Facilitate the adoption of TDABC

João Pedro de Barros Gomes Cruz
Almeida
Instituto Superior Técnico
Lisboa
joao.cruz.almeida@tecnico.ulisboa.pt

Abstract— The pursuit for cost efficiency has always been of extreme importance for organizations and, particularly in these recent years after the economic crisis, its relevance has increased due to market pressure for keeping profit margins and low product prices. However, even though cost transparency has been one of organizations' major concerns, the most recent costing methodologies, like TDABC, have high implementation costs that do not convince the decision makers to be worth the outcomes. With that in mind, we propose with this work a way to facilitate the adoption of TDABC and, at the same time, reduce its implementation cost using framework based process cost templates. Our proposal was demonstrated through a field implementation and evaluated by experts in interviews and closes-ended questionnaire, using the Moody and Shanks Framework and Österle principles. All in all, this research was able to propose a solution that can be a step towards increasing the adoption of TDABC based on results that showed it can reduce the time of implementation and therefore its cost. Furthermore, we believe this proposal has the potential to leverage the benefits of TDABC by facilitating its implementation and be the laying ground for a framework focused on cost process templates.

Keywords— TDABC, Process cost Templates, Cost Awareness, Process Frameworks, CMMI

I. INTRODUCTION

The present global economic context, defined by a global free market, is forcing companies to rethink the away they satisfy the demands of their customers. The competitive market environment forces companies to deliver low price innovative products thus reducing their profit margins. In face of this problem, organizations are realizing that cost awareness and cost analysis are essential to maximize profits.

The way cost awareness is practiced has been changing through the years specially since automation started to change organization's principal costs from direct labour and direct materials to indirect cost and back office. The proportion of overhead costs in companies increased from 10% to 40% between 1950s and today. Furthermore, as it was mentioned before, the pressure competitors hold over each other forces organizations to extend cost efficiency to their operations thus making the more complex organizations, that deal with huge overhead departments, to feel more difficulties achieving the required level of operational effectiveness [1].

For a manager to be able to put in place the appropriate measures and to achieve the abovementioned level of cost efficiency the organization needs to have access to the information of how costs are distributed. In order to obtain this information several cost methodologies were developed. Even though having this information is a competitive advantage for the organizations, the cost of applying these methodologies and correspondent costing tools is still too big for some manager to see it as worth the investment [2]. Furthermore, there are still a lot of methodologies that are not appropriate for the new organizational paradigm dominated by overhead costs.

The methodology we are going to analyse is Time Driven Activity Based Costing (TDABC), a version that eliminates some problems of the previous Activity Based Costing (ABC) model but is still considered as a bad investment for a lot of managers [2]. TDABC arose from the low rate of adoption, disappointment, uncertainty and dissatisfaction that surrounded ABC [3]. Although it represents a better version of ABC and has been successfully implemented in some small, medium, and large private and public companies, the truth is that the adoption rate of

TDABC is turning out to be even lower than that of the ABC methodology [3]. With that in mind, we focused our research in developing a proposal that aims to help solving this low adoption. Therefore, our proposal consists in the use of process cost templates and framework guidelines to implement TDABC on an organization by the means of a cost analysis service [4].

This research is going to follow the iterative methodology of Design Science Research (DSRM) [5] [6] and is going to be built around the guidelines established by that same methodology.

II. PROBLEM

This step is mapped in DSRM process model as the problem and motivation step. In the first place, we identified and atomized the problem as it is described in the section below along with the motivation of the proposed solution. Afterwards, we state the research questions based on the previous problem definition.

A. Overviews

The increasing competitiveness of the markets is demanding lower prices, forcing to be more cost aware in order to keep their profit margins. This demand for cost efficiency requires a strong cost analysis capacity that organizations very often do not have. In sum, companies have the option of searching for more revenues through higher prices – creating market disadvantage and reducing demand – or reduce costs.

Nowadays several costing methodologies are put in place to enhance organization's cost awareness. These methodologies focus on understanding the activities the organization performs, in order to design the flow of cost until the product or service is delivered. This allows the managers to be aware of where and how much money is spent and what is the profitability of each service or product. One of the first methodologies was Activity-Based Costing (ABC), which was introduced in the 1980s, allowing companies to obtain more accurate costs of their processes, products, and customers. This methodology ended up

having a low adoption because of the high cost to estimate and maintain ABC systems for large enterprises. Some companies employed more than a dozen employees to maintain ABC systems. Furthermore, the ABC software took many weeks to collect data and calculate product and customer profits and losses each month [10].

In addition to these ABC's problems some other more methodological problems arose. In the first place this model requires that most of the resource expenses are assigned to the activities based on interviews and surveys, a process, not only expensive and time consuming, but very often inaccurate. As a solution to this problem Kaplan and Anderson proposed Time-Driven ABC that defines a set of equations of time for each activity performed inside the organization thus eliminating the costly and subjective surveys of employee's time allocations. Furthermore, it skips the step of driving resources cost to activities thus eliminating the need to allocate department's costs to the multiple activities it performs [10]

However, even though TDABC solves the biggest problems of ABC, many managers still focus on the cost side of implementing such methodology instead of looking to the benefits it can bring to the organization. This mentality leads to the precipitated and generalized conclusion that the benefits do not exceed the substantial cost of implementing and maintaining TDABC [2]. Furthermore, in 2003 surveys on the subject registered a 50% usage of ABC [11] but in 2015 ABC was out of use and some TDABC principles were only used, by 22% as part of organizational time management [12].

Therefore, we can summarize the main problem of our research as: **low adoption of TDABC**. To solve this problem, we propose the use of process cost templates and framework guidelines to implement TDABC on an organization by the means of a cost analysis service [4]. This will allow us to reduce the time of making a proper TDABC cost analysis thus reducing its cost of implementation.

B. Motivational Demonstration

In order to better understand the context and to be able address properly the real problems during a TDABC implementation we performed a TDABC cost analysis in a small organization. The organization in question, which we can't disclose the name, organizes workshops on a given matter. Since we intended to analyse the profitability of each workshop student we needed to understand the processes involved in the organization, its costs and its revenues.

In order to perform a TDABC cost analysis, we started by gathering the resources and their CCR's – in this particular case the used capacity was 100% for all resources since resources are only hired or bought when they are needed - as they are presented in the following table. With this information gathered we focused on defining the 5 activities that comprised part of this organization's work. However, since the activity responsible for the cost of running the workshop accounted for 92% of the costs we are going to give it more attention.

Resource	CCR
Ads	4,8€/day
Meetup Membership	15 €/year
Photographer	1200/year €
Content Writer	30€/post
Bootcamp Manager	65,8€/day
Professors	183,9€/day

Table 1 - Table of resources for the motivational demonstration

In order to run the workshop only the professors, the manager and the space were needed, however, since the space was free of charge only the first two presented as costs for the organization. The workshop manager had a fixed income every month and the professors received for every day they actually worked which meant the days the workshop was running during the year plus the promotional workshops performed to attract future students. Therefore, after the cost analysis was fully ran, we assessed that the organization's costs circled around 169 962 € and that the revenue obtained from the workshop's tuitions circled 367 360€ which translates into approximately 54% of profit.

During this demonstration, we got a point of view that allowed us to perceive the problem in a different way. For this simple demonstration two weeks of work were required and we realized the factor that led to major delays was the difficulty in understanding how activities were performed and organized inside the organization since nothing was streamlined. As an example, we took two meetings to understand how the costs with a PR agency and Facebook ads costs could be translated into time equations since the first one was used only once and the organization didn't know if they were going to use it again and the Facebook ads activity was performed in an unpredictable way which made our job of defining a time equation difficult. Therefore, this spontaneous and less streamlined definition of processes, very common in small organizations but still real in bigger ones motivated us to find a proposal that might help both the streamlining of processes but also to perform the TDABC cost analysis.

C. Research Questions

As it was above mentioned, even though TDABC is an optimized version of ABC with lower processing costs, increased system flexibility, improved accuracy, and enhanced simplicity [13], for a lot of managers it still is not an investment worth the outcomes [2]. With this being said, it is clear that there should be a less time consuming and resource demanding approach to implementing TDABC. Therefore, in cooperation with a cost analysis service, of a process cost template that facilitates the implementation of a TDABC cost analysis of that same process. We believe this will accelerate the process of cost analysis since there is a higher starting point that might reduce the need for meetings and field visits. Considering all this, we defined the following research question as the basis of our work: **How can framework based process cost templates help reduce the time and, consequently, the cost of implementation?**

In sum, since we want to facilitate the adoption of TDABC, this research question can be answered by developing a framework based artefact that defines a set of resources and time equations for a given process therefore facilitating the future implementation of TDABC. Furthermore we can define that the main objective of this research is to present a

framework based process cost template that, on the one hand, works as an accelerator and resource reducer for TDABC implementation but also gives organizations and the departments a cost awareness of their processes and resources [10].
Besides this main objective, this template wants to take other objectives into consideration: The template should be adaptable to different organizations; The template must be expressed so that it can be used and understood by people with different backgrounds.

III. Related Work

This step is mapped in DSRM process model as the second step and consists on defining the objectives of a solution. We are going to define the goals of our solution based on the previously defined problem and the related work. The related work is going to provide the concepts, methods and available guidelines that are going to help us reach the best solution.

A. Costing Templates

In this sub-section, we are going to talk about costing templates for companies inside the same industry. These are a way of accelerating the implementation of a costing methodology.

1) Business Processes and Cost Templates

Business process templates are a mechanism to reduce costs of implementing a given cost methodology through reutilization and standardization of business processes for organizations in the same industry. As it was described in the literature, *"a method, that models an industry's business processes and costs, and creates a template than can be later instantiated to organizations belonging to that same industry"* [14].
The above-mentioned method was developed as a composition of two phases, the Modelling phase and the Application phase. The first phase is a one-time development procedure where the field or industry is analysed and where a generic cost model is developed using an organization in that same field/industry. The second phase of the methodology is responsible for implementing the previously developed template in a specific organization. The model instantiation consists in applying real costs to the model, removing or adding activities that might be in excess or missing and even changing some if necessary in order to reflect the specificities of that particular organization. These adjustments are necessary since all companies, however similar they are in that industry, have different structure particularities and different costs that need to be embedded in the model [14].
The Modelling phase is composed by the following six major steps that allow the modelling of an industry costing template [14][15]:

1. **Cost Object Hierarchy** – This step will indicate in which cost objects the results will reflect and how they can be organized to help structuring the analysis. This is done by creating a tree that represents the multiple levels of aggregation of the cost objects, starting at the individual transaction level and then moving up creating groups according to where the analysis should be focused.
2. **Identification of Resources** – After defining the cost object hierarchy all the resources should be gathered and organized in resource pools (set of resources that work together for some role). This structure of resources makes it easier to identify direct costs, and create ways to allocate the overhead costs to functional departments.
3. **Definition of Activities** – After identifying all the resources and structuring them, the executed activities must be identified. For each identified activity, the usage of resources should be assessed. In order to associate the activities with resources and their costs, BPMN and TDABC's time-equations are used. Furthermore, each activity is linked through a time-equation with only one resource pool.
4. **Construction of Business Processes** – Given that the value proposition of this methodology relies on maximizing reutilization, a way to achieve that is to use the same activity in different processes. The business processes are, in short, a composition of different activities with a given order. Therefore, to obtain process costs the ones that resulted from the time-equations defined for each activity composing that same process should be summed.
5. **Allocation Processes to Products** – Costing the cost objects (e.g. services/products) is done by summing all the costs of the processes that contribute to that cost object.
6. **Definition of Segmentation Products** – In this step are defined, in the template, some common levels of variation since inside some industry there is sometimes some segmentation that can be based on a number of variables.

The generic industry cost template that results from this phase is then used in the application phase and applied in the organization. This phase is composed by the following five steps [14]:

1. **Resource Cost Gathering** – The model defined in the previous phase defines the resources of the organization and how costs are allocated to support and functional resource pools. Although, in order to apply the template to a specific organization, it is necessary to gather the total cost of each resource and the practical capacity for each of the functional resource pools (in order to calculate the CCRs).
2. **Segmentation Variables Choice** – In this step the segment of the template is chosen based on the variations that better match the organization.
3. **Application of template** – Instantiating the model means replacing all the variables (the cost of resource pools, the practical capacity of each resource pool and the CCRs calculated with these values) defined in it by the actual values of the organization.
4. **Adjustment of template** – Since organizations usually have particularities that differentiate them from other companies in the same industry, adjustments to adapt the template for a particular organization should be done. These adjustments include actions like adding, removing and adapt activities or changing variables in the time equations.

5. **Calculation of costs** – The cost calculation is done by applying the TDABC methodology. The model receives the input data from transactions and applies that data to the time equation variables in order to calculate costs.

In a final stage, although not considered as an independent step, there is a control component which aims to give a continuous attention to improving the quality of the template. In this phase the manager's feedback on the generic model is of great importance. All in all, this method takes advantage of the concept of business process standardization in the sense that the more organizations standardize their processes the more accurate the model will be. It can help organizations, particularly the small ones, by facilitating the standardization of their processes, without obviously losing their particularities, allowing, at the same time, a reduction in the cost of implementation [14].
This proposal is not completely able to solve the identified problem since it is still difficult, costly and time consuming to apply the modelling methodology in organizations of bigger size when a basis (e.g. framework) to work from is not being used. This requires analysing completely the companies processes right from the beginning through observation and interviews instead of using them just to fill in the blanks.

B. Costing Tools

In this sub-section, we are going to explore the context of costing tools in TDABC implementation.
Even though costing software is essential to perform cost analysis, the costs associated to a software like this prevents many organizations, especially SMEs, from thinking of it as an option. Although this is still a reality, according to recent reports, by the end of 2018 the majority of organizations will have a migration plan in place to shift their spending from perpetual software licensees to subscription-based pricing [16]. This change in the paradigm allows companies to see a software as an operational expense instead of a capital one making it more attractive, especially for SMEs.
A costing methodology like TDABC can be very difficult and time consuming to implement, fortunately there is software that facilitates the implementation. This kind of software has been developed to ease the data capture, results processing, implementation methodology, and analysis functions for most of the mainstream costing tools. Usually they are integrated with source transaction systems and are able to export results to business intelligence software [17].
The most common tools used for TDABC implementation - Acorn Systems, SAP PCM, SAS ABM, Oracle Hyperion PCM, Cognos, QPR CostPerform, etc. – are perpetual license products that require a big investment. As it was abovementioned, this investment can be a barrier to many organizations thus opening space in the market for Software as a Service (SaaS).
Based on that market loophole, our research is going to use a cloud-based costing service developed by digital costing [18]. This tool allows organizations to reduce their costs by offering costing as a service instead of an investment, allows the full application of the TDABC methodology by receiving an imported input of data from the ERP and provides to the managers a set of reports about the capacity of the resources and the profitability of the cost objects.

IV. PROPOSAL

This step is mapped in DSRM process model as the design and development step and focus particularly on creating an artefact. This artefact is a proposal for a practical solution to the problem previously identified.
As it was mentioned in previous sections the fact that, for many managers, the benefits do not exceed the substantial cost of implementing and maintaining TDABC plus the fact that it represents a big capital investment for organizations, are the main problems preventing the adoption of TDABC. Therefore, our proposal aims to reduce the factors of cost increase such as time required for implementation, expertise and expensive software.
Based on this context, we propose the use of **process cost templates and framework guidelines to implement TDABC on an organization through a cloud-based costing tool.** In reality, in order to reduce the scope of the research, our proposal consists on developing a cost template for the process of IT Services Development using CMMI and COBIT5 as references. We decided to choose this process since, according to the insight we got from experts, it stands out from the researches already performed in the field by being a less standardized process across organizations. This will allow us to challenge the concept of cost template and understand more about how it works in different contexts. Moreover, it is of our belief that this proposal will reduce the expertise and time of implementation needed to execute the methodologies mentioned in the related work, as it was previously proposed by Jorge Emanuel et.al [15]. Furthermore, we have noticed from the previous work that conclusions were difficult to reach due to the use of a very standardized business process that limited the assessment of how cost templates could be implemented in more complex processes that may suffer much more differences from organization to organization.
In sum, the use of process cost templates consists in defining, *a priori* - using the appropriate frameworks together with interviews and field visits - the process, its activities, the resources that maybe involved and, finally, the time variables that influence those activities. The way we see it, this previously defined cost template will accelerate the implementation of TDABC in organizations by reducing the need to observe the processes in field, by reducing the number of meetings with staff and by reducing the number of experts and expertise needed to implement such costing methodology. Taking as an example the motivational demonstration described in chapter 3 if we had a cost template for how to manage bootcamps it would be possible to adapt it to that context in fewer meetings and field visits. A cost template supports the communication by giving both a process overview and displaying a similar cost structure.
In this research, we developed a cost template for the process of IT Services Development strongly focused on the activities that take part on the actual Software Development, which justified our choice of CMMI as fundamental framework. With this cost template, we intend to provide organizations with a tool that enhances cost awareness – which leads to a more accurate pricing - when it comes to the developed software, both internally and externally. Furthermore, we used COBIT5 to help us assess the labour resources associated with each activity. The use of both

these frameworks, together with interviews to experts in the field, gave us the ability to create a cost template with a good level of detail that is still able to provide organizations with the flexibility to adapt it to their own environment.

A. Framework usage and boundaries

As it was abovementioned this cost template makes use of both CMMI framework and COBIT5 framework. Since in this research we decided to limit the scope to the process of IT Service Development, which consists on all the practices starting in the planning of a product or service until its final execution and verification, the use of both these frameworks was also limited to fit that scope, meaning not all the literature provided by both the frameworks was used in this research.

The use of CMMI was comprised to the document of CMMI-DEV v1.3 since this document focuses on providing a set of best practices regarding the activities involved in the development of products and services [19]. Furthermore, It addresses practices through all the product's lifecycle from conception through delivery, highlighting all that is needed to build and maintain the total product [19].

The use of COBIT5 was comprised to *COBIT5:Enabling Processes* [20] in order to obtain the governance and management responsibilities associated with each of the CMMI processes. The mapping of the CMMI and COBIT5 was done through the ISACA's COBIT5/CMMI practices pathway tool [21].

The CMMI-DEV document is composed by 22 process areas, from these, only 5 are categorised as Engineering processes (Product Integration, Requirements Development, Technical Solution, Validation and Verification). Being these last processes more directly linked to the software development as a process we decided they should be the laying ground of our cost template. Having clarified the use and boundaries of both CMMI and COBIT5 we proceed to present and explain the developed cost template.

B. Process Cost Template

To create an IT Service Development cost template, we started not only by analysing the CMMI-DEV v1.3 - in particular, the five engineering processes (Product Integration, Requirements Development, Technical Solution, Validation and Verification) - and *COBIT5: Enabling Processes* but also the particular field we were working in, as proposed by Lourenço et. al [14]. The analysis and creation process was always followed by IT specialists which gave us the needed validation and feedback. Furthermore, after analysing and understanding how the template process should be organized in terms of activities we needed to analyse with a practitioner and academic the relevant cost variables and the main resources involved.

In order to follow the logical process of development we will start by showing a general view of the template and its four main activities. Afterwards, we will proceed to detail each sub-activity that composes each of the main activities. The main activities that compose our cost template are:

1. **IT Service Requirements –** This activity's major responsibility is to assemble the requirements of the service in development, refine them and establish functionalities and quality attributes. Therefore, it starts by assembling the stakeholders needs and transforming them into customer requirements. Afterwards, the technical requirements should be extrapolated from the previously defined requirements. Thirdly the activity focuses on identifying external and internal interfaces plus their requirements. Finally, scenarios and operational concepts are defined in order to refine requirements and defining functionalities and quality attributes.
2. **IT Service Design –** This activity focuses on defining the possible solutions, choosing the right solution, design it. Therefore, it starts by selection the right solution for the problem and the product components that are going to compose it. Afterwards, the capabilities and structure of each of those product components is defined. Finally, the team decides how should those product components be acquired (Make, buy or reuse).
3. **IT Service Implementation –** This activity is responsible for the implementation of the previously developed design and for developing all the necessary support documentation.
4. **IT Service Verification –** The phase of verifications occurs along the development of the product; it is responsible for verifying the product against the requirements and the customer.

In all its extension, this IT Service Development cost template is comprised by 4 activities and 13 sub-activities. To represent those, we decided not follow the same BPMN notation proposed by Lourenço et. al [14] so that, as it was discussed with different experts, it could be more easily understood by the non-engineer staff and therefore meet one of the previously defined objectives. As it can be seen by the following picture, which represents the used notation for just one of the sub-activities, the time equations and the respective resources used by each one of them represent the needed variables to calculate the cost of each of the sub-activities using TDABC.

Furthermore, each of the sub activities – identified with the CMMI and COBIT5 processes they with - has a description intended to provide context on that given activity and some best practices and procedures for that context. This feature provides the cost template the ability of redirecting the user for further process optimizations.

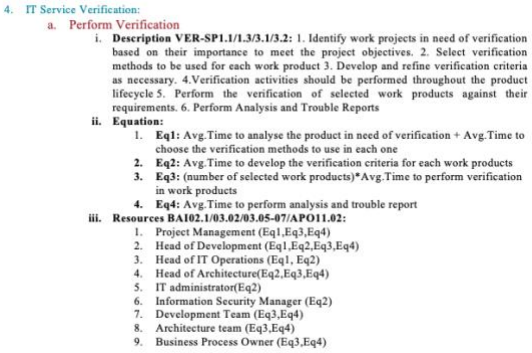
4. IT Service Verification:
   a. Perform Verification
      i. **Description VER-SP1.1/1.3/3.1/3.2:** 1. Identify work projects in need of verification based on their importance to meet the project objectives. 2. Select verification methods to be used for each work product 3. Develop and refine verification criteria as necessary. 4.Verification activities should be performed throughout the product lifecycle 5. Perform the verification of selected work products against their requirements. 6. Perform Analysis and Trouble Reports
      ii. **Equation:**
         1. **Eq1:** Avg.Time to analyse the product in need of verification + Avg.Time to choose the verification methods to use in each one
         2. **Eq2:** Avg.Time to develop the verification criteria for each work products
         3. **Eq3:** (number of selected work products)*Avg.Time to perform verification in work products
         4. **Eq4:** Avg.Time to perform analysis and trouble report
      iii. **Resources BAI02.1/03.02/03.05-07/APO11.02:**
         1. Project Management (Eq1,Eq3,Eq4)
         2. Head of Development (Eq1,Eq2,Eq3,Eq4)
         3. Head of IT Operations (Eq1, Eq2)
         4. Head of Architecture(Eq2,Eq3,Eq4)
         5. IT administrator(Eq2)
         6. Information Security Manager (Eq2)
         7. Development Team (Eq3,Eq4)
         8. Architecture team (Eq3,Eq4)
         9. Business Process Owner (Eq3,Eq4)

Figure 1 - IT Service Verification sub-activity from the cost template

In reality, as we can see on the image above, we divided each of the sub-activities the following way: firstly, description and best practices - mostly based on CMMI recommendations but also on feedback - secondly their time equations and, finally, the resources involved in each time equation.

V. DEMONSTRATION

This chapter is mapped in the DSRM process model as the demonstration step where we present the value of our proposal. Therefore, we decided to do it by implementing the proposal in a Banking organization where we gathered information. Moreover, this demonstration intends to show that the previous proposal can be used to solve the problem presented in chapter 2.

In order to demonstrate our proposal, we intended to calculate the cost of a service development at an IT Department using an organization as starting point – in this case a Banking organization. The demonstration consisted in instantiating the cost template in a IT department. However, due to the limitation of manpower and time, we focused most the efforts in detailing the implementation of the design. Even though all the other sub-activities were also instantiated with the help of a few experts in the area, the level of detail was reduced due to the lack of time for more infield observation and access to further privileged information. All in all, the template was instantiated with real values but for privacy reasons is going to be presented with simulated data. After building and implementing the model it was evaluated, as we will see in chapter seven, with experts to guarantee not only that the template could be implemented in different organizations but also to understand its quality in several parameters.

In the demonstration, we will start by explaining the process of adapting the template, collecting the required data and, finally, showing how they were implemented both in the excel model and Costing Service.

A. Implementation at a Banking Instituiton

Our work was performed in a Portuguese private banking institution listed on Lisbon's Stock Exchange. The Banking Institution's IT Department on which we performed this field study is an organization with strong process maturity in IT Service Development. In a costing perspective, the organization implemented a model that allowed the costing of the services developed in house. The cost of all the areas of Development of an IT Service (Management, Functional Analysis, Non-Functional Analysis, Pre-production and Product Support) was extrapolated using percentage from the calculated Development cost. Therefore, our implementation proposes not only to enhance the accuracy of the calculation of the Development Cost but also the other steps of the process.

1) Template Adaptation

The first step in the cost analysis is to understand the resources involved in the Development of an IT Service. In a costing point of view, the resources involved in all the activities of these process represent both direct and indirect costs. The first being composed by Internal employees, Hardware and infrastructure costs and the second miscellaneous costs and other organization's expenses that can't be mapped directly to the development of IT Services.

The set of internal employees, Hardware and infrastructure involved is composed by project managers, administrators from different areas, DevOps staff, Architecture staff, IT administration staff, risk analysis staff and audit staff. In terms of hardware and infrastructure the cost allocation varies from project to project – since it is out of the scope of our cost template and we can't detail specific information about what hardware and technologies were used we will not give much emphasis to this matter. The second set is composed by a set of costs that we didn't have access but comprises expenses such as electricity, building rent, office material, among others.

After understanding the resources involved in the process we needed to know both the number of each of the resources assigned to that service development and their CCR's. In the following table (Table 2) we listed all this information. In order to understand the CCR of each resource we needed to know the actual cost of each of the resources and its practical capacity. Since none of these values could be disclosed we considered different costs for each resource and, based on the organization, we considered a capacity of eight hours per day and twenty days per month, with a practical capacity of 87,5% based on what we retrieved from the interviews. Therefore, taking the DevOps team as example, the monthly cost is 17600€ and the practical capacity per month is 140 hours which means the whole team CCR is 125,7€ per hour and the CCR of each team member is 12,57€ per hour. After assessing the resources, we can move to analyse the adaptations to the cost template in terms of time equations and understand how the costing of Design implementation sub-activity was modelled.

Resource	CCR (per hour)	Number of units
CIO	**89,3 €**	**1**
Project Manager	**59,2 €**	**1**
IT administrator	**23,8 €**	**1**
IT administration team	**50,2 €**	**4**
Head of DevOps	**25 €**	**1**
DevOps team	**125,7 €**	**10**
Head of Architecture	**25 €**	**1**
Architecture team	**125,7 €**	**10**
Risk Team	**50 €**	**5**
Audit Team	**50 €**	**5**

Table 2 - Used Resources, their CCR's and number of units

The cost template adaptations were performed after a set of several meetings with experts both from within and out of the organization. Overall, it took us two months to gather all the needed information and finish this model, this time accounted for 7 meetings – two meetings with the organization representatives and five with two experts - with the experts and organization. The cost template adaptation finished with 13 activities, and 40 time equations. Besides the activity of design implementation that is further explained in the following section we are going to detail the example of three of the identified activities.

In the activity, responsible for developing alternative solutions and selection criteria the first-time equation of the cost template and the forth one were translated into one time equation for both the Project Manager and the Head of DevOps. The first one has as only variable the number of

meetings performed for the development of the screening criteria and based on the interviews we considered an average time of two hours plus the time taken to select the set of solutions for consideration based on the criteria. The second equation allocated to the Head of DevOps is basically the previous equation but instead of the time of selection has the time spent developing the screening criteria for solutions and the selection criteria. The second equations of the cost template translates into a simple equation that only allocates the time of creating a report on the available technologies and its allocated to the Heads of the three areas. The third equation is divided in two, the first one is allocated to the whole resources in the DevOps department and has as variables the number of alternative solutions, the average time for the development of an alternative solution and the whole second equation. The second one is composed by that variable that measures the number of meetings the Project managers has during the development of solutions times the average time the experts estimated to be one hour. The fifth equation presented in the cost template was split in two equations that analyse the time spent in evaluation meeting with the project manager and the actual time spent to evaluate each solution, as seen in the following picture. The sixth equation was passed as the same equation to the Head of DevOps and architecture. The project manager was left out since the meeting with the project manager wouldn't have a big in pact in terms of time in the experts' opinions. Finally, the last equation in the cost template measures, in practice, the time the Head of DevOps and IT administrator take to develop a report on the product component solutions.

The activity responsible for assessing and transforming the stakeholders' needs into customer requirements kept, like it was presented in the cost template, two time equations. The first equation was allocated to the project manager and the head of DevOps and was composed by three variables that measured the number of re-evaluations during the project lifecycle, the number of stakeholders and finally the time to gather the needs of the stakeholders. The second equation also allocated to the same resources was composed by the number of re-evaluations variable and a variable that measures the time taken to define the customer requirements and prioritize them.

Finally, the activity responsible for performing the verification of the product and the work products was suffered some minor alterations. The first equation in the cost template was kept similar to the cost template with two variables and allocated to the Project Manager and Head of DevOps. The second equation accounted for the number of selected work products times the average time to develop a verification criteria for each work product. This equation was allocated to the Head of DevOps and Architecture, to the IT administrator and the IT Security Manager. The third equation depends on the number of work products, the average time to perform the verification for each of them plus the number of meetings with the project manager. This equation is allocated to the Head of DevOps and Architecture while the Project Manager has only the time spent in the briefing meeting and the teams. Moreover, the time spent performing the verification without the briefing meetings is allocated to DevOps and Architecture Team. Finally, the forth equation has as variables the time to elaborate an analysis and trouble report and the number of report meetings with the project manager. The DevOps and Architecture allocate only the first variable; the heads of both areas allocate both variables and the Project manager only the last one.

On the following section, we will detail the adaptations and implementation of the activity responsible for the implementation of design.

2) Costing Model Implementation

As it was abovementioned, due to time, manpower and even limitations imposed by the organization, our field analysis needed to be limited in terms of scope which reduced the level of detail in other sub-activities. Therefore, the design implementation, being the most relevant step in terms of cost - according to the organization - seemed the right choice for further analysis. Looking at the costing template, we started by defining the variables on which the time measures were going to depend. After analysing with the experts on the IT department we decided to use as variables for our table of times: complexity, precedence of work, type of implementation. The variable of complexity was directly related to the number of requirements of the project. On this variable, the organization provided the information on which they defined the level of complexity based on those requirements both for work with precedence and without precedence. The type of implementations mainly performed by the department consisted in: Online Implementation that consisted on implementing a full application backend and frontend; Interface online that consisted on developing API's for information requests; Batch implementations consisted on changing or creating batch files (Including Job Control); Database that consisted on performing all kinds of database changes; Parameterization that consisted on preforming value parametrizations. Therefore, with field analysis, several interviews and some previously provided information we came up with the following time table (Table 3) that defines the time of implementation depending on the type, the precedent and complexity of the implementation.

Implementation Time (Hours) Codif. / Unit Testing	Without Precedent				With Precedent			
	Very Simple	Simple	Medium	Complex	Very Simple	Simple	Medium	Complex
Online	10,0	25,0	50,0	100,0	4,0	10,0	20,0	40,0
Online Interface	10,0	25,0	50,0	100,0	4,0	10,0	20,0	40,0
Batch	10,0	25,0	50,0	100,0	4,0	10,0	20,0	40,0
Database changes	2,5	6,3	10,0	20,0	2,5	6,3	10,0	20,0
Parametrization	1,3	5,0	10,0	20,0	1,3	5,0	10,0	20,0

Table 3 - Table of implementation times

Having the times gathered and the CCR's of each of the involved resources we moved to calculate the cost of the design implementation sub-activity. The project we are costing, adapted from the real project, consisted in four types of implementations without precedent and of high complexity. The following table presents the time spent in implementation by the DevOps team and the respective cost.

Item	Type	Quant.	Precedence (U/P)	Complex.	Estimated Time (h)	Adjust. (h)	Adjust. Description	Total (h)
E-commerce website	OL	1	N	C	80,0	15,0	Delay	95,0
E-commerce website API	IO	1	N	C	80,0	15,0	Delay	95,0
Database creation for products/members etc.	TB	1	N	C	16,0	3,0	Delay	19,0
Upload of parameters	PR	1	N	C	16,0	3,0	Delay	19,0
				Total Time	192,0	36,0		228,0
							Total Cost	28 659,6€

Table 4 - Table of cost analysis for the design implementation

However, the time and cost spent in management actions by the project manager and the Head of DevOps still needs to be accounted for. Therefore, based on our observation the time equations that defined the time spent by both those resources was the number of implementation meetings times the average time spent. We were able to assess that the resources involved were: The Project Manager with two meetings a week lasting one hour with the Head of DevOps; the Head of DevOps everyday with the team during thirty minutes. Therefore, the whole cost of the management actions is 1554 euros. In Sum, the cost of the whole design implementation sub-activity is around 30213 euros. After performing the cost of the design implementation sub-activity and having the model with all the time equations and resources implemented in the costing service the organization was provided with a tool that allowed them to understand with more precision the actual cost of IT service development. Even though we didn't have time to gather the input data for all the remain sub-activities since it would require a much longer research and field work this model provides a much higher starting point for an increased cost awareness in this IT Department.

VI. Evaluation

This section corresponds to the evaluation phase of DSRM that aims to determine if the proposed solution of this research is able to solve the problem mentioned in section three. Since our research was based in DSRM we decided to follow some of the five evaluation methods proposed by the literature [5].

In order to evaluate our proposed artefact, we used a Field study as observational method, a static analysis as analytical method and an informed argument as descriptive method. Therefore, the evaluation of this research was done the following way:

1. **Demonstration** will be used to evaluate the cost template based on the feedback obtained.
2. **Close-ended questionnaires** to get feedback about the cost template from experts in the area.
3. Design Research Evaluation Framework [22] using Moody and Shanks Quality Framework [23] and Principles of Österle [24] in order to evaluate the quality of the model and the research.

A. *Close-ended Questionnaires*

In order to evaluate our presented proposal, it was important to interview some experts in the area. The preformed interviews lasted around 40 minutes and consisted, firstly, in a brief explanation of the cost template, its organization and structure. Secondly, we conducted a close ended questionnaire that evaluated the developed cost template according to the previously defined objectives of the research. And, finally, we got informal feedback from the experts.

In this evaluation, we interviewed three experts: one academic with more than 20 years of experience in Information Systems management and co-author in papers regarding TDABC and cost templates; one practitioner and academic with experience as CIO and Ph.D. on Information Technology Administration; one practitioner with a published paper on costing templates and five years of experience in the industry. For all the interviewees, the cost template structure and notation was clear and understandable. The presented close-ended questionnaire contained eight questions designed to help assess the value of the proposal and how it stands compared to the defined objectives. The asked questions were:

1- Do you Believe Cost Templating of Processes might be a way to reduce the time of implementation of TDABC methodology? (0-10 measure)
2- Do you believe that this proposal of Service Development Cost Template, is an understandable model with a clear notation? (0-10)
3- Is the presented template complete and coherent with what usually are the steps of Service Development? (0-10)
4- Do the Time equation's variables provide the proper level of detail, allowing further adjustments if necessary? (0-10)
5- Do the specified Resources provide the proper level of detail, allowing further adjustments if necessary? (0-10)
6- Does the mapping of processes, equations and resources seem coherent, in your experience? (0-10)
7- Do you believe this template would be adaptable to various organizations (different sizes and different areas of business besides banking)?
8- Do you Believe that this approach will allow organizations to have a more accurate cost estimation of the services developed? (0-10)

1) *Results*

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8
Expert 1 (academic)	8	4	6	8	8	3	4	8
Expert 2 (academic and practitioner)	8	5/9[1]	6	8	8	8	9	10
Expert 3 (practitioner)	8	7	6	8	9	8	7	8

Table 5 - Result by question and Expert[1]

B. *Moody and Shanks Quality Framework and Principles of Österle*

The evaluation according the four principles of Österle intended to assess the quality of the performed research. In order to present this results we took into consideration all the previously held interviews. Furthermore, the evaluation results of the application of Moody and Shanks Framework are going to be presented in the benefits dimension of the four principles of Österle evaluation since the multiple dimensions of this evaluation represent the benefits provided by the proposed template. Therefore, the evaluation results are:

Abstraction – This template, according to the experts' analysis, has the ability to be applied in the IT Departments of different Organizations provided that the right changes are performed in order to make it fit the particular environment.

Originality – Although proposing process cost templates has a solution was something already done before it was performed in very standardized processes. Therefore, reducing the ability to assess the potential of using cost templates in complex processes. All in all, our research was seen by the experts as an original proposal since it also might be the laying ground for a process cost framework.

Justification – The proposed template is supported by the theoretical concepts defined in the related work, by the demonstration performed and finally the evaluation and feedback gathered during the interviews with the experts.

Benefit:

Simplicity – According to the experts the presented template has the appropriate size and complexity. The number of variables and resources addressed provides the necessary level of detail without jeopardizing the future adjustments that might be needed in order to adapt the template to a different organization.

Completeness – According to what was analysed with the experts the template is complete since it is coherent with the steps performed in an IT service development process and CMMI. However, the coherence with the actual processes performed might decrease significantly in organizations with less process awareness and framework oriented.

Flexibility – According to the experts the template presented a level of flexibility in its resources and time equations conveyed by the ability to adapt the variables and resources to fit the context of different organizations.

Integration – The template is consistent with the organization that's going to implement it since it costs a process of that same organization.

Understandability – According to the experts' feedback even though the model has a clear notation its understandability is still dependent on the user's knowledge on the field.

Implementability – Implementability is dependent on two factors. First of all, it is dependent on the ability to measure the time for each of the time variables on the time equations (a higher level of granularity will require more information thus requiring more resources). Moreover, it will depend on the difference between the cost template reality and the reality of the organization since a bigger gap between them will also require more resources.

Integrity – Since the template was built on top of CMMI activities and best practices it defines the business rules considered to be more relevant. However, differences in the activities actually performed in a given organization might be found and introduced in the template.

Correctness – According to the experts involved the presented cost template was considered to be in conformity with the general context of IT Service Development. However, as it was previously mentioned, the cost template might diverge more or less from organization to organization, specially in organizations less framework oriented.

[1] The second expert separated his grade saying that for an expert the notation would be a 9 but for someone not specialized in the field it would be a 5.

VII. Conclusion.

In a global market context where organizations fight for an increasingly demanding customer the ability to provide disruptive but price competitive products are absolutely crucial. However, the ability to deliver competitive prices often comes tied to a strong reduction of profit margins. The struggle for keeping profit margins has prompted organizations to seek for a bigger cost transparency that helps the decision-making process in dimensions such as services, products or customers. In sum, costing analysis has the capability of providing managers and decision makers with precise cost insights to support bottom line actions (e.g price adjusting, reducing product costs).

In order to perform this cost analysis several costing methodologies can be put in place. However, in this research we focus on the low adoption of TDABC. Since ABC was introduced in the 1980's that problems such as its questionable precision in cost estimation and long implementation times are well known. Furthermore, according to a survey performed in 2016 42% of the respondents showed to be dissatisfied with ABC [25]. However, these problems were not enough motivation for managers to see the new version, TDABC, as a costing methodology worth implementing [2]. This being said, we intended with this work to propose a solution for facilitating the adoption of TDABC costing methodology by trying to reduce its time of implementation and therefore its cost.

This research was performed through the iterative methodology of DSRM [5] [6] and the guidelines defined by the same methodology. Therefore, we started by defining as fundamental problem of this research the low adoption of TDABC and then proceeded to analyse the present literature and to understand what previously built solutions might serve as laying ground for our work. This led us to propose the use of process cost templates and framework guidelines to implement TDABC. Therefore, and in order to reduce the scope of the research, our proposal consisted in developing a cost template for the process of IT Services Development using CMMI and COBIT5 as reference.

In order to show the results of implementing the previously developed cost template we performed a demonstration in a banking institution by implementing the cost template in the IT department. Due to time and human capital limitations we focused more our implementation on the actual

implementation. All in all, through the cost template we gathered the resources involved and adapted the time equations for that given context.

Finally, we evaluated the proposal by using the Design Research Evaluation Framework which led us to define our work as an ex-post naturalistic evaluation with close-ended questionnaire and interviews as process of evaluation and Moody and Shanks Quality Framework and the Principles of Österle as criteria of evaluation.

On the following sections, we will detail the main contributions of this research.

A. Main Contributions

We believe this research was able to provide to the scientific community some contributions. On the one hand, it provided a solution for the identified problem while, on the other hand, it established the laying ground a future work for, for example, developing a framework for process costing. Moreover, the main contributions were the following.

Firstly, as it was abovementioned, it helps solving the problem of low adoption of TDABC by reducing the time of implementation and therefore its cost. This might be a step to change managers minds since cost was always one of the main concerns for this type of projects. Therefore, we can also say that the developed template works as an accelerator for cost analysis.

Secondly, since the implementation of a costing methodology requires a great knowledge about the processes involved this cost template is able to help mapping processes or even redesigning them according to the CMMI best practices. Finally, it will provide organizations a cost awareness on the developed software that will allow a better decision price making and a more confident organizational strategy.

All in all, we believe this proposal has the potential to leverage the benefits of TDABC by facilitating its implementation. Furthermore, it can be the laying ground for a framework focused on cost process templates.

REFERENCES

[1] B. Popesko, "How to manage the costs of service departments using Activity-Based Costing," *Management*, vol. 5, no. 402, pp. 1–10, 1985.

[2] O. P. Hall and C. J. McPeak, *Are SMEs ready for ABC?*, vol. 11, no. 4. 2011, pp. 11–22.

[3] M. NAMAZI, "Emergence of the Time- Driven Activity- Based Costing," pp. 1008–1020, 2016.

[4] A. Machado, C. Mendes, M. Mira da Silva, and J. Almeida, "Time-driven activity based costing as a service," in *Lecture Notes in Business Information Processing*, 2015, vol. 241, pp. 633–653.

[5] A. R. Hevner, S. T. March, J. Park, and S. Ram, "Design Science in Information Systems Research," *MIS Q.*, vol. 28, no. 1, pp. 75–105, 2004.

[6] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, "A Design Science Research Methodology for Information Systems Research," *J. Manag. Inf. Syst.*, vol. 24, no. 3, pp. 45–77, 2007.

[7] G. Cokins, "Why is traditional accounting failing managers?," *Hosp. Mater. Manage. Q.*, vol. 20, no. 2, pp. 72–80, 1998.

[8] J. K. Myers, "Traditional Versus Activity-Based Product Costing Methods : a Field Study in a Defense Electronics Manufacturing Company," *Proc. ASBBS*, vol. 16, no. 1, 2009.

[9] D. T. Hicks, "Activity-based costing : making it work for small and mid-sized companies," *Wiley cost Manag. Ser.*, p. xix, 357, 1999.

[10] R. S. Kaplan and S. R. Anderson, "The Speed-Reading Organization," *Bus. Financ.*, vol. 13, no. 6, pp. 39–42, 2007.

[11] D. K. Rigby, "Management Tools 2003," *Bain Company, Inc.*, pp. 2–3, 2003.

[12] D. R. and B. Bilodeau, "Management Tools & Trends 2015," 2015. [Online]. Available: http://www.bain.com/publications/articles/management-tools-and-trends-2015.aspx.

[13] E. Ayvaz and D. Pehlivanli, "The use of time driven activity based costing and Analytic Hierarchy Process method in the balanced scorecard implementation," *Int. J. Bus. Manag.*, vol. 6, no. 3, pp. 146–158, 2011.

[14] A. G. Lourenço, "Analyzing Cost and Profitability using Process-based ABC," no. May, 2013.

[15] J. Emanuel and R. De Andrade, "Templates for Calculating IT Services Costs," no. November, 2014.

[16] S. Pike and P. V. President, "IDC FutureScape : Worldwide Security Products and Services 2017 Predictions," 2017.

[17] J. Gurowka and R. A. Lawson, "Selecting the Right Costing Tools for your Business Needs," *Wiley Period.*, vol. 85, no. 1011, pp. 440–441, 2007.

[18] D. Costing, "Digital Costing - TDABC made easy." [Online]. Available: http://digitalcosting.com/.

[19] C. Development, "CMMI® for Development, Version 1.3 CMMI-DEV, V1.3," no. November, 2010.

[20] I. W. I. Org, *Enabling Processes*. 2012.

[21] "COBIT 5/CMMI Practices Pathway Tool." ISACA.

[22] J. Pries-Heje, R. L. Baskerville, and J. R. Venable, "Strategies for Design Science Research Evaluation," *Eur. Conf. Inf. Syst.*, vol. Paper 87, pp. 1–13, 2008.

[23] D. L. Moody and G. G. G. Shanks, "What Makes a Good Data Model? Evaluating the Quality of Entity Relationship Models," *Proc. the13th Int. Conf. Entity-relationsh. Approach*, pp. 94–110, 1994.

[24] H. Österle *et al.*, "Memorandum on design-oriented information systems research," *Eur. J. Inf. Syst.*, vol. 20, no. 1, pp. 7–10, 2011.

[25] Deloitte, "Cost transparency Helping finance create business value," 2016.