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A process collection methodology towards TDABC costing optimization of IT services: a case study in an Ecuadorian university

Carlos Ribadeneira[1], Lorena Tuapante[2], Lorena Siguenza-Guzman[3], Fabián Ayabaca[4], Andrés Tello[5], Paul Vanegas[6]

cribadeneira.e@hotmail.es, paul.vanegas@ucuenca.edu.ec, lore.tuapante39@gmail.com, lorena.siguenza@ucuenca.edu.ec, fabian.ayabaca@ucuenca.edu.ec, andres.tello@ucuenca.edu.ec

[1,2,3,4,5,6] University of Cuenca, 010203, Cuenca, Ecuador

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Abstract: ICT plays a paramount role in successful organizations. In order to achieve organizational goals, ICT services have to be closely overseen. Tools such as costing methods allow managers to be alert. Implementing a costing method for ICT services not only helps to justify investments, but also optimizes the cost of services. However, methodologies related to providing input to develop a costing model are limited. This research ameliorates ICT service management by proposing a process collection methodology that contributes to the creation of a costing model with TDABC. The proposed methodology has been tested in an IT department in an Ecuadorian University. It matched the collected information with ITIL enabling the department to manage its IT service performance. The obtained processes, activities, times and resources from operative IT services displayed substantive input to design a costing model to improve the IT department and; thereby, the organization's management as a whole.

Keywords: process collection; technological services; IT department; costing model; TDABC.

1. Introduction

Information and Communication Technology (ICT) is a staple element integrated in nearly every business or organization. Innovative business models, cost reduction and expansion opportunities are some of the advantages that an efficient ICT management provides. ICT has been fundamental for improving productivity and the development of knowledge-intensive products and services (Soto-Acosta, Colomo-Palacios & Martinez, 2010). In the case of universities and other educational organizations, ICT has shown a consistent upturn due to the improvement of education quality, highlighting the need to manage them adequately.

However, despite the ICT potential, its management in universities faces several challenges, e.g., justifying expenses and finding investments in order to either improve

current IT services or develop new ones. Therefore, it is important to identify the effects of the amount of money put into ICT and its benefits. A Time-Driven Activity-Based Costing System (TDABC) contributes to improving processes, service variety, price settings, and customer relationships (Siguenza, Van den Abbeele, Vandewalle, Verhararen & Cattrysse, 2013). Manufacturing, health, hospitality, logistics and nonprofit services are some of the industries that have taken advantage of TDABC implementation; however, there is scarce research regarding IT services.

This research aims to design a methodology to make process identification possible, which is an essential input to pave the way to TDABC implementation. Organizations that provide IT services possess a restricted array of methodologies despite the fact that an IT service is made up of a combination of information technology, people and processes (IT service management, 2011). The designed methodology helps identify the processes immersed in the IT services. Furthermore, the methodology enables technological departments to collect processes, activities, times and resources from operative IT services. It prevails over other homologous methodologies because of its capacity not only to distinguish the difference between levels of services and processes but also to suggest a generalizable level of detail when collecting the activities. The proposed methodology has been tested collecting processes that belong to the operative services in the technological department of Communications and Networking and in one service from Computing Services from an Ecuadorian university.

The rest of this document is as follows. A literature review presented in Section 2 gathers prior studies to contextualize the research and widen the theoretical base needed to support the research. Section 3 includes the methodology, addressing a systematic approach formed by sequential steps to capture processes from the IT organizations. The results and discussion of the methodology application in a university IT department are presented in Section 4, disclosing the overriding results of the successful process collection. Lastly, Section 5 draws uppermost conclusions and future work recommendations to fortify the proposed methodology.

2. Literature Review

Consoli (2012) mentions that the use of ICT plays a paramount role in organizations because it generates efficiency, effectiveness, innovation, growth and competitive advantages. Moreover, IT constitutes a primary means of dealing successfully with reducing uncertainties revolving around administrative processes and production (Dewett & Jones, 2001). As a result, organizations outperform others by matching IT expenditures harmoniously with internal capabilities and processes. IT services ameliorate the quality, timeliness and performance of decision-making and organizational management (Huber, 1990). Universities are an epitome of organizations redesigning activities because of the effectiveness of ICT. According to Egoeze, Misra, Maskeliūnas, & Damaševičius (2018), the application of ICT in higher education has empowered universities to work towards the optimization of teaching and learning processes, research, administrative management and communication.

ICT application unfolds a plethora of challenges in terms of management. Therefore, an accurate determination of cost is a crucial factor for service providers in organizations.

Time Driven Activity Based Costing (TDABC) facilitates budgeting and process improvement by allocating costs to the cost objects (Siguenza et al., 2013). As a result, TDABC allows managers to acquire more precise information about redundant resources not only to enhance efficiency but also to achieve cost goals (Ayvas & Pehlivanli, 2011). TDABC requires only two parameters: the cost per time unit of supplying resource capacity and the unit times of consumption of resource capacity by the products, services and customers (Kaplan & Anderson, 2003).

Within logistics and service operations, TDABC adoption displays great success (Everaert, Bruggeman, Sarens, Anderson & Levant, 2008; Kaplan & Anderson, 2007). Siguenza et al., (2013) confirm it in a literature review where it is shown that a considerable number of logistic industries and non-profit sectors such as health and libraries embrace TDABC implementation. There are some cases of studies applied on IT services. For example, Adeoti and Valverde (2013) applied TDABC for the improvement of IT service operations. Nevertheless, in order to make TDABC conducive to be developed, it is necessary to estimate the unit times of activities. This information can be determined through interviews with employees or by direct observation (Kaplan & Anderson, 2007). Therefore, a process collection is a key element since it is necessary to know all processes and activities before the implementation of TDABC in an organization. A process collection supplies information to carry out a cost allocation to the cost objects on the basis of time units consumed by activities. Presenting the process in a friendly way facilitates to pinpoint shortcomings. An amicable visual representation of a process is fundamental to comprehend the sequential flow and logic of a set of activities (Araujo, Rodrigues Filho & Gonçalves, 2016). Business Process Model and Notation (BPMN) offers advantages related to modeling business processes, thus businesses can understand their internal procedures in a user-friendly notation and communicate them effectively (Object Management Group, 2011).

Despite the weaknesses found in process collection methodologies regarding notation and TDABC alignment, this research considered three methodologies (Caldana, 2016); Ortega (2009); Andrade & Elizalde (2018). Even though the considered methodologies focus on industries that are not fully comparable with an organization that provides IT services, a couple components can be taken into consideration to collect processes. For instance, the methodologies agree on the significance of gathering a team, obtaining preliminary information and processing information of the organization being analyzed. The methodology in this research conceives time estimation, meanwhile, adjusting validation, processing and notation stages that are vaguely discussed in the previous methodologies.

After the process collection, assessment of the information is crucial. Therefore, to assess the efficiency, reliability and adaptation of processes and procedures, as part of IT service operation, it is necessary to be guided by a framework that provides best management practice (IT Service Management, 2011). Information Technology Infrastructure Library (ITIL) offers guidance to service providers on the provision of quality IT services, processes, functions and other capabilities needed to support them. In other words, ITIL aims to give value to the services providers and customers. Therefore, ITIL service operation describes the processes and tools to optimize the utilization capacity and improve managerial decision making (IT Service Management, 2011).

3. Methodology

This research sets out to develop a methodology to collect operative IT services in a structural manner following ITIL guidelines, allowing managers to use this information as a starting point to blueprint Time Driven Activity-Based Costing. The proposed methodology is comprised by three phases: preparation, process collection, and process comprehension and ITIL alignment. These phases have steps targeting to identify not only the processes within the IT services, but also the time consumption per activity and resources. Figure 1 shows the overview of the proposed methodology. Next, the phases and their steps are described in depth.

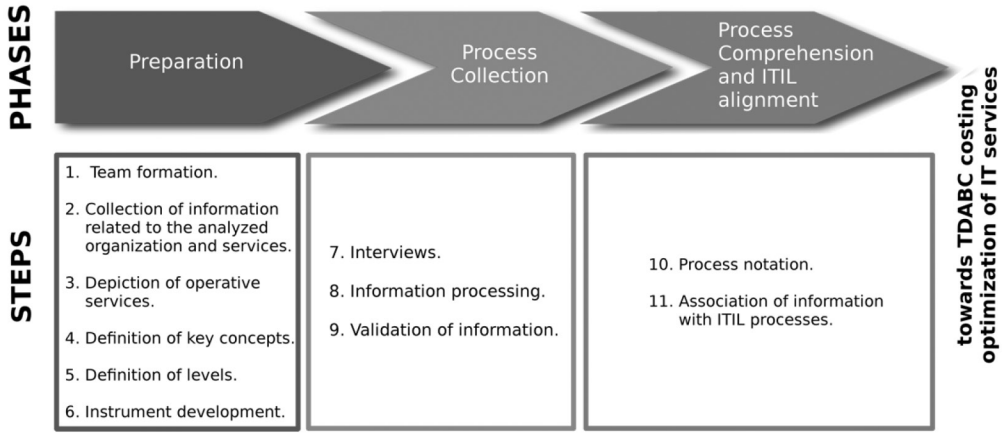

Figure 1 – Proposed methodology overview

3.1. Phase: Preparation

1. Team formation:

   As a first step, team formation has to be coordinated and duly organized. Commitment to team prosperity and shared goals are key attributes for successful teamwork (Tarricone & Luca, 2002). Therefore, having the consent and cooperation of the employees of the targeted IT department or organization is crucial for the success of the methodology application. Service managers must be onboard with the objectives established by the researchers. Hence, including them in periodic meetings could be beneficial due to their expertise and insights about the services in question. The cooperation of experts in complementary fields enriches the quality of the process collection. Having a multidisciplinary team fills in the gaps overlooked by the researchers in charge of managing the information. For example, a multidisciplinary team could consist of experts versed in process management, IT, administration, and service provision.

2. Collection of information related to the analyzed organization and services

   Before the fieldwork begins, an organization analysis has to take place. Strategic plans and any type of previous studies belonging to the organization must be taken into consideration. This preliminary research contributes to the comprehension

of the organization's context and protocols used to provide services. Moreover, delving deeply into the organization philosophy and the IT services facilitates the execution of the process collection since it is possible to disclose forthcoming obstacles that could hinder the analysis. A plan can be devised when the information is properly revised; so the team can proceed with the next steps.

3. Depiction of operative services

   By this point, the team has an overarching understanding of how the IT organization works. The multidisciplinary team requires as much information as possible to begin with the next stages. Therefore, considering its amalgamation of backgrounds, a depiction of the IT services provides the information needed to fully understand their flow. IT employees and service managers play an important role regarding the depiction since they bring relevant insight to clearly diffuse the service to all the team members. IT services have abstract components which may cause confusion in identifying processes; thus a logical order to organize them constitutes an essential aspect to apply this methodology correctly. One approach to solve this problem involves the use of layers. In this work, physical, logical and application layers were used to clarify the elements of the IT services. Similarly, processes based on each IT organization's characteristics can be suggested, letting the process collection follow a standardized structure. As for IT services, they were classified as final services and enabling services. Enabling services are services per se that have their own functionalities, yet they are indispensable for a final service to be delivered. In short, a depiction of operative services with the elements mentioned above, simplifies the complexity of each IT service, providing a blueprint to enable the team to assign activities to processes.

4. Definition of key concepts

   This step conceptualizes the key terms in order to strengthen the process collection. Moreover, it matches the depiction with process modelling using BPMN standards. The conceptualization helps categorize the information acquired in the depiction, so processes and activities can be detected. IT service management (2011) mentions that each process has a clear scope with a set of activities that transforms input to deliver the output reliably. However, activities are sometimes described as processes because they have a chain of tasks, whose objective is to accomplish a goal such as ensuring that the IT services are being operated effectively. This methodology acknowledges the set of activities as enabling processes, since they are input for final processes and contain subsumed atomic activities. Final processes, comprised by enabling processes, are used throughout the service lifecycle making the IT services conducive to work properly (IT Service Management, 2011). Collecting the enabling process would set the foundation to understand the final process, IT services and the connection between them.

5. Definition of levels

   Defining levels is a staple modeling principle that is not restrictive to any field of application; a level decomposition essentially simplifies complex processes into simpler constituents (Bahill, Szidarovszky, Botta & Smith, 2008). Therefore,

applying this principle into process collection helps to control inconsistencies because it generalizes a way to collect information methodically, strengthening its validity and replicability. Also, having levels regulates how detailed the activities should be for the collection, so activities are not overly complex or excessively simplified. The number of levels depends on the previous steps; it should be in synchrony with the concept definition. From the definition of key concepts five levels from greatest to least were defined: IT services, enabling services, final processes, enabling processes and atomic activities. Based on the particularities of the targeted organization, a condition chart could be devised by the team. Its purpose is to be a guideline to classify the information into levels. The chart used in this step has three conditions in place: activity time ≥ 20 min, level of detail required and number of atomic activities ≥ 3 tasks. If either two or three conditions are complied with, the activities are considered as enabling processes. The condition chart should be discussed with the organization employees and team members to reach an agreement about it.

6. Instrument development

   In this step, an interview format and matrixes are created by the team. These instruments will be the recipients of information that will be collected in the following steps. The previous steps offer a guideline to develop the content of the instruments. The instruments facilitate the information analysis. The International Organization for Standardization (ISO) provides international standards that can be useful to develop the instruments required to collect information. For example, coding, inputs and outputs are elements contained in the international standards' matrix paving the way to design the instruments. Considering the characteristics of the organization, these instruments seek to belabor the activities immersed in the processes. First, the interview format captures information about the IT services or enabling services, processes, times, frequencies and resources. Second, the information is transferred to the matrixes and classified on the level where it belongs. The matrix has the following elements: service or enabling service, IT department, service or enabling service description, coding, enabling process, final process, atomic activities, time per activity, service manager, frequency and resources. The matrixes could be subject to change based on organization specificities.

3.2. Phase: Process Collection

7. Interviews

   Services and service managers have to be clearly identified to proceed with the interviews. The interview stage captures the process and activities from the IT services by asking the service managers a set of questions. The interview format is developed in the prior phase as a guide to collect the information in detail. Recording the interviews is advisable to avoid collecting either faulty or incomplete data. Questions should be asked sequentially, so that the information given as a response is aligned to the levels previously established and in terms of the defined concepts. Interviewees have to understand the goal of the interview. Thus, activities, resources, times and even frequencies should be

obtained effectively. The interview process is essential to attain the parameters used in TDABC from the process collection, covering aspects such as: credential and verification, IT service identification, enabling services identification, final processes and enabling processes detection, atomic activities, resources, frequency and times consumed per activity.

8. Information processing

In order to process the information acquired in the interviews, a matrix is filled out. The interview's information has to be classified into the levels shown in the matrix Table 1; however, only one epitome of a final process of an IT service is presented for illustrative purposes. The activities have to comply with the condition chart. Attention has to be devoted to fill out the matrix; therefore, at least two members of the team must verify the information classification.

Service: E-Virtual							
Final Process: Operation							
Enabling process	**Atomic Activities**	**Time – Minutes**				**Frequency (Year)**	**Resources**
		Optimistic	***Most likely***	***Pessimistic***	***Expected***		
Request fulfillment	- Requirements analysis	10	15	30	17	508	CPU, monitor, keyboard, mouse, virtual server, hypervisor, orchestrator, help desk software, email suite, office suite, Moodle software, firewall software, IP phone, medium disk storage.
	- Solution of the requirement	5	15	30	16	508	

Table 1 – Interview's information

9. Validation of information

The matrix that is filled out in the previous step ameliorates the validation. The matrix has activities, times, frequencies and resources presented in a user-friendly manner. Hence, service managers could easily recognize the information, allowing them to not only make corrections, but also observations concerning the data. The service managers in charge of validating the information should be fully aware of the suggested levels and the condition chart because of the need to truly depict the IT organization. A follow-up peer review has to take place to ensure the validity of the information. The selected reviewers must be experts in managing IT services. They also need to have a general understanding of the organization. The goal is to ensure a realistic and accurate representation of the services in question.

3.3. Phase: Process Comprehension and ITIL alignment

10. Process notation

    The sequential and logical sets of activities collected and validated in previous phases require a graphical representation in order to prevent misunderstandings. This step focuses on depicting the process through a process notation. In this sense, BPMN facilitates communication between the organization and its stakeholders (Araujo et al., 2016). To this end, Bizagi Modeler offers a notation based on BPMN standards, which is adequate to diagram the collected information.

11. Association of information with ITIL processes.

    ITIL Service Operation conveys the best practices for managing IT services. It possesses processes and activities used throughout the service lifecycle supporting effective service operation. Merging ITIL processes and activities with the collected processes, ensures taking advantage of opportunities for growth and improvement. Moreover, organizational weaknesses are revealed, allowing the team to pinpoint looming threats within the organization. One way to link the ITIL service operation with the analyzed organization is by having the IT service managers complete an ITIL assessment. UCISA, a professional body that represents higher education institutions in the UK that are concerned about information systems, published an interactive tool to carry out such an assessment (UCISA, 1993). UCISAS's ITIL assessment allows researchers to evaluate the service operation readiness of the organization. It is divided into seven sections: service management as a practice, service operation principles, service operation processes, common service operation activities, organizing service operation, service operation technology consideration and implementing service operation. Furthermore, the assessment comprises pervasive features portraying a baseline to assess event management, incident management, request fulfillment, problem management and access management aligned to the IT organization's context. The assessment's results help put the collected processes into perspective, enabling researchers either to contrast information or justify it.

4. Results and discussion

Unlike other methodologies, the one presented in this research effectively deals with abstract services, offering guidelines to establish a graphic representation, levels and details to facilitate the collection, meanwhile, making it a robust input to develop a costing method following TDABC. The research's ultimate goal was to verify the methodology's validity and replicability in a real context. As a result, the proposed methodology has been applied in an Ecuadorian University, specifically in its IT department. The department's main objective is to manage, coordinate and execute IT projects in order to improve the academic and managerial quality of the university. In addition, it operates and controls the technological infrastructure as well as safety, supporting every IT system available. The IT department has three subsumed

departments in charge of communications and networking, computing services and information systems.

Resorting to the proposed methodology a total of 24 final processes were collected, which belonged to IT services and IT enabling services, Figure 2 presents the obtained process map. It mostly focused on the Department of Network and Communication. However, the methodology was also applied to the Department of Computing Services, collecting processes from one of its final services. After acquiring the IT individual diagrams, levels and the condition chart to classify the information, several interviews were carried out. Next, the information was processed and validated, allowing the team to have atomic activities, frequencies and resources at its disposal. Additionally, the collected information contained not only the processes immersed in IT services, but also an estimation of the time units required to perform an activity, crucial input to carry on the development of a costing model based on TDABC. The time estimation including optimistic, pessimistic and normal time was subject to a plethora of analysis, which aimed to identify the longest and shortest activities as well as the time distribution of the IT service managers and the overall annual time consumption per service, as shown in Figures 2, 3 and 4.

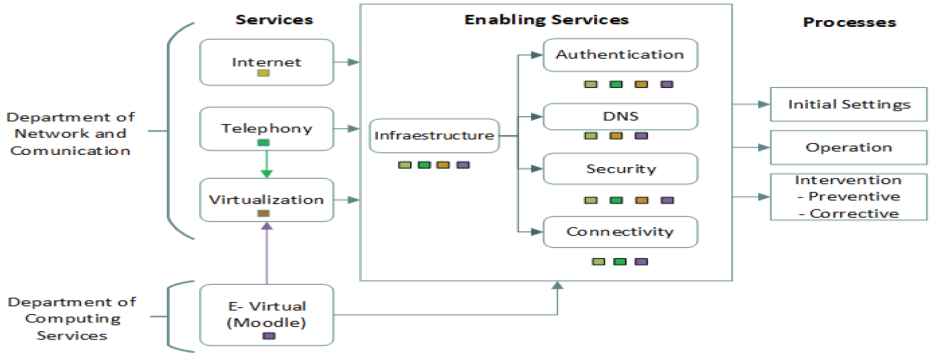

Figure 2 – Process map

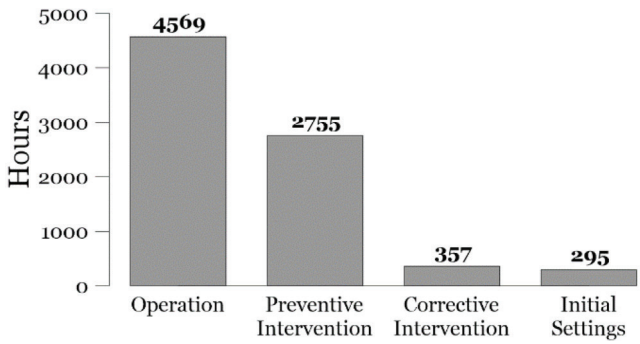

Figure 3 – Distribution of Annual Time in Final Processes

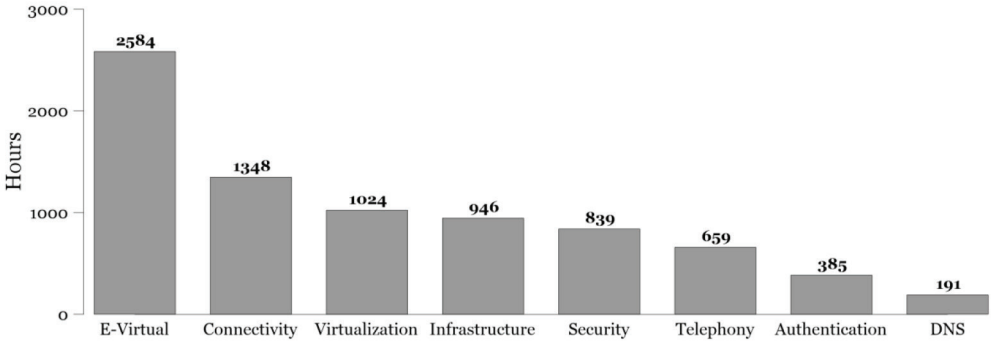

Figure 4 – Distribution of Annual Time in Services and Enabling services

The process collection provided valuable information to distinguish improvement areas in IT services and in the overall department. The example above contains information collected from an IT service called E-virtual, which enables managers and professors to create digital classrooms and enter students' grades. On the one hand, E-virtual consumed more time than any other IT service, but on the other hand Connectivity, which is responsible for network and device connections, took more time than any enabling service. Also, it is quite notorious that the final process (operation) form E-virtual and Authentication consumed more time per year than any other final process. This data paved the way to streamline IT service manager's time distribution. At the same time, it gathered enough information with respect to atomic activities and their performing time, so a costing model of the IT department can be conceived. Besides, the association of information with ITIL processes displayed potential threats to IT service management. The assessment provided a preliminary diagnosis of the service operation readiness of the IT department. The main findings of the assessment evolved lack of formality, protocols and written description, which exacerbated service operation

5. Conclusions

This study provides a process collection methodology which endows researchers with systematic instructions to gather processes, times per activities, frequencies and resources within IT services. IT processes were revealed and synthetized to such a degree that atomic activities were found. The data provided support to incorporate unit time of activities to time equations witch are fundamental to capture real world operations in TDABC, allowing IT service managers to approach difficulties impinged on justifying expenses and finding investments.

The methodology application took place in an IT department of an Ecuadorian University where IT services, enabling services, final processes, enabling processes, atomic activities, times and resources were gathered through interviews of service managers. Distinguishing processes from IT services became manageable using the methodology. Processes and services could have subtle differences that can hinder their

identification. The collection revealed activity times that were out of proportion on the E-virtual service, specifically in the final process "Operation" enabling meaningful decision making on time consumption triggers. Moreover, the ITIL assessment on operative services unfolded similarities with the departments' management regarding processes such as initial settings, operation and intervention. However, it also disclosed a plethora of improvement points related to the lack of indicators, protocols, operating procedures and software license planning.

The methodology should be subject to more extensive tests and applications in a larger assortment of IT departments. Besides, a thorough analysis with respect to TDABC outcomes should be taken into consideration to hone the methodology. A TDABC application should also be carried out to test the input provided by the methodology. Future work is needed to develop improvements on the methodology's limitations to associate IT services and processes with greater detail and interdependence. One way to mitigate such pitfall is to carry out a painstaking ITIL assessments not only focus on service operation but also on service design, transition and strategy. Such an assessment provides a larger scope to pinpoint opportunities for improvement. Different time methods should be studied alongside of the methodology to reduce bias when colleting the information. Also, more research has to be done to strengthen the link between ITIL's best management practices and the methodology.

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