The Design of a Public Service Cost Model Tool to Evaluate Digital Transformation in Brazilian Government

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Abstract: Digital transformation plays a central role both in private and public sectors. In addition to increasing efficiency and practicality in service delivery, digitalization may generate economic savings for the agency provider and for the citizen user of the service. In this context, a central issue emerges: how to quantify economic savings in digitalization? The Brazilian federal government has been implementing many initiatives to promote digital government, and ways to measure the costs of a service are in constant development. One of these ways is through the use of a methodology adapted from the European standard cost model. The present paper aims to provide the design of a tool to estimate the costs of services both for the government and for the citizen, and for physical and digital delivering of a service, by applying a prototyping technique using the mentioned adapted methodology. We present the design and implementation of the tool. As future work, an analysis of the use of the tool in Brazil, how it impacts in the decision of digitalize a service and real economic savings may take place. Our main contribution is to provide a specification that can serve as a basis for similar tools, besides the idea of how to systematically apply a cost model using a tool which can be easily applied by other organizations without advanced knowledge in the area.

1 INTRODUCTION

The Brazilian federal government has been encouraging and investing resources in digital transformation of the federal public services. Digital transformation brings benefits such as lowering barriers to entry, reducing the possibility of fraud and reducing the time spent by users and the costs involved in interactions. These positive externalities can impact fundamental human values by the promotion of more sustainable and inclusive public services. Nevertheless, quantifying the potential cost savings depends on specific methodologies. In this context, two main initiatives were designed by the government: a Digital Citizenship Platform (Brasil, Presidência da República, 2016b), which aims to increase the access of Brazilian citizens to digital public services, and the Digital Transformation Program, called Transformation Kit, which was a set of six phases aiming to encompass the need for agencies and entities to promote digital transformations by analysing the perspective of the citizen user, as well as the view of companies. The Transformation Kit featured, among other tools and models, a methodology called Public Service Cost Model, developed by the Brazilian government's Ministry of Economy, based on an adaptation of the well-known European Standard Cost Model (SCM) (Network, 2005), for measuring administrative burdens. The model seeks to assess the impact of the public services transformation policy, estimating the costs to users (citizens or companies) and to the government agencies, both before and after the transformation of the service. Based on these cost analyses, it is possible to study specific impacts of the digitalization, differences of these impacts by types of services and to measure them. The task of measuring costs of a provided service is not trivial, but

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less trivial is the task of projecting costs of a digitalized service. The services that citizens and organizations consume have costs of different types: time, money, requirements to execute the service, among others. Therefore, understanding the costs is challenging, and it is very critical to have a more realistic view of strategic decision-making for digital transformation. Such analysis enables a better understanding of the service itself, through the identification of barriers and possible improvements, delivering a higher quality and possibly lower cost service to the citizens. The present work aims to present the design of a tool to estimate the costs of services before and after digital transformation by implementing an adaptation of the SCM. Such a tool is essential to provide information in order to support decision on whether to apply digital transformation to a service. The rest of this paper is organized as follows: in Section 2, we show a brief literature review, in Section 3 we present our methodology of research and development, in Section 4 we present the cost measurement model, in Section 5 we present the results, in Section 6 some discussion, and in Section 7, conclusion and future work.

2 LITERATURE REVIEW

2.1 Digital Government

With the new technologies, people create new expectations of how they can interact with institutions, in particular with governments, since many procedures and obligations can be fulfilled easily and efficiently using such technologies (OECD, 2014).

Therefore, the government needs to create new approaches to public governance, which may involve digitalization and less red tape and bureaucracy of services. This phenomenon is called e-government. E-government is "the simplified handling of information, communication and transaction processes for providing an administrative service through the use of information and communication technologies within and between authorities, and between authorities and private individuals or companies" (Becker et al., 2012).

This has three major focuses (Fang, 2002): E-government, which refers to the internal administrative, organizational and communicative activities of the government, E-commerce, which interfaces the government and the market, and E-citizens, which interfaces the government and the citizens, allowing the practical and efficient availability of services to the citizens.

Therefore, the concept of digital government reaches many scopes, which evinces the greatness and importance of a process of digital transformation in the government. Brazilian government is increasingly supporting the implementation of e-government by applying many initiatives to support digital transformation of services, which we address in the next section.

2.2 Digital Transformation

Digital transformation is "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019). Digital transformation in the public sector is one of the most trending fields of investigation, in which approximately one third of recently published works are acting (Kutzner et al., 2018).

To encourage the transformation of public services into digital ones, aiming to deliver them through digital media, the Brazilian government published some relevant decrees between 2014 and 2016, and we cite some of them along this section. The decrees defined the Policy of Digital Governance and the Digital Citizenship Platform, in the context of the Federal Public Administration (FPA), both under the responsibility of the Ministry of Planning, Budget, and Management (MP) (Brasil, Presidência da República, 2016b; Brasil, Presidência da República, 2016a).

The Digital Citizenship Platform configures a set of methodologies and solutions that aim to enlarge and to simplify the citizen access to services and to support the public agencies in the digital transformation of services. All the services provided are offered through the federal government services website[1]. Together with this website, a program of automation of public services was launched in order to support public agencies to identify, to prioritize, to digitalize, and to implement the services with improved quality and transparency to citizens.

2.3 The Costs of Services

In recent years, there has been considerable variation in the efforts of developing countries to reduce administrative burden (CA) (Torriti and Ikpe, 2015) and to estimate gains when transforming services (Charalabidis and Askounis, 2010). Government initiatives to reduce these costs tend to be associated with many business-related benefits, such as: minimizing direct and indirect regulation costs; facilitate the initial and

[1] https://www.gov.br.

operating costs of regulated companies; and track the impact of regulation after implementation (Matei and Matei, 2012).

According to Brazilian legislation, a public service is the "action of the federal public administration agencies and entities to meet the needs of the society related to the exercise of a right or the performance of a duty, both directly or indirectly", whereas a digital public service is a "public service whose deliver occur through digital medium" (Brasil, Presidência da República, 2016b).

The challenge of assigning a cost to a service is a very important task when the government need to decide if it is worth to transform a physical service to a digital one. Up to our knowledge, no formal method for this is available in the literature for the specific need of computing a cost of a public service.

Nevertheless, the very first strategy to attribute costs to a service emerged in 1905 and consists in the sum of the cost of three factors (Kaplan and Anderson, 2007): (i) labour, which includes the cost of employee and machines per unit of time, (ii) material, which includes all the cost to provide the necessary material to produce a product or to deliver a service, and (iii) overhead, which are all the secondary costs, such as energy, rent, transportation, among others. From this approach, three classical cost models to general public services arose: the Activity Based Costing (ABC), the Time-Driven Activity Based Costing (TDABC), and the Standard Cost Model (SCM), which we briefly describe in the next sections.

2.3.1 The ABC and TDABC Models

With the evolution of service provision, the sum of labour, material, and overhead as an estimation of a service cost became infeasible since a service provider does not provide a unique service or product anymore. In 1980s, a new pricing model arose: ABC (Activity Based Costing). To implement ABC, it is necessary to identify: (i) which activities are involved to provide a service or to produce a product, (ii) how many times each activity is performed, (iii) the service or product total cost by a unit of time, and (iv) the total time spent in each activity. With the service total cost and the total time spent in each activity, it is possible to compute the cost per activity. Nonetheless, this model was not well accepted, since it is not an easy task to build such a model (for example, to estimate the total time spent in each activity is a very difficult task when the process of production of service delivering is very complex).

To solve this complexity, the TDABC (Time-Driven Activity Based Costing) was proposed. This model consists in estimating a capacity cost rating, which is an estimate of how much an activity costs per unit of time given the total budget of a department (or company, or agency, among others) and the total time (in the same unit of time) that people in the department really work.

2.3.2 The Standard Cost Model

The Standard Cost Model (SCM) was created in the nineties in the Netherlands aiming to measure the reduction of administrative burdens for businesses. It uses a high level of details to measure administrative costs. By administrative costs, the SCM refers to two types of costs: (i) the costs of regulation, which refers to costs imposed by regulation on businesses (different types of regulation costs are depicted at Figure 1) and (ii) administrative burdens, that are part of administrative costs which comprises the activities that are conducted only because regulation requires it.

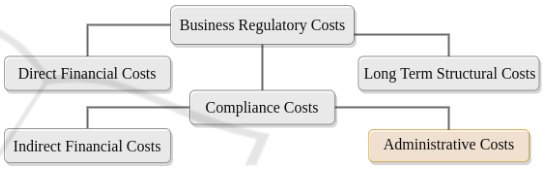

Figure 1: Different costs of regulation for businesses, adapted from (Network, 2005).

From the SCM it is possible to decompose regulations into measurable manageable components. The SCM has four main components: (i) the information obligations (IO) are the obligations to make information available to public sector or third parties due to regulation, (ii) the data requirements are the elements of information that must be provided, (iii) the administrative activities, which are the necessary activities to provide information of each data requirement, and (iv) the cost parameters, that are parameters to measure the costs of each administrative activity and consists of price, time, and quantity.

Each IO consists of one or more data requirements, which in turn are informational elements in agreement with the requesting IO. Is possible to provide information for each data requirement, and a series of administrative activities must be performed. These activities can be performed internally or outsourced. Putting all these elements together, we can state the main SCM formula: the cost per administrative activity is the product between price, time, and quantity. To compute the final cost, overhead costs must be also considered (such as acquisitions, energy, and other means that may be used).

The Brazilian government developed a model adapted from the SCM. The adapted model calculates

the potential impact of public service digital transformation projects. It provides an understanding of the costs of users (citizens or companies) generated by interactions (user journey) with the public administration and the internal costs of the public entity responsible for providing the services. It also incorporates the estimated investment required for digital transformation. Details on this model are given in Section 4.

3 RESEARCH DESIGN AND METHODS

The techniques used for the design of the proposed estimating cost tool involves prototyping and the diagnostic phase of action research (Petersen et al., 2014).

The diagnostic phase was used to selection of the study object and its characterization, identifying the main problems and needs of the organization that lead to the construction of a service pricing tool.

The diagnostic stage involved the collaborative analysis between the research team and project stakeholders, which aimed to understand the organization's needs in relation to automated support to measure service costs.

With the Diagnosis phase, it was possible to define a set of modules that the tool will encompass and, with that, define the interaction cycles for eliciting requirements. The identified modules were:

- Cost for service users;
- Cost to the agency;
- Investment cost;
- Indicators and Dashboards; and
- Service management.

After the diagnosis, prototyping steps were performed (Functional selection, Construction and Evaluation, in cycles.) The Prototyping was the main technique as a well-defined phase in the process of production of a model that can show all the essential characteristics of a final product (Floyd, 1984). This model can be used both as a sample or a guide for future production. The idea is that the developed prototype in this work may give room to produce the tool itself in a future work.

The prototyping strategy consists of "[...] elicitation of requirements in which user needs are extracted, presented and refined successively, constructing a functional model of the final system quickly and in its working context" (Bischofberger and Pomberger, 2012).

We adopted an exploratory prototyping, which encourages improvements to the initial phases of requirements and functional analysis (Floyd, 1984), while the steps followed were functional selection, construction, and evaluation, employing the use of horizontal prototyping.

The steps were executed in interactive cycles involving the prototyping team and the interested part. In these cycles, a prototype was built, evaluated and refined, producing an initial version in the beginning of the process, until one that satisfied the needs of the interested part. Figure 2 represents the described prototyping strategy that we are considering in the present paper.

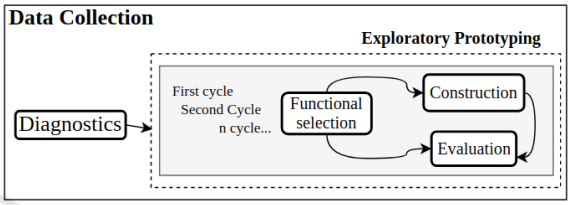

Figure 2: Exploratory Prototyping Steps for The Data Collection.

The requirements elicitation is divided into phases, in which we consider prototyping cycles that enable a feedback communication tool and that show the technical feasibility of a software. For this, we employ an applied, qualitative, and descriptive research, and making use of informal interviews and meetings.

In 12 meetings with the interested part, it was possible to complete 11 prototyping cycles. Functional selection was performed at the first meeting of the cycle, while construction took place in the space reserved until the next meeting, when the validation for the closure of the cycle and functional selection for the opening of the next cycle occurred.

The first prototype elaborated was non-functional, containing the explicit functionalities to align the overall view of the involved ones. In the second cycle, the prototype evolved into functional.

The first interview was carried out in order to accomplish the Functional Selection so that, afterwards, a cycle per interview was carried out. From the second interview, the prototype built so far was presented, then evaluated, and new features were selected.

The prototype was built and validated in an interview, then the necessary changes were made to be taken to the next meeting. From the analyzes made, questions and identification of new needs arose, the analysis emerged questions and identification of new needs, which led to the need for changes and new

functional selections. From the construction and analysis of a new prototype, a cycle was closed and a new one started.

In the first cycle, an overview of the system and the first in-depth module was established: Cost for service users. About 4 other cycles focused on the Cost module for service users, and 2 cycles for Cost for the agency. The investment cost required 1 cycle, the same amount as Indicators and Dashboards and Service Management. Finally, the remaining cycle was dedicated to the refinement of parts of the systems not provided for in the modules, such as login and usability.

The number of cycles for each module is not accurate due to the partner's reflections after the interview, which led to suggestions for changing to modules considered completed. Therefore, two or more modules were specified in parallel during some cycles, something already expected according to the applied technique. The greater the number of inconsistencies or problems identified during prototyping, the less effort will be expended in maintaining the system after its development.

At the end of the interactions, schemes and equations of the tool were elaborated. Along with the prototype, the generated artifacts enabled the definition of business rules, functional requirements and the use case diagram of the proposed system.

4 THE PUBLIC SERVICE COST MODEL

In order to measure the cost of a service, the Brazilian government employed an adaptation of the SCM, called Public Service Cost Model, which consists in estimating three expenses: (i) the cost for the citizen to use the service, before and after the digital transformation (ii) the cost for the service manager to deliver the service, before and after the digital transformation and (iii) the investment to carry out the digital transformation.

Bearing in mind that the transformation of services is focused on the citizen, it's essential to measure the cost of the service to the citizen. This implies discovering all the activities that a citizen must perform to complete a given service, the target audience of the service, the time spent to perform each activity necessary to conclude the service and the annual number of requests for the service.

To estimate the costs to the citizen, it is considered that each service is composed of activities that must be performed. Then, the estimation consists in evaluating two costs:

- The *time cost* (TC), which is $T \times Q \times R_m$, where
  - T is the time required to perform each activity of the service,
  - Q is the total amount of users that need to use the service along a period (a year, for example). This is just the product of the average frequency that one user demands the service during the considered period, and the total amount of users that require the service, and
  - R_m is the value given for each unity of time. In the model, it is considered the average wage income of a citizen per hour.
- The *monetary cost* (MC), which is $C \times Q$, where Q stands for the same in *time cost* and C is the estimated cost of an activity of the service.

A remark on the activity cost estimation of a service is in order. Although this is a subjective issue and depends on the interpretation of the service manager on how a service is performed, to define a minimum scope, a service might be composed by four major steps: (i) *to search for service information*, the step in which the citizen understand how to use the service and which are the mandatory documents or requirements, (ii) *to collect and prepare the documents*, the step in which the citizen search for, prepare and organize all the requirements to apply to the service, (iii) *to require the service and deliver the documents*, the step in which the citizen formally require the service and delivers all the documents and requirements to achieve the goal aimed when performing the service, and (iv) *to receive the service*, the step in which the results of the service are delivered to the citizen.

For example, suppose a citizen applying to obtain a driver's license. In step (i), the citizen first searches for all the requirements to obtain the license. For this, the citizen may search on the web and even go to a driving school to obtain further information. In step (ii), the citizen try to meet all the requirements he or she discovered in step (i), collecting all the documents generated when meeting the requirements. In step (iii), the citizen formally requests the service and delivers all of the documents to the agency responsible to issue the driver's license. Finally, in step (iv), the citizen receive the driver's license or, if some requirements are still missing, receives a communication of the fact. For this, the citizen may need to go to the agency that issues the driver license, or the license will be delivered by post.

The journey of the service user, as exemplified above, generates a series of interaction costs that can have quite different values if face-to-face activities are required or if it is possible to perform them digitally. To measure the difference between the two ways of

obtaining the service, the Brazilian government uses an Excel spreadsheet as a support tool where, once the necessary parameters have been raised, the total cost of the service for the citizen is calculated. A view on this spreadsheet is depicted in Figure 3. As the tool is not specific to this context, a spreadsheet is used for each federal public agency, and the cost in time of gathering information and making comparisons is high. The correlation with ABC and SCM is clear on this point: the models require interviews whose analysis is complex due to the high number of data collected.

Raising the necessary parameters involved in the measurement is one of the biggest challenges. Currently, the service manager is not the responsible for this task, but it's recommended for them to be able to do this, understanding all the necessary information required and that verification of errors are not supported when computing costs from the given parameters.

The other part of the measurement consists in measuring the costs to the service provider, in two senses: (i) the cost to deliver the service before and after the digital transformation and (ii) the cost to perform the digital transformation of the service.

To measure the cost to deliver a service, some points are essential to be analyzed.

- the *personnel cost*, considering all the labor cost necessary to deliver the service,
- the *physical space cost*.
- the *supplies cost*, measuring all the spent supplies during the service delivery process, such as paper,
- the *infrastructure and information technology cost*, that every segment nowadays demands investments with computers, enterprise resource planning systems, and websites,
- the *training cost*, employed to empower the staff, and
- the *maintenance cost*.

Notice that all these costs may be potentially reduced with digital transformation. On the other hand, the investment necessary to perform the digital transformation consists in the total cost with analysis, technology and specialized team to transform the service.

Measuring services cost has two main purposes: comparison and prioritization.

- Comparison: the cost for the citizen to carry out a non-digitized service can be compared with the cost of the same service when it is digital, bringing savings information that assists in strategic decision making.
- Prioritization: with the cost analysis of several services in the same federal unit, it will be able to prioritize which service to type first.

The following are the activities that are taken into account when the service is priced.

- Identification and understanding of requirements and changes; supplier identification
- Generation, preparation (calculation) and verification information according to the procedure
- Internal meetings between employees involved in the compliance process
- Preparation and presentation of reports; filling and sending forms
- Meetings, tests, inspections, external agents, public or private, waiting times and time dedicated to making payments
- Mobilization of virtual applications for public or private offices, waiting times and time dedicated to making payments
- Copy, distribute and report files
- Receiving and understanding information, requests and responses
- Meetings, tests, inspections, external agents, public or private (lawyers, auditors, inspectors, etc.)
- Copy and distribute file information
- Receive and understand information, requests, and information answers
- Fees
- Other costs
- Substantive costs
- The costs of waiting for responses (opportunity cost)

To better understand the proposed strategy of cost estimation, let us consider as example a service of receiving a research grant at a public Brazilian university. We consider that 2,500 users require this service per year. Recalling that we intend to estimate costs for the user, costs for the service manager and investment costs, let us start from the costs estimation for the user. We first identify the activities into the four steps previously cited. We consider

1. to search for service information through (a) the web, (b) the university campus, and (c) telephone;
2. to collect and prepare documents we consider (a) collecting documents and (b) filling out forms;
3. to require the service and deliver documents through (a) the university campus, (b) internet, and (c) telephone/fax;

Table of Public Service User's Cost													
Agency:													
SERVICE:													
Service's Legal Framework:													
Activities description			T	C	F	N	Q	RM	Cost for the citizen				
									Time	Monetary Cost	Total		
Required Citizen Activities	Activity description	Channel	Time it takes (hour)	Activity cost (R$)	Frequency which the activity has to be performed per year	No. of citizens who used the service	Quantity = F*N	Avarage income (IBGE / Mtur) (R$/hora)	Time cost CT = T*Q*RM (R$)	CM = C*Q (R$)	Total Cost to all citizens VT = CT+CM (R$)	Cost per citizen CC = VT/N (R$)	
1ª	INFORMATION SEARCH												
Service							-	R$0,00	R$ -	R$ -	R$ -	R$ -	
Step	Total - Information Search										R$ -	R$ -	
2ª	COLLECTION AND PREPARATION OF DOCUMENTS												
Service								0,00	R$ -	R$ -	R$ -	R$ -	
Step	Total - Collection and preparation of documents										R$ -	R$ -	
3º	DOCUMENT DELIVERY												
Service								R$0,00	R$ -	R$ -	R$ -	R$ -	
Step	Total - Document Delivery										R$ -	R$ -	
4º	DOCUMENT WITHDRAWAL												
Service								R$0,00	R$ -	R$ -	R$ -	R$ -	
Step	Total - Document withdrawal										R$ -	R$ -	
	Total										R$ -	R$ -	

Figure 3: A view of the currently in use spreadsheet to estimate the costs to the citizen.

4. to receive the service (a) in the university campus, (b) through e-mail, and (c) through telephone/fax.

For each activity, we estimate: (i) how much time (in hours) an activity requires (T), (ii) the cost (in BRL, C), and (iii) the amount of users that perform the step using the activity (Q). The value for each unity of time considered is 18.75 BRL, that in our case represents the hourly wage of the professional allocated to perform the task for the user. The estimation of pre and post-transformation costs, according to the Brazilian Ministry of Economy, are detailed in Tables 1 and 2. The total cost for the user is 479,155.31 BRL before and 381,943.28 BRL after digital transformation. Therefore, in this case, digital transformation may cause a savings of 97,212.03 BRL, approximately 20%. As can be seen from tables 1 and 2, the costs of the second step have hardly changed. For this particular transformation, it would be necessary to discuss whether the service itself could offer simplification of the amount of documents required. But this is something that service managers must do. The cost model also helps in the perception of the possibilities for improving the service.

The other two estimations are simple and we will omit the examples. Nonetheless, values adopted are always obtained from reliable databases that compute average values in Brazil.

5 RESULTS

The requirements elicitation led to a set of modules that compose the tool. The modules identified were (i) costs to users, (ii) costs to agency, (iii) investment costs, (iv) dashboards and indicators, and (v) services management.

Besides the modules, we identified three important groups for the tool concept: the service, the users and the government agency. The service concerns data, steps, and activities. Data characterizes the service, and is composed by information such as name, responsible agency, coverage, goals, target audience, average demand, and legal information). Steps and activities are closely related and refer to the steps and activities the citizen may execute to complete the service. The users may be citizens, the service manager, and the administrator, who manages all the tool and information. Finally, the government agency is the responsible to deliver the service.

To predict costs, we consider that a service has three classes of costs: the costs for the citizen, the costs for the agency and the investment costs. The costs for the citizen are composed by the sum of the costs of the steps, which in turn is composed by the costs of their activities. To compute the cost of one activity, we consider the number of users that request the service in one year, the average time for the execution of the activity, the average income of the users of the service per hour and the monetary cost of the activity.

The costs for the agency take into account the human resources cost, the real estate cost, and the infrastructure and technology cost. The investment cost, in turn, considers the people allocated to digitalize the service and their average wage, and the average time expected to complete the digitalization. An additional cost may also be considered to cover unexpected costs. An scheme summary is depicted in Fig-

Table 1: Costs to user before digital transformation. The steps as well as the meaning of each column are in accordance with the model presented in Section 4.

Step	Act.	T	C	Q	$TC\ (T \times C \times R_m)$	$MC\ (C \times Q)$	Total
1	a	0.25	0.00	750	3,515.63	0.00	3,515.63
	b	1.925	12.64	1,000	36,093.75	12,640.00	48,733.75
	c	0.25	0.00	750	3,515.63	0.00	3,515.63
2	a	6	4.00	2,500	281,250.00	10,000.00	291,250.00
	b	1.925	0.00	2,500	30,937.50	0.00	30,937.50
3	a	1.925	12.64	1,250	45,117.19	15,800.00	60,917.19
	b	0.75	0.00	500	7,031.25	0.00	7,031.25
	c	0.191	0.00	750	2,685.94	0.00	2,685.94
4	a	1.925	12.64	500	18,046.88	6,320.00	24,366.88
	b	0.15	0.00	1,250	3,515.63	0.00	3,515.63
	c	0.191	0.00	750	2,685.94	0.00	2,685.94

Table 2: Costs to user after digital transformation. The steps as well as the meaning of each column are in accordance with the model presented in Section 4.

Step	Act.	T	C	Q	$TC\ (T \times C \times R_m)$	$MC\ (C \times Q)$	Total
1	a	0.15	0.00	1,750	4,921.88	0.00	4,921.88
	b	1.925	12.64	250	9,023.44	3,160.00	12,183.44
	c	0.191	0.00	500	1,790.63	0.00	1,790.63
2	a	6	4.00	2,500	281,250.00	10,000.00	291,250.00
	b	0.5	0.00	2,500	23,437.50	0.00	23,437.50
3	a	1.925	12.64	250	9,023.44	3,160.00	12,183.44
	b	0.5	0.00	1,625	15,234.38	0.00	15,234.38
	c	0.191	0.00	625	2,238.28	0.00	2,238.28
4	a	1.925	12.64	250	9,023.44	3,160.00	12,183.44
	b	0.15	0.00	2,000	5,625.00	0.00	5,625.00
	c	0.191	0.00	250	895.31	0.00	895.31

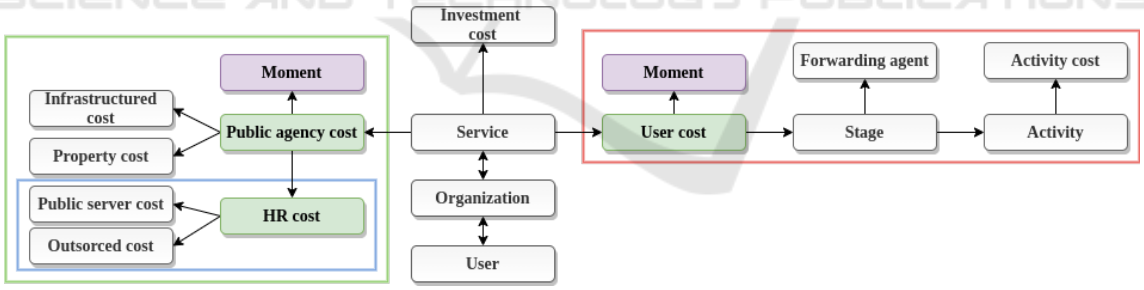

Figure 4: Scheme that represents the relevant structures for the application of the investment cost.

ure 4.

Figure 5 shows the service relationships to the investment cost. Pre-transformation and post-transformation have the same structure, with their respective services that have data, stages and activities. Each service can have n stages, which, in turn, may contain m activities that represent the steps that must be followed to perform a stage.

After digital transformation, these stages and activities may potentially change itself in form and number. Each activity considers citizen's actions that involve time or monetary costs, such as displacement, waiting (queues, response time), searching for information about a service, payments, among others, and therefore, costs are attributed to activities. With these costs at hand, pre-transformation and post-transformation costs are given as the sum of the activities' costs that compose each stage of the service.

The tool was implemented using a client-server architecture. With such architecture, all the services the tool offers can be accessed easily by any other interested and authorized part via application programming interfaces (APIs). The architecture, as well as technologies used in implementation, are shown in

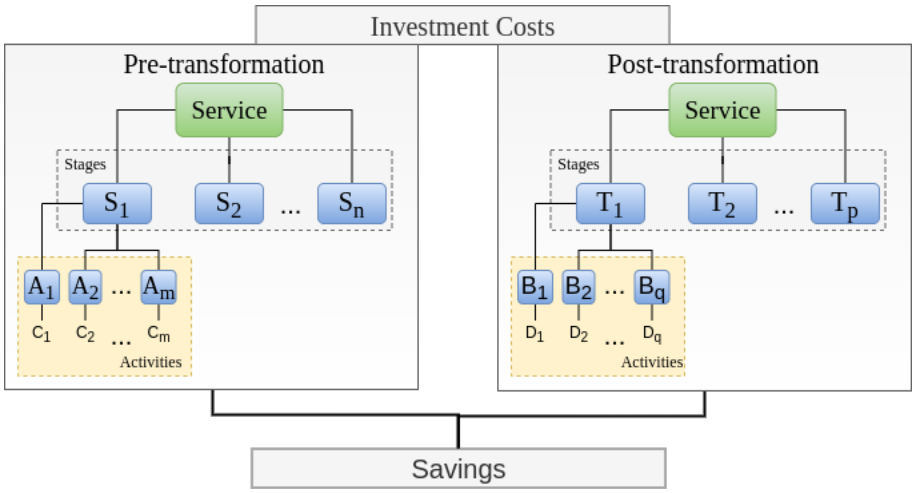

Figure 5: Scheme of pre- and post-transformation of service.

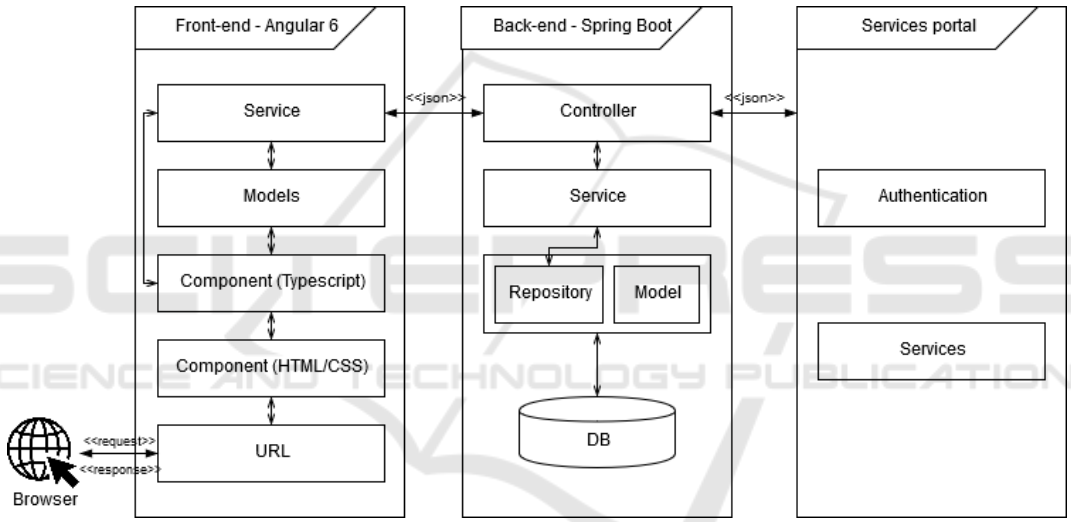

Figure 6: Client-server architecture of the cost model tool.

Figure 6. The interface of the tool consists in registering the services, their execution stages and respective activities of each stage.

Preliminary analysis by the government shows that there are more than 2,000 potential services for digital transformation in the Brazilian government currently. The Ministry of Economy observed, in the first half of 2019, in a set of 316 digital services, which for each BRL 1 invested in the process of digital transformation of services, an annual financial feedback of about BRL 12.19 is obtained by the government, with 30 days return on investment. Furthermore, bureaucracy was reduced by a time saving of 59,891 hours annually.

Currently, the tool is being connected to LimeSurvey[2] to compute costs based on answers provided in the surveys. Such connection makes the tool more accessible and easier-to-use. Furthermore, available data on these surveys will enable the automated computation of costs of more than 1,000 services.

6 DISCUSSION AND IMPLICATIONS

In order to decide if a service may be digitalized or not, many factors may be considered, but there is no doubt that cost analysis is one of the most important steps in the digital transformation process. Therefore,

[2]LimeSurvey (https://www.limesurvey.org) is a free and open software to publish on-line surveys and, from these, collect responses, generate statistics, and export data to other applications.

a tool to predict costs of a service is extremely relevant in this context.

Some cost models can be found in the literature, such as ABC, TDABC, and SCM. But these are theoretical frameworks that have no easy and systematic application in practice but requires a deep study of each service to develop a cost model. In the present paper, we propose a tool that, although based on an adaptation of the SCM, provide a systematic application of a cost model, by which one can predict the cost of a service without major difficulties and even without previous knowledge of a cost model such as the SCM. The connection with LimeSurvey, that is being developed, represents a higher level of abstraction, which makes it even easier to apply the tool.

There are many public services offered by the Brazilian government and coordinated by several service managers in various locations in Brazil. Managers are the ones who know about the service requirements, and who are able to provide the information needed to fulfill a cost model. However, completing a cost model demands some effort. In order to facilitate the cost measurement of a service, a form was created in LimeSurvey. This form is able to abstract the model to simple questions that, through treatments and calculations, are able to fill the cost model, so that managers can answer the form without a previous study about the model used. These calculations take into account the responses of the form and the constant terms that have been studied and created through valid references in Brazil.

With the automation of cost prediction, service managers can focus in providing the service itself and afterwards be aware of the economic savings digitalization may bring to the citizens and to their organizations.

The impacts of these savings for both the government and the population are very relevant. On the one hand, the government can better reallocate its resources and apply them to other areas, such as education and health, which may improve a lot the population's quality of life. On the other hand, the ease of access to execute essential services by the population changes the commonly bureaucratic relation between the citizen and the government. This means that, besides the economic and time savings, the citizen satisfaction may change positively with such actions.

Regarding the tool proposed in this work, it is important to note that it seeks to adapt to different contexts of digital transformation, but defining a scope proposing steps and activities. Over the years, it is known that the way the population interacts with its government can change a lot, requiring the inclusion of new stages and/or activities, in addition to modifying some constants used for the calculations. Updating the constants is also supported by the tool, ensuring the tool's survival and usefulness over the years of use, in one or more application contexts.

7 CONCLUSION AND FUTURE WORK

In this paper, we provide the design of a tool to estimate the cost of public services both for government and citizens. The aim of this tool, in the context of digital transformation, to support the decision on whether the transformation of a service is worthwhile. Using a prototyping strategy strongly supported by a requirements elicitation process, we propose the development of a tool that is based on the classical SCM.

Our main contribution consists in providing a tool that can estimate costs just based on predefined information that any service manager can supply, such as personnel cost, physical space cost, supply cost, among others (see Section 4), while classic cost measuring models may require knowledge in specific techniques of measuring costs itself. The Ministry of Economy seeks to facilitate data collection to measure the costs of services to be digitally transformed by the Brazilian Government.

The tool presented in this article has brought this facility and may generate measurable results in the coming years. As future research, analysis of these results is in order, besides further investigations of ways that may facilitate the use of the cost model tool as well as comparison with state-of-the-art tools and prototypes used in costs evaluation presented in the literature.

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