_4 \text{ (min)} \quad (1)$$

For example, the time of execution of the process in question when it is possible to prepare the product with the specification included in the RFP ($X_1 = 0$) and where the offer has been prepared in reply to the RFP ($X_4 = 1$) in two variants ($X_2 = 2$) and has been amended only once ($X_3 = 1$), is 295 minutes. On the other hand, the time of execution of the process when the product cannot be prepared ($X_1 = 1$, $X_2 = X_3 = X_4 = 0$) is constant and stands at 22 minutes.

If it is possible to accept the order for execution, the time equation may be simplified as follows:

$$t_{executed} = 30 + 120X_2 + 25X_3 \text{ (min)} \quad (2)$$

The data from Tables 1 and Table 2 enable the elaboration of cost formulas of the labour resource relating to any course of the "RFP – offer" process. A general cost formula look as follows:

$$C_p = (5 + 12X_1 + 5X_4)c_{AO} + (5 + 100X_2)c_{TD} + (20X_2 + 15X_3 + 5X_4)c_{FD} + (10X_3 + 10X_4)c_{MB} \quad (3)$$

where: c_{AO}, c_{TD}, c_{FD} and c_{MB} mean units costs of the labour resource in individual organisational units , i.e. in the Administrative Office, Technical Department, Finance Department and Management Board respectively.

Where the possibility of accepting the order for execution exists, the cost formula of the labour resource may be simplified as follows:

$$C_{executed\_p} = 10(c_{AO} + c_{MB}) + 105X_2c_{TD} + (5 + 20X_2 + 15X_3)c_{FD} + 10X_3c_{MB} \text{ (PLN)} \quad (4)$$

3. Process efficiency analysis

Time equations and cost formulas of the labour resource for the "RFP – offer" process make it possible to analyse process efficiency. Table 3 includes an analysis of time efficiency of the process for four different customers: A, B, C, D, who have placed the same number of RFPs (5) but their RFPs required different treatment. In the case of customers A and B, 40% of RFPs were rejected, while 60% had to be worked on. While preparing the offer for customer A, two variants that were checked quite carefully were adjusted which required each time making amendments. For customer B on the other hand, an offer in only one variant could be prepared but it was subjected to such a strict check that as many as four amendments had to be introduced.

In the case of customers C and D, 60% of RFPs were rejected, while 40% had to be worked on. As in the case of customer B, the offer for customer C could be prepared in only one variant which was subject to a very strict check, which also required four amendments. The offer for customer D was prepared in three variants which were thoroughly checked which involved each time the introduction of three amendments. Table 3 includes unit times of execution of rejected and processed RFPs for individual customers. The last but one column of the table includes the total time of processing of all RFPs submitted by customers A, B, C and D.

It follows from the table that the processing of the RFP submitted by customer A was the longest, while the processing of the RFP submitted by customer C the shortest. Assuming that only the above four customers were served and that the pool of requests was 20, it is possible to determine the share of each customer in total service time. It turns out that despite a different manner of processing of the requests of customers A and D (different number of rejections and variants and checks of the offer prepared), their share in total service time is nearly identical and stands at around 30%. The implementation of information processes for customer C demonstrated the highest efficiency in terms of service time.

The number of rejections of the request and the number of variants in which the offer is prepared are of key significance for the length of service time. It is shown clearly in formula (1). Table 4 presents an analysis of cost efficiency of labour resources used for the implementation of this process for the same four customers as previously.

Table 3. Time efficiency analysis of the "RFP – offer" process executed for four customers

Customer	Number of RFPs	Number of rejections	Number of variants of the offer	Number of amendments	Unit of time per rejected RFP (min)	Unit of time per executed RFP (min)	Total time of servicing RFPs (min)	Share of service time in the pool of RFPs (%)
Customer A	5	2	2	2	22	320	1004	29.9
Customer B	5	2	1	4	22	250	794	23.6
Customer C	5	3	1	4	22	250	566	16.8
Customer D	5	3	3	3	22	465	996	29.6
Total	20	10	7	13			3360	100.0

Source: author's own elaboration.

Table 4. Cost effectiveness analysis of the "RFP – offer" process executed for four customers

Customer	Number of RFPs	Number of rejections	Number of variants of the offer	Number of amendments	Unit of time per rejected RFP (min)	Unit of time per executed RFP (min)	Total time of servicing RFPs (min)	Share of service time in the pool of RFPs
Customer A	5	2	2	2	8	187	578	29.0
Customer B	5	2	1	4	8	161	498	25.0
Customer C	5	3	1	4	8	161	346	17.4
Customer D	5	3	3	3	8	272	569	28.6
Total	20	10	7	13			1 991	100.0

Source: author's own elaboration.

The data indicate that the unit costs of service for the requests of individual customers are proportional to their respective service times. Therefore, taking into account the total cost of processing the requests, it is the highest for customer A and the lowest for customer C. Differing manner of processing the requests of customers A and D did not have an impact on their share in the total cost of service which, standing at around 29% in each case, is nearly identical as before. The above result means that the current structure of costs of labour resources shown in Table 1 does not have an impact on the cost efficiency of servicing the "RFP - offer" processes for the four customers in question. It follows directly from formula (4) in which the weight of the component standing for the costs of the labour resource incurred to execute a single "RFP-offer" process at the Management Board is several times smaller than the weight of components representing these costs at the Technical and Finance Departments. Thus, even if the unit costs of the labour resource at the Management Board are 150% of the costs in the Technical and

Finance Departments, and 275% of the costs of the Administrative Office, this fact does not have an impact on the total cost of servicing the "RFP-offer" processes.

4. Summary

Time-driven activity-based costing (TDABC) is a contemporary modification of the activity-based costing concept (ABC) in which the main criterion is time. The use of TDABC facilitates the preparation and implementation of process models and enables faster gathering of the required data. It also facilitates modification and expansion of the models. The above benefits make TDABC useful for precise determination of both the time and the costs of information activities. Having a process model in the form of e.g. a network of activities, one can nearly automatically form a time equation of an information process. It enables to simulate various executions of the process and to analyse their time efficiency. Additionally, if the degree of utilization of other resources (e.g. labour) for information activities undertaken as part of the process and their unit costs are known, cost formulas may be developed describing process execution. In such case, it is possible to make a cost effectiveness analysis of using these resources in the information process. As has been demonstrated, it enables for example an investigation of the impact of the cost structure of a labour resource on the efficiency of execution of an information process. Similarly, the impact of the cost structure of other resources on the above efficiency may be studied. The above reveals huge advantages of the presented approach to information processes, such as flexibility and simplicity of interpretation of results. In this way, TDABC becomes an effective tool in information process costing.

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Wykorzystanie rachunku kosztów działań sterowanego czasem (TDABC) do wyznaczania kosztów procesów informacyjnych

Streszczenie:

Celem artykułu jest przedstawienie możliwości wykorzystania rachunku kosztów działań sterowanego czasem (ang. *Time Driven Activity Based Costing* – TDABC) jako skutecznego narzędzia do oceny efektywności działań i procesów informacyjnych. Pomiar kosztów informacji i działań informacyjnych jest utrudniony z wielu przyczyn. Powoduje to, że w ekonomice informacji nie wykształciły się ani oddzielna koncepcja, ani metodologia rachunku kosztów tego rodzaju. Skutkuje to brakiem stosownych narzędzi do wyceny wartości nie tylko informacji, ale i produktów informacyjnych. Do oceny kosztów procesów informacyjnych można wykorzystać rachunek kosztów działań sterowany czasem. W artykule pokazano to na przykładzie procesu „zapytanie – oferta", który zamodelowano za pomocą sieci działań. Następnie określono czas oraz zasoby pracy potrzebne do realizacji działań wchodzących w skład tego procesu, a także ich nośniki. Pozwoliło to zapisać równania czasowe i formuły kosztowe dla jego przebiegu. Wykorzystując te formuły, dokonano analizy efektywności czasowej i kosztowej realizacji tego procesu informacyjnego dla różnych klientów. Dzięki temu można było dodatkowo zbadać wpływ struktury kosztów zasobu pracy na efektywność przebiegu tego procesu.

Słowa kluczowe: rachunek kosztów działań sterowany czasem, TDABC, koszt informacji, koszt procesu informacyjnego, analiza efektywności procesu informacyjnego