Desigining Public Service Process Models for Understandability

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Abstract: This paper discusses the use of process models as an instrument to promote transparency and communication between public organizations and their clients (citizens). It depicts a way to design public services process models aiming at increasing their understandability. The design is based on a catalogue containing characteristics, operationalizations and mechanisms for designing understandability on public service process models. The use of the catalogue by process analysts and the level of understandability acquired by the generated models were evaluated through case studies at a public educational organization. The results show that the proposed catalogue is applicable - process analysts were able to apply it in a reasonable time - and that more simple process models can be obtained, adequate for process explanation for citizens/users.

Keywords: understandability, desigining public service, organizational transparency, electronic government and democracy

1 Introduction

Organizations have been charged for their ability to provide transparency regarding their performance, management and outcomes. Such ability is deemed as a step ahead towards offering good quality services to their clients/citizens. Different laws and treaties have been signed demonstrating the intention both from the public and the private sectors to obtain transparency, such as Sarbanes-Oxley (2002), BASEL - Basel Committee on Banking Supervision (1988), EITI – Extractive Industries Transparency Initiative (2002) and the Open Government Partnership – OGP (2014). In Brazil, the Transparency Law (Brazil, 2009) and the Access Law (Brazil, 2011) have been enacted, guiding public organizations toward publishing information for citizen use through their web portals. Additionally, the Service Portfolio for Citizens (Brazil, 2011a) has rendered mandatory for Brazilian public institutions providing services to the population to present detailed information about each service provided.

One implication of this movement towards organizational transparency is that it can be seen as an important step to widen democracy and citizen participation in public matters (Harrison et al., 2011) (Diirr, Araujo and Cappelli, 2009) (Fung, Graham, and Weil, 2007). Organizational transparency can be seen as the basis for democratic information access, social participation and dialogue between public organizations and citizens, giving ground to innovative approaches to support this dialogue (Niehaves and Malsch, 2009) (Candielli, Albarelli and Cortesi, 2010) (Harrison et al., 2011).

Organizations have been interested in self-understanding in order to improve efficiency and to better manage their processes. To address this challenge, they have invested in Business Process Management (BPM) approaches (Smith and Fingar, 2006). To implement BPM, organizations must build models representing their business process operations (Sharp and Mcdermott, 2010) (Dumas et al, 2013). These models are artifacts for defining, analyzing, implementing and managing organizational processes (Barjis, 2008). Business process models comprise important instruments for communicating information about organizational processes among those responsible for process management and operation (managers and actors) as well as those who consume their outcomes (clients) (Melcher et al, 2009) (Ferreira, Araujo and Baião, 2010). This work argues that business process models can be used to promote organizational transparency about public service processes. However, the simple presentation of a process model to the public may result ineffective. Process models are technical artifacts, which may not be easily understood by common citizens. Therefore, the research questions addressed in this paper are meant to: i) explore a way of using public services process models as an artifact to provide organizational transparency; ii) elaborate on the knowledge and a method to design process model descriptions that can be understandable by citizens starting from internal organizational business process models; iii) evaluate the feasibility of running the design method and; iv) obtain preliminary results on the level of understandability of the process models obtained using the method.

This paper presents the definition, organization and detailing of characteristics which can be applied in designing public service process models understandable by citizens. Process models built by organizations

through their BPM initiatives can be designed into new presentations to promote citizen understanding about their operations. The proposed solution relies on the concept of organizational transparency (Leite and Cappelli, 2010) wherein transparency is defined as a set of aspects suggesting the existence of policies allowing for providing information according to general characteristics of access, use, presentation, understanding and auditability. Following this concept, organizational transparency is only achieved when information is provided in a high-quality level, which means it is understandable and available for customer use and accountability.

Design of organizational process models for public understandability is suggested to achieve process information understanding and, consequently, its transparency. Design means the inception, elaboration and specification of an artifact (Logman, 2008), and it is performed based on the designers' experience and rationale, and on a set of quality attributes for the artifact being designed. In the software design domain area, the body of design knowledge encompassing the set of quality attributes which can be used to design an artifact is usually organized as catalogues (Chung et al, 2000). The proposed solution follows this approach and comprises the definition of a catalogue of understandability characteristics for the design of process models to the organization's external environment. Guidelines for supporting the designer – process analyst – in applying the catalogue are also proposed. Case studies have shown that process analysts with basic experience in process modeling do not face difficulties in applying the design process. Studies also show that catalogue content was sufficient to modify the organizational process model into a new model following catalogue instructions. However, it has not been possible yet to find enough evidence that the resulting process model is completely understandable by the target audience.

The paper is organized as follows. Section 2 discusses the potential of Business Process Management artefacts to provide process transparency in the context of Electronic Government and Democracy. Section 3 details the structure of a catalogue of understandability attributes for designing public service process models. Section 4 describes the results of case studies and Section 8 concludes the paper.

2 Background

Electronic Government and Democracy comprises the virtual interaction between government and citizens (Egger, 2005) (CeDEM 2014). One of the main objectives of these research areas is to improve public service quality, along with the possibility of empowering citizens in public matters and providing ways to help citizens interact, using tools usually known as social software – e.g.: wikis, blogs, social bookmarking (Hague, 1999) (Oates, 2008) (Shirky, 1998). The initiatives allow for the opportunity of creating new processes and new relationships among the rulers and the ruled, of opening the government to citizens, helping them expose their work, information and services, and of discovering new communication channels (W3C, 2009)(Macintosh, 2004)(CeDEM 2014) (EGov 2013).

The literature shows different models to describe and classify citizen participation levels in public contexts. Citizen participation is often classified in an increasing scale, where, at each level of this scale, citizens are empowered in their possibilities for participation, discussion and decision-making in government processes and issues. Through this scale, different relationships between government and citizens can be configured, wherein, at the lower levels, government and citizens bear very distinct responsibilities and roles, and at the higher levels, roles and responsibilities are mixed and interchanged. It is argued that initiatives to provide interaction between government and citizens should start with practices and tools providing basic levels of participation, continuously improved to higher levels in this scale. Silva (2005:121), by analysing the use of the Internet by the governments of the main Brazilian cities, classified the initiatives found in the study into the following participation levels: 1) information and service provision - the interaction between government and citizens is mainly one-way: government provides information to be consumed and renders services more efficient; 2) public opinion gathering - it is still mainly a one-way interaction, in which the governments do not establish a full dialogue with the civil sphere; instead, it just collects opinions on a given subject; 3) accountability and transparency - citizens are empowered with more political responsibility and control over government decisions through the provision of information about performance and results; 4) deliberative democracy - decisions are made after discussions and mutual understanding between government and representatives from the civil sphere; 5) direct democracy – decision-making can be performed with the direct citizen participation.

The present work focuses on the first of these levels - where government is the service provider and citizens their clients/consumers. Citizens act as service quality gauge where citizen satisfaction with the services impacts the community's existing participation motivation and culture. It is important to explain that this paper uses the term ´public service´ meaning the set of activities performed by a public organization in order

to directly deliver a product or service to citizens, in any domain – health, education, administration, social service etc. Public service provision is herein considered as a user-oriented activity, wherein information about the service and its use must be provided.

Rendering service provision processes transparent might be a step toward expand democracy and citizen participation in public affairs (Diirr, Araujo and Cappelli, 2011)(Diirr, Araujo and Cappelli, 2009). Citizens will be willing to participate in process improvement if information about this process can be provided, especially on how the process is performed, what the rules restricting it are, what documentation and information is needed etc.

Organizing and making this information available is not an easy task and, very often, organizations limit themselves to describing to their clients what services are provided and what citizens must do in order to have these services. Information about how the process is performed internally within the organization, its costs and complexity, its needs to follow specific regulations, are usually omitted. This information, although not directly mandatory for having a service provided, helps educate and show process complexity to service users, opening up opportunities for dialogue.

Besides the need for service transparency, public and private organizations have addressed the management of their processes in order to be featured in their market areas and/or improve productivity and quality (Smith and Fingar, 2006)(Becker, Kugeler and Rosemann, 2003)(Tregear and Jenkins, 2007)(Aguilar-Saven, 2004). Business process management is considered an important approach in organizations, helping with the tracking, data generation and performance measurement operational processes review to improve their efficiency. Business process management comprises a set of methods conceived to help organizations in modeling and managing their business, in addition to allowing for the performing of a continuous improvement process lifecycle entailing the following:

- Planning: comprises the understanding of the internal and external organizational environments, especially concerning the organizational business strategy. Key processes are identified, as well as their weaknesses and opportunities. Processes are prioritized and the tasks needed for their implementation are described.
- Modeling and improvement: information about the current process (as-is) is obtained and proposals for process change (to-be) are described. Process models and their associated documentation are generated.
- Process execution: new processes are deployed and performed in the organization. The effects of the new process, including positive and negative impacts, are observed.
- Process control and data analysis: managers can make decisions based on process behaviour, observing whether outcomes are kept as expected or whether deviations can be observed and addressed.

Processes can be defined as a set of interrelated activities, performed in response to an event, aiming at achieving a specific result for one or more clients (Sharp and Mcdermott, 2010). Activities are well-characterized work steps, which consume/generate work products (data, documents etc), performed by different actors according to a set of rules defining the order of activity performance and under which conditions these can be carried out (Eriksson, Penker, 2000). All this information - activities, rules, data, actors etc - encompass organization process models (Dumas et al, 2013).

Process models comprise the main result of the process modeling and improvement activity. These models help the organization in building a structured view of their processes, which can be used as a reference for management purposes. Different process views can be created, focusing on the different aspects – activity flow, information flow, business objectives etc - of an organization's complex reality (Eriksson, Penker, 2000) (Sharp and Mcdermott, 2010). Process models are used as an instrument to communicate organization operation and discuss improvements and innovations (Melcher et al, 2009) (Aguilar-Saven, 2004) (Ferreira, Araujo, Baião, 2010). Figure 1 depicts one example of a business process model.

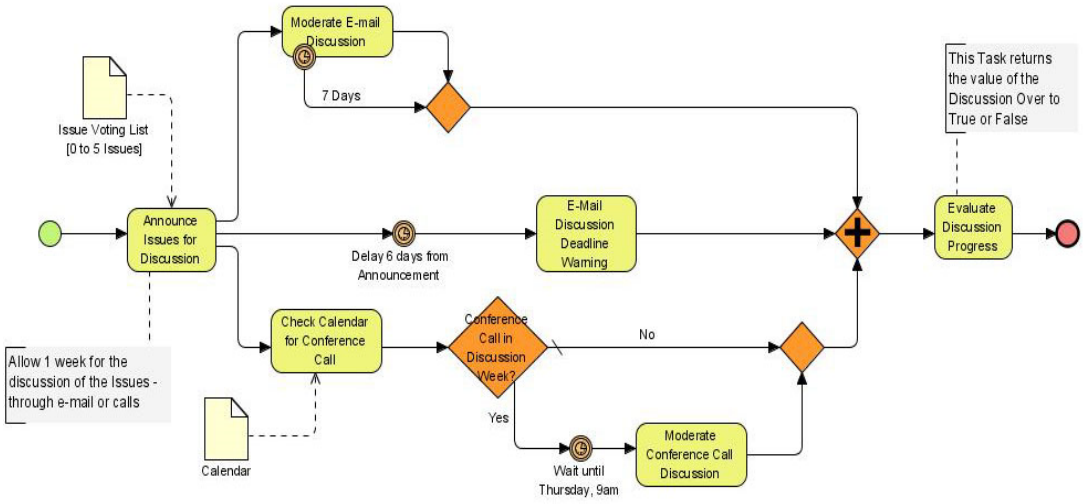

Figure 1 Example of business process model

Business process models have been used as communication artifacts within organizations. For instance, a process analyst can communicate to IT professionals how the organization performs its business in order to secure information system requirements; also, process models can be used as organizational training material. Research work discusses and proposes alternatives for improving process model understandability, especially concerning their use as internal communication artifacts (Ferreira, Araujo, Baiao, 2010) (Chaitin, 2006) (Recker and Dreiling, 2007)(Mendling Reijers and Cardoso, 2007) (Mendling and Strembeck, 2008).

Considering the business process management initiatives within public organizations, it is argued that organizations can use the process models obtained through these initiatives as a communication artifact for citizens about the manner how services are provided. However, just bringing process models to the external environment light would not be effective if we consider that process models may not be easily understood by citizens. Transparency is not only achieved just by providing information; also, the information must be easy to understand. (Fung, Graham and Weil, 2007) (Leite and Cappelli, 2010).

At a first glance, business process models are difficult to be understood by citizens, due to their technical purpose and language. Business models are internal documents, directed to technical reading and described using specific notations. Citizens may be not interested in technical details about the process, but rather in understanding their objectives, rules and information flow. The issue is, then, how to publish process model information to ensure citizens' understanding.

Research works (Niehaves and Malsch, 2009) (Candiello, Albarelli and Cortesi, 2010) argue that new process management methods should be defined in order to cope with the dialogue between citizens and government. This work is aligned with this argument, adding the idea that, by being provided transparency on service provision, citizens become better informed and the number of ungrounded complaints about the service may decrease, since users become aware of the complexity and effort that the organization must cope with. By learning the process, citizens can be more knowledgeable and motivated to discuss improvements and changes to the process (Chaitin, 2006), rising participation and democracy.

3 Designing public service process models for transparency

The present work addresses the issue of presenting process models to people who usually do not purport technical skills about business process modeling languages and notations, and who are, overall, not aware of the organizational business domain. Converting a process model into a model to promote public understanding can be faced as a design task. To design means to configure and elaborate on the characteristics of an artifact, so as to make it suitable for specific use. It is both a technical and creative process, usually oriented to the need or objective of solving a specific problem. The design for better public service provision process model understandability comprises the specification and construction of a new process model, based on the exiting business process model as a result of the business process management cycle. The design will be guided by the organization's communication objectives, business domain and characteristics.

Design work starts from the assumption that process models built for internal purposes can be used and transformed into models which will be understood by citizens (external environment) in general (Figure 2).

This activity does not comprise process reengineering or optimization, as expected by Business Process Reengineering (BPR) or Business Process Optimization (BPO) initiatives. It just aims to change model representation and information provided about the process so as to render these more understandable to users. It also relies on the existence of defined characteristics sought to be designed in this artifact, and on the definition of the main steps for its application. Therefore, a catalogue of understandability characteristics for process models and the overall steps for a design process using this catalogue have been proposed herein.

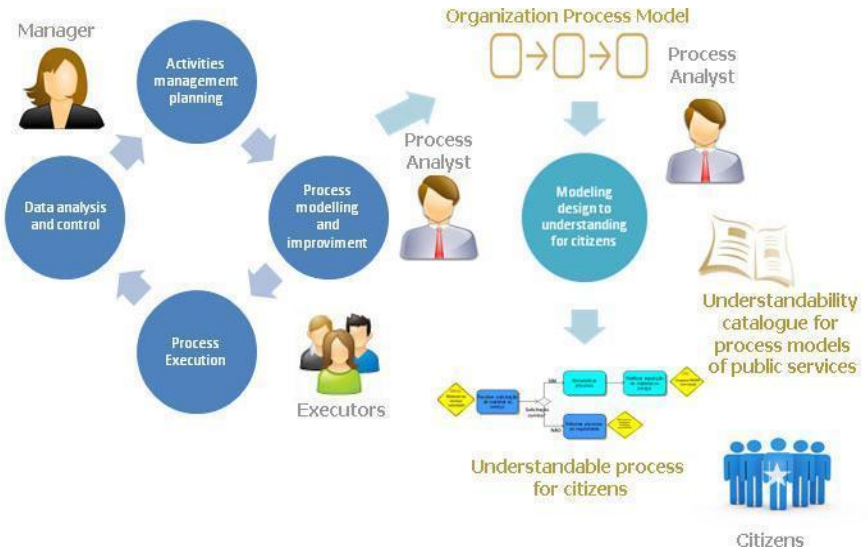

Figure 2 - Overview of the business process model design approach for understandability

3.1 Catalogue of Understandability Attributes for Public Service Process Models

Designing an artifact is a creative activity requiring intense use of knowledge. It includes the balance of both functional and quality (non-functional) requirements to build an adequate product to a group of users. As a knowledge activity, it is expected that the knowledge generated during the design process of an artifact could be reused in the design of similar artifacts.

The Software Engineering area has developed approaches to structure knowledge which can be used to design non-functional requirements in software artifacts. For instance, the NFR (Non-Functional Requirements) Framework proposed by Chung (Chung et al, 2000) defines a systematic way to break down quality characteristics for software systems, how to give them priorities, how to implement them, and how to balance their impacts and their mutual interdependence in the artifact under design. NFR-frameworks can be built for different quality requirements - usability, efficiency, security, performance etc. - being mainly composed of three elements: i) NFR - softgoals - the expected quality objective; ii) soft-goal operationalization - orientations about how the soft-goal can be implemented in the artifact; and iii) contributions - relationships among soft-goals and between soft-goals and their possible operationalizations.

The NFR-Framework elements are organized in a structure called Soft-goal Interdependency Graph (SIG). SIGs allow for relationship visualization among elements. Soft-goals can be related according to the following associations: “BREAK” (one soft-goal does not allow another soft-goal to be achieved); “HURT” (one soft-goal negatively impacts another soft-goal, although it can be still achieved); “UNKNOWN” (one soft-goal contributes to the other but it is not possible to determine whether this is a positive or negative contribution); “HELP”(one soft-goal positively impacts the effects of another soft-goal); and “MAKE” (one soft-goal provides positive impacts which renders the other soft-goal possible to be achieved). An example of a SIG can be seen in Figure 3.

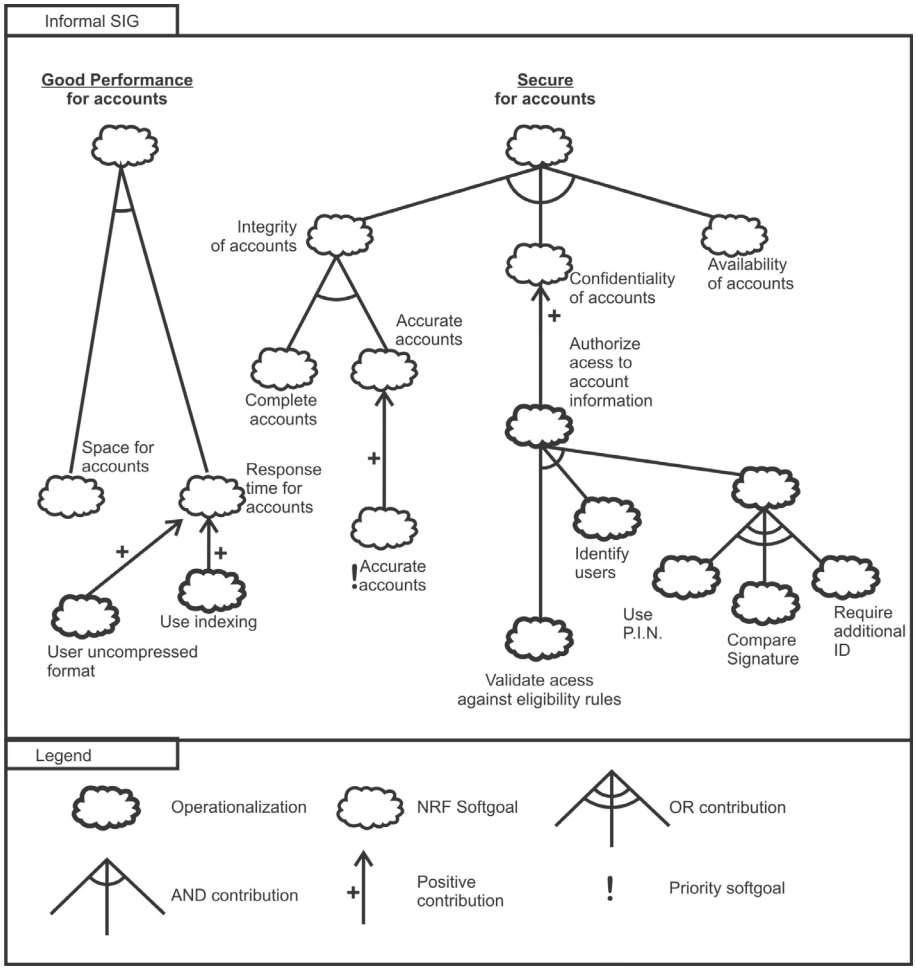

Figure 3 - NFR framework structure

Operationalizations may also be depicted in a SIG. An operationalization is an action which must be implemented in order to achieve the related expected quality in the artifact under development. Figure 4 shows an example of a SIG representing performance characteristics for a software artifact. “space” and “time” are soft-goals which contribute to performance. “data compression” is an operationalization which contributes positively to achieving space requirements.

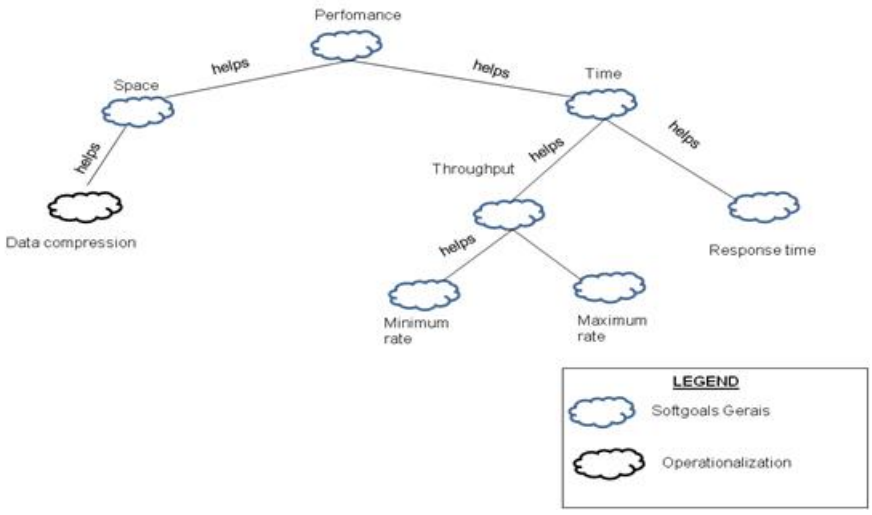

Figure 4 – Example of a SIG for “performance”

A set of SIGs and the detailed documentation of its elements can be organized in catalogues (Chung et al, 2000) (Cysneiros, Yu and Leite, 2003). Non-functional requirements catalogues structure knowledge on how to

design quality attributes in a given artifact. Catalogues evolve with time, and new knowledge generated from new design experiences can be continuously included. Catalogues are indexed by type and topic. “type” means the quality objective to be achieved - security, performance, usability etc. “topic” means the kind of artifact to which the quality attributes are to be applied - software, document, diagram, product, process etc.

Catalogue use during a design activity comprises identification of which soft-goals are expected, as based on the client’s, the designer’s and targeted users’ viewpoint; balance of impacts among soft-goals (*unknown*, *hurt*, *help*, *break* or *make*); and choice from the set of the available operationalizations, i.e. how the soft-goals will be implemented in the artifact.

The knowledge contained in a catalogue is related to a particular domain (or topic), but can be reused and adapted to different domains. In this work, understandability is considered as an artifact quality attribute, since it can be an expected characteristic of a group of its users. Therefore, the NFR-Framework approach can be used to organize knowledge about how to include understandability in an artifact (or topic), e.g., a public services process model. In our case, this catalogue can be applied in any type of public services: education, health care, public administration, social services, public housing, water and electricity supply.

The following actions were performed in building the catalogue of understandability (type) of public service process models (topic): i) identifying the understandability attributes relevant for public service process models; ii) analyzing the interdependencies among them; and iii) describing operationalizations/implementations for each attribute, as follows.

The Organization Transparency Catalogue (Leite and Cappelli, 2010) was the starting point for this identification. The Catalogue of Organizational Transparency proposes a five-step model to define the organizational transparency concept: i) **accessibility** - information about the organization is available to the external environment; ii) **usability** - available information can be easily obtained and used; iii) **informative** - information is made available with expected quality; iv) **understandability** - external users can understand the available information; and v) **auditability** - external users can manipulate, criticize and generate new data with the available information. Each level comprises a set of quality attributes indicating what an organization must deploy in order to implement transparency practices (Figure 5).

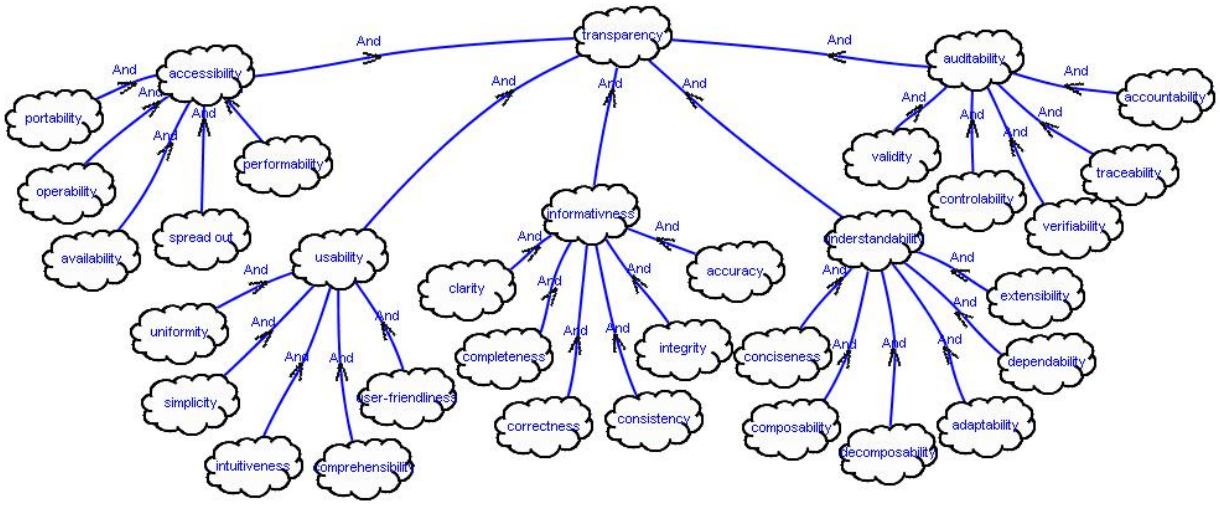

Figure 5 - Organization Transparency SIG (Leite and Cappelli, 2010)

Understanding is the human ability to consciously reproduce previously obtained information (Recker and Dreiling, 2007) (Longman, 2008). Understanding a process model is, then, assuring that someone can read a process model and be able to reproduce the information it contains, The attributes comprised in the understandability step and in the ensuing steps (usability and accesibility) were analysed on their relevance considering the new topic at hand - public service process models - and the design intention - transforming existing technical process models into descriptions which can be read by the target audience. As a result, the

following attributes were considered relevant to public service process models: *adaptability*, *clarity*, *concision*, i*ntuitiveness*, *simplicity* and *uniformity*.

Adaptability is the ability to allow changes in process and its representation in agreement with stakeholders' needs. This characteristic was created because the target audience may consist of different profiles, and each one may have different interests in different parts of the process, thus making it necessary to adapt the process to the relevant clients' interest. *Intuitiveness* is the ability to allow stakeholders to read process model representations without requiring previous knowledge of the domain and/or of the notation used to describe the process. This characteristic is important because public service clients usually have little or no knowledge of process notation and of its domain. Process model should use less technical language and make use of well-known metaphors/analogies to represent process elements. *Clarity* is the ability to allow for the discrimination of an object/element used in process representation avoiding ambiguity. *Conciseness* is the ability to summarize the content. This is an important characteristic because a concise process helps in securing information faster.The last characteristic is *uniformity*, the ability to provide a unique form of description and representation of each process element.

Although all the identified attributes contribute positively (HELP) to the understandability of a public service process model, some attributes may have negative impacts between one another (HURT). The only possible negative contribution identified in the catalogue entailed the relationship between clarity and conciseness. High-level conciseness in a process model may hurt the clarity of its elements. Some elements can be omitted if we excessively summarize too much the available information in the model, thereby raising challenges to clarity. These two attributes, albeit independently contributing to understandability, must be balanced when together, taking into account the expectations of the target audience and business objectives. How much of conciseness must be lost in the name of clarity, or vice-versa, is a design decision. Figure 6 shows the SIG for the public service process model understandability attributes catalogue.

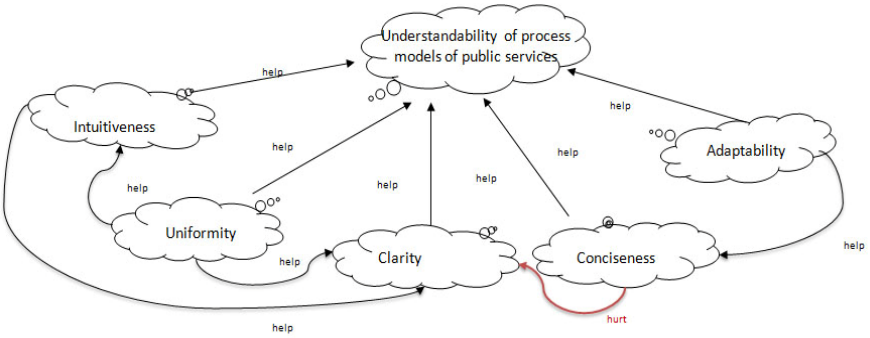

Figure 6 - SIG of public service process models understandability attributes

Each attribute in the catalogue has a set of operationalization and implementation mechanisms. For instance, *Adaptability* can be implemented through "defining different views of the process model representation according to the target audience". It is suggested that this implementation is performed by: i) identifying the target audience – which actor takes part in the process; who in the external environment is interested in information about the process; describing each audience group representative´s profile; ii) associating which process elements should be presented in the model for each profile in the audience group; and iii) defining the way each element will be contrasted (colour, size) in the model, considering each profile. Another operationalization for the *Adaptability* attribute is "describing the process model", which means providing a textual description of the model.

As illustration, consider a process model for building a university course timetable. The actors are as follows: the course coordinator, teachers and other school departments, whereas those possibly interested in the process should be the students. In this case, different views of the process model could be built: one for the students and another for the teachers and the coordinator. Other school departments were combined into the students' view. The students' view of this process model should be simplified, e.g. by omitting the alternative process flows, while for teachers/coordinator all the alternative branches of the process are important. Additionally, for the teachers and the coordinator, the activities where one takes part should be detached in the model. Additionally, a short description of the process model could be provided.

3.2 Use of the catalogue

One condition for using the catalogue is starting the design activity from a previous process model, described using workflow representations (Chung et al, 2000) (Cysneiros, Yu and Leite, 2003)(Aguilar-Saven, 2004). This is important, as this version of the catalogue organizes operationalization and implementation mechanisms which take into account the existence of common elements in workflow representations: actors, activities, flow among activities, inputs, outputs, resources (documents) and business rules.

Another requirement for using the catalogue is collecting the process owner/manager's expectations about the target audience's understanding needs of the public service/process. These steps also help understand the type of service (education education, health care, public administration, social services, public housing, water and electricity supply*)*. These expectations help the designer choose the attributes in the catalogue relevant as design objectives. For each attribute, the analyst may also choose the operationalizations and implementation mechanisms fitting into the design scenario. If none of the operationalizations seem adequate, the designer can suggest and include a new one, contributing to catalogue evolution and knowledge construction about the design task and the specific service under transformation.

4 Case study

A case study (Yin, 2013) was performed, with two main objectives: ascertaining the overall structure and content of the catalogue and its use by process analysts, and determining whether the designed process models could be understood by their target audience (citizens). Methodologically, a number of steps were followed for achieving the first goal: (i) issues and variables to answer them have been defined; (ii) the transformation process model was conducted using the catalog and process documentation; (iii) defined variables were collected; (iv) analysis of the collected variables was carried out; (v) changes to the catalog were defined. For the second goal the steps were: (i) issues and variables to answer them have been defined; (ii) a questionnaire on understanding of the process was prepared and applied to groups of participants; (iii) levels of understanding to classify the responses were defined; (iv) the questionnaire answers were classified; (v) analysis of participants´ understanding were made; (vi) changes in the design process and in the catalog were defined. The following sections describe the study context, design, execution, results and limitations of the study.

4.1 Context

The case study was conducted at the Federal University of the Rio de Janeiro State (UNIRIO), a public institution, which had been required by the Brazilian Government to improve its business process (Gespublica, 2011), and to improve information transparency to the external environment, especially concerning its services. The process used in this study was the university's internal funding request for research activities (called PROAP). This funding management involves a set of departments, including the research departments associated to graduate education activities - which requests funding; the university Graduate Dean's Office (PROPG) - which approves requests, the Planning Dean's Office (PROPLAN) - which controls the university budget; the Administration Dean's Office (PROAD) - which performs contracts and payments; external enterprises - which provide material and services; and the Governement Agency (CAPES) - which provides the funding. The process had been modeled as a result of an internal process modeling and improvement activity.

After a meeting with the process owner - the PROPG head- the process target audience was identified - students, researchers and graduate courses coordinators at UNIRIO. This audience´s profile could be described as highly-educated people, where students and researchers aim at making requests and following up these requests until their completion. Coordinators, in their turn, aim at following up all requests and understanding the process in order to guide researchers on how to obtain and request funding. As described by the process manager, the focus for process understandability should be the students, since they represent the number of "clients" which make fewer funding service requests within a 4-year period being, therefore, less experienced with its process and rules.

The process manager expected that, by changing process presentation, it would be possible to establish greater commitment among process actors and more visibility on how the process flows among them, avoiding bottlenecks, and causing requests for information to be addressed to the right department. A good description of the process could also improve participants' knowledge of its rules, avoiding communication problems and delays. The process manager also reported that, due to the greater number of doubts perceived in the requests, the information to be prioritized for understanding the service entailed process rules, required

documents and the overall workflow. Management information and accounting for the Brazilian Government could be omitted to the public at this stage.

4.2 Evaluating catalogue structure and its content

One case study issue was evaluating whether the structure and content of the catalogue allow the designers (process analysts) to use it without great disruptions. The following evaluation question was defined: **Q1: What is the difficulty level in the execution of the design for understandability of public service process models?** This question was answered by measuring the following variables: i) the time needed to perform the design using the proposed catalogue; ii) The number of doubts raised during the task; iii) The process analyst's satisfaction level; iv) Annotations about any missing information/instrument perceived by the analyst during design.

Another issue was, **Q2: Is the set of attributes, operationalizations and implementation mechanisms presented in the catalogue sufficient to perform the design task?** The following variables were used to evaluate this question: i) Which attributes were chosen by the analyst; ii) the frequency of attribute choices; iii) the number of new operationalizations created for each chosen attribute; iv) the frequency of operationalizations used for each chosen attribute; v) the number of implementation mechanisms used for each chosen attribute; vi) the number of new implementation mechanisms created for each chosen attribute; and vii) the analyst's satisfaction level of the analyst in using the catalogue.

Two analysts were asked to perform the process model design. Analyst 1 had extensive experience in process modeling (5 years experience in process modeling projects), high-level knowledge about the process domain (he took part in the process modeling team) and participated in the meeting with the process manager to discuss the understandability requirements for the service. Analyst 2 had low-level experience in process modeling (as a student in a process modeling discipline), little knowledge of the domain (he had just once requested the funding and had never read the process model before), and did not take part in the meeting with the process manager (he used the annotations made by Analyst 1 after the meeting). The analysts were required to apply the catalogue, considering the requirements identified with the process manager. The analysts used the catalogue and process model documentation - a word file including the process diagram and associated textual descriptions[1]. The process model showed high complexity, with a high number: 62 activities and many decision points.

The measures obtained for the variables on Q1 are shown on Table 4. Application time (1h) was considered reasonable for a design task. Doubts were minimal: Analyst 1 raised a doubt about the description of one operationalization. Analyst 1 described a high satisfaction level with the design results, as shown by one of his comments: "What a difference in process size!! From 100 to 11 activites!! Much better to read this way and understand all that may happen from request to delivery of the material/travel expenses.". Analyst 2 also reported a high satisfaction level: "I found it great, and everything is as I wanted.".

Table 4 – Results on the difficulty to apply the catalogue

Variable	Analyst 1	Analyst 2
Time used	1h	1h
#doubts	1	0
need for other instruments	No	No

The measures obtained for the variables on Q2 are shown on Table 5. Analysts have chosen all the attributes proposed in the catalogue, with the suggestion of two new operationalizations.

[1] http://www2.unirio.br/unirio/cgcp/projetos/internos/proap-1/produtos

Table 5 - Catalogue structure and content

Attribute	#operationalizations used/# operationalizations	# mechanisms used/# mechanisms in the catalogue		
	Analyst 1	**Analyst 2**	**Analyst 1**	**Analyst 2**
Adaptability	1/2	1/2	3/4	2/4
Clarity	7/7	7/7	8/19	11/19
Conciseness	2/2	2/2	4/4	3/4
Intuitiveness	2/2	2/2	5/5	5/5
Uniformity	3/3	3/3	5/8	6/8

As shown on Table 5, many implementation mechanisms for the attribute "clarity" were not used. A detailed review showed that some implementation mechanisms are mutually exclusive, i.e. choosing one does not mean not needing to choose the other. For instance, the operationalization "Associate each business rule to the activities they impact." bears two implementations: "Include a symbol to represent the rule near the related activity." and "Draw a line between the rule and the activity", which are mutually exclusive.

Figure 10 shows the model designed by Analyst 2, using the operationalizations suggested by the catalogue. The important changes of this diagram from the original model in eEPC are as follows: the use of doll icons to represent actors; the number of activities reduced, so as to focus on the activities relevant to the audience; metaphors, such as traffic signs to represent events and exclamation points to represent associated rules were also used. The analyst also decided to describe, in the decision points, the specific questions/decisions that should be made.

As commonly occurs in a design task, Analyst 2 designed a different model, based on different decisions. For instance, the sizes of the two models were different: analyst 1's model had only 11 activities, the analyst 2's model had 23 activities. This difference may be explained by the analysts' profile. As Analyst 1 had more knowledge about the domain and process, it was easier for him to identify what would be relevant for the audience, by cutting off more information. Analyst 2 remained bound to the process manager recommendations and, by having less knowledge about the domain, preferred to keep the process more complete.

This evaluation aimed at ascertaining whether users can understand the generated models, and at which level. The question we attempted to answer was, **Q3: Is the process client (citizen) able to understand the process, correctly answering a set of questions about it?** The following variables were defined for measurement purposes: a) number of questions users answered wrongly; b) number of questions answered correctly; and c) level of satisfaction with the diagram.

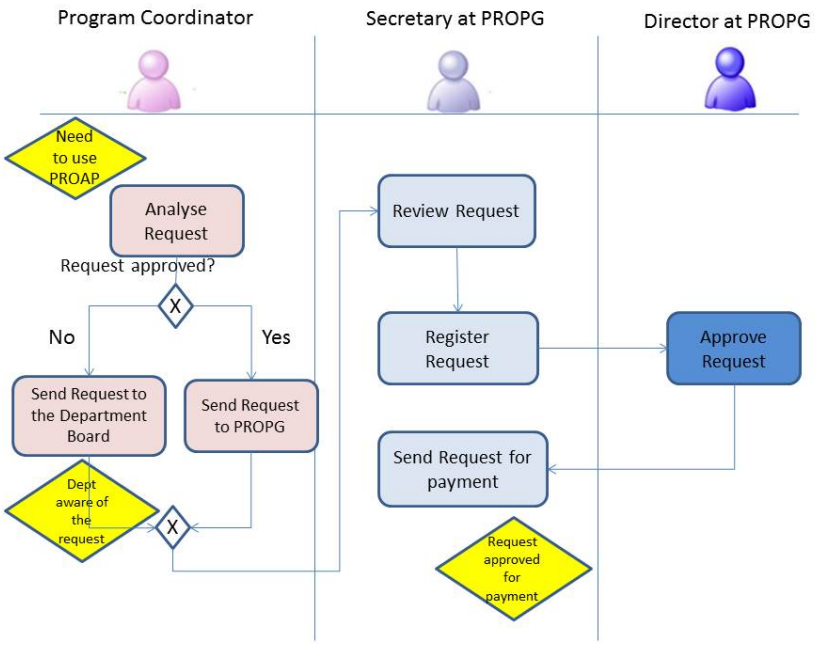

Figure 10. Process model designed by Analyst 2

1.1. Validating process understandability

The process models were published online

(http://np2tec.uniriotec.br:9089/wikiprocess/index.php/PROCESSO_PROAP) for open target audience (students, teachers, coordinators, staff etc.) access. A questionnaire was also made available with questions to measure participants' understanding of the process. The questions were built based on process formal documentation available in the organization and on the items considered relevant by the process manager: rules, process steps, actors and artifacts used/generated by/from the process.

Participants were organized into 6 different groups, based on their profiles - students, teachers and managers – and on the process model they used to answer the questionnaire. All were invited to participate through electronic messages, and had 21 days to answer the questionnaire. Table 6 shows the results obtained.

Table 6 - Results for the group using the process model designed by Analyst 1

	Process models knowledge	University processes knowledge	Number of funding requests performed	Funding knowledge	Satisfaction with presentation	% right answers
Student 1	High	Low	0	low	Medium	13%
Student 2	High	Medium	2 to 4	high	Medium	75%
Student 3	Medium	Medium	0	medium	Good	75%
Student 4	High	Low	1	high	Medium	88%
Researcher 1	Medium	Medium	More than 4	high	Good	57.14%

Table 7 - Results for the group using the process model designed by Analyst 2

	Process models knowledge	University processes knowledge	Number of funding requests performed	Funding knowledge	Satisfaction with presentation	% right answers
Student 1	High	Low	1	Low	Good	75.00 %
Student 2	Medium	Medium	1	Low	Good	12.50 %
Student 3	High	Medium	1	Medium	Good	12.50%
Student 4	High	Medium	never	Low	Good	62.50 %
Student 5	High	Medium	2 to 4	Medium	Medium	62.50 %
Student 6	High	Medium	1	Medium	Good	50.00 %
Student 7	Medium	Low	1	Medium	Medium	37.50 %
Student 8	High	Medium	2 to 4	Medium	Medium	75.00 %
Researc her 1	Medium	High	Never	Medium	Good	53%
Researc her 2	High	Medium	More than 4	High	Good	76%
Researc her 3	High	Medium	More than 4	Medium	Medium	76%
Manage r1	Medium	Medium	2 to 4	Low	Bad	40%

Each participant's level of understanding was classified as follows: low understanding (0-25% of correct answers); medium understanding (50-75% of correct answers) and good understanding (75-100% of correct answers). Table 8 shows the results.

Table 8- Analysis of the understanding level

Understanding range	Number of respondents	%
75 to 100%	7	41.20%
50 to 75%	5	29.41%
25 to 50%	2	11.77%
0 to 25%	3	17.65%

It was observed that the process models turned out to be simpler from a technical viewpoint, but not simple enough to be understood by all citizens/clients participating in the study. It is important to notice, however, that participants were not strongly committed with the process when answering the questionnaire - they were not willing at that point to have the service provided: they were just reading the process to answer the questionnaire.

The results obtained in this study move towards the idea that designing public service process models for citizens´ understanding can raise interaction among citizens and public institutions. Information about the processes can help citizens understand the flow of activities that all participants (both professionals and citizens) must perform in order to have the service delivered; which parts of the process need user intervention and which parts are under the public institution responsibility; the rules imposed upon the process and the restrictions applied both to users and to the public organization which can help them understand, for instance, that difficulties in having the service provided are due to excessively restrictive rules. Finally, understanding the process renders users aware of interaction possibilities with different process actors bearing better understanding of who will be able to answer for the process at each point of execution. This knowledge, associated with appropriate communication tools, could naturally lead to citizen-public administration direct communication, raising their proximity level. Public policy-making opportunities can be therefore envisioned, where citizens and public administration can discuss around process aspects, problems and innovation, as described in (Diirr, Araujo e Cappelli, 2014)

4.3 Limitations

One of the study limitations was the number of participants - 2 analysts and 17 respondents from a sample of 98 members. It was not possible to conclude whether user profile, knowledge about the model, knowledge about the organization impact on process understanding, and at which level. Answers were too heterogeneous, not allowing us to conclude whether the models were understandable enough.

A second limitation was the respondents' profile: 16 were students or teachers from the computer science department - people who employ logical reasoning, accustomed to following procedures/processes, and with greater possibility of having knowledge about process modeling. It has not been possible to evaluate yet whether a person without process modeling knowledge would be able to understand the process. The only person with this profile - one of the process managers - answered the questionnaire, but his participation cannot be considered significant to generalize conclusions.

One last limitation is the fact that the context under study is limited to the university community. Broader communities, comprising a diversity of citizens, making use of services with a great number of users should bring new challenges to this proposal. Although this case study has been applied at a public university, all problems as lack of visibility, bottlenecks, lack of understanding of the process flow, lack of participant knowledge, communication problems, lack of knowledge about the rules governing the process, are common to different types of processes in the public sector, which makes us realize that this solution can be extended to the public sector in general.

5 Conclusions

This paper described instruments for public service process model understandability design. The main contribution of this research is the definition of the Catalogue of Understandability Attributes for Public Service Process Models. The catalogue can be used to convert organizational business process models into

process models which can be understood by citizens. Furthermore, this research suggests a new use of business process models as an artifact to provide organizational transparency.

The results described in this paper help us answer the questions outlined for this research, as set further. Regarding ways of exploring public service process models as an artifact to provide organizational transparency, the paper showed that through the use of the Catalogue of Understandability Attributes for Public Service Process Models and the proposed method, understandability of an organizational process models can be designed in order to provide process descriptions to help organizations explain citizens the steps, responsibilities, rules, etc, the organization must fulfill to provide the service.

The Catalogue of Understandability Attributes for Public Service Process Models comprises the knowledge for helping process analysts in their design decisions on how to transform business process models into understandable models for citizens. A method showing how to use the knowledge comprised into the Catalogue was also provided. Both the Catalogue and the method were respectively evaluated as useful and feasible to achieve the proposed design objective. It was possible to say that the catalogue can be applied both by experienced and unskilled process analysts. Additionally, the initial set of attributes, operationalizations and mechanisms proposed in the catalogue sufficed to convert organizational process models into a process model which can be understood by the external environment for a specific public context.

Regarding the resulting process model understandability, the process model was not sufficiently simple to be understood by all its clients/citizens. However, the point raised as ruptures in such communication can be solved by a new version of the catalogue, and knowledge obtained in its use can be used as feedback for new versions.

Even not concluding that the process model became more understandable, we believe that, with this approach, the provision of public service description becomes more transparent and visible, which can contribute to discussions about the services, increasing citizen participation and engagement. This is due to better understanding of the process by citizens, enabling discussion about this process and creating a closer relationship between citizen and government.

As future work, the catalogue will be applied in new studies within the context of different public organizations. Studies with a greater number of users and more diverse profiles are also planned. Studies about the correlations between understandability attributes, process model characteristics and level of understanding is another possibility. Additional future work entails comparing the understanding of the original business process model and the process generated after catalogue application. It will be possible, by this comparison, to measure how much the model generated after catalogue application became more understandable than the model generated in business process management.

It is also necessary to perform further studies on the contributions among the understandability characteristics. An analysis should be performed to identify the relationship between characteristics and sub-characteristics covering all elements of the SIG of Understandability for Public Service Process Models. For this, the PCT (Personal Construct Theory) technique, already used in the Software Engineering field by other researchers (Gonzalez-Baixauli, Leite, and Laguna,2006:) (Prates, De Souza, and Barbosa, 2000), can be used.

Further work evolution comprises the creation of modeling guidelines for public service process understandability by the organization inspired in the public service process model understandability catalogue. Also as future research, evaluation of the integration of this research with other ongoing studies in the context of Agora project (http://www.uniriotec.br/~agora) is expected, especially its integration with the solution to promote conversations about the public service process (Diir, Araujo, Cappelli, 2011), aiming at citizen participation in process improvement .

Finally, automatic performing of organization-generated business model transformation into an understandable business model is proposed. The business process model maintenance would be facilitated if this transformation is automatically performed. It would only be necessary to make the change in the organizational model, which would then automatically be reflected in the understandable process model.

Acknowledgements

The authors thank CNPq and CAPES for financial support. This research is part of the Research and Innovation Group in CiberDemocracy (sites.google.com/site/ciberdem/) and part of the Brazilian Institute for Web Science (webscience.org.br).

References

Aguilar-Saven, R.S. (2004) 'Business process modeling: review and framework'. *International journal of production economics*, v.90, n2 (Jul) pp.129-149

Barjis, J. (2008) ´The Importance of Business Process Modeling in Software Systems Design´. *Journal of The Science of Computer Programming*, v.71, n.1, pp.73-87.

Basel Committee on Banking Supervision, [Online], Available: http://www.bis.org/ [28 jun 2014].

Becker, J. Kugeler M, and Rosemann, M. (2003) *Process Management*. Berlim: Springer.

Brazilian Government (Brazil), (2009) Law 131 – Availability in real time of information's [Online] - Available: https://www.planalto.gov.br/ccivil_03/Leis/LCP/Lcp131.htm [28 jun 2014].

Brazilian Government (Brazil), (2011) Law 12.527 Acess Law - Regulation of information´s access [Online] - Available: http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2011/Lei/L12527.htm [28 jun 2014].

Brazilian Government (Brazil), (2011a) Statute Nº 6.932, Provides a simplification of public service to citizens [Online] Available: http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2009/Decreto/D6932.htm [28 jun 2014].

Candiello, A., Albarelli, A. and Cortesi (2010)'"A. Three-layered QoS for eGovernment web services'. *In Proceedings of DG.O'2010*, pp.217-222, 2010, Puebla, Mexico.

CeDem (2014) - *International Conference for E-Democracy and Open Government*. [Online], Available: http://www.donau-uni.ac.at/imperia/md/content/department/gpa/zeg/bilder/cedem/cedem14_proceedings.pdf [28 jun 2014].

Chaitin, G. (2006) 'The Limits Of Reason', *Scientific American* , vol 294 N3, pp. 74-81.

Chung, L. Nixon, B. Yu E. and Mylopoulos, J. (2000) *Non-Functional Requirements in Software Engineering*. Massachusetts.USA:Kluwer Academic Publishers.

Cysneiros, L.M. Yu, E. and Leite, J.C.S.P. (2003) 'Cataloguing Non Functional requirements as Softgoal Networks', *Proceedings of 11th International Requirements Engineering Conference*, pp 13-20, Monterey, California.

Diirr, B. Araujo, R. and Cappelli, C. (2009) 'An Approach for Defining Digital Democracy Support based on ICT'. *Proceedings of the 13th International Conference on Computer Supported Cooperative Work in Design*, Chile, Santiago.

Diirr, B. Araujo, R. and Cappelli, C. (2011) 'Talking about Public Services'. *In: International Conference on eParticipation (ePart),* Delft. Holanda.

Diirr, B. ; Araujo, R. M. ; Cappelli, C. (2014) 'Encouraging Society participation through conversations about public service processes'. *International Journal of Electronic Government Research* (to appear).

Dumas, M., La Rosa, M., Mendling, J., Reijers, H.A., 2013. *Fundamentals of Business Process Management*. Springer.

Eggers, W (2005). *Government 2.0: Using Technology to Improve Education, Cut Red Tape, Reduce Gridlock and Enhance Democracy*. New York: Rowman and Littlefield Publishers, 2005.

EGov 2013 – 12th IFIP WG 8.5 International Conference, EGOV 2013, Koblenz, Germany, Proceedings.Lecture Notes in Computer Science. Vol 80742013.

Extractive Industries Transparency Initiative, [Online], Available: http://eiti.org / [28 jun 2014].

Eriksson, H. and Penker, M. (2000) *Business Modeling with UML: Business Patterns at Work*. New York: John Wiley & Sons.

Ferreira, J. S. J. Araujo, R. M. and Baião, F. A. (2010) 'Identifying Ruptures In Business-It Communication Through Business Models'. *12th International Conference on Enterprise Information Systems*, Funchal-Madeira-Portugal.

Fung, A. Graham, M. and Weil D. (2007) *Full Disclosure: the Perils and Promise of Transparency.* Londres:Cambridge University Press.

GESPUBLICA. Government guide of management processes (2011) [Online] Available : http://www.governoeletronico.gov.br/biblioteca/arquivos/guia-de-gestao-deprocessos-de-governo [5 Jan 2013].

Gonzalez-Baixauli, B. Leite, J.C.S.P. and Laguna, M.A. (2006). 'Eliciting Non-Functional Requirements Interactions Using the Personal Construct Theory'. *In14th IEEE International Conference* , vol., no., pp.347-348, 11-15.

Hague, B. (1999) *Digital Democracy: Discourse and decision-making in the information age*. Routledge.

Harrison, T. M. Guerrero, S. Burke, G.B. Cook, M. Cresswell, A. Helbig, N.; Hrdinová, J, and Pardo, T. (2011). 'Open Government and E-Government: Democratic Challenges from a Public Value Perspective'. *Proceedings of the 12th Annual International Digital Government Research Conference.* pp. 1-9.

Leite J.C.S.P. Cappelli, C. (2010) 'Software Transparency', *Business & Information Systems Engineering* 2(3): Springer 127-139.

Longman (2008) *Dictionary of Contemporary English*, 4 ed. Ed.Logman.

Macintosh, A. (2004) ´Characterizing E-Participation in Policy-Making´ *37th Hawaii International Conference on System Sciences*.

Melcher, J. Mendling, J. Reijers, H. A. and Seese, D. (2009) 'On Measuring the Understandability of Process Models', *1st Workshop on Empirical Research in BPM* ,Ulm, Alemanha.

Mendling J. Reijers H. and Cardoso, J. (2007) 'What makes process models understandable?' *Vol. 4714 of Lecture Notes in Computer Science,* Springer, Brisbane, Australia, pp. 48-63.

Mendling, J. and Strembeck, M. (2008) 'Influence factors of understanding business process models' *11th International Conference on Business Information Systems (BIS 2008),* Vol. 7 of Lecture Notes in Business Information Processing, Springer-Verlag.

Niehaves, B. and Malsch, R. (2009) 'Democratizing Process Innovation? On Citizen Involvement in Public Sector BPM'. *8th International Conference Egov*., Linz, Áustria

Oates, S. (2008) *Introduction to media and politics*. Thousand Oaks: Sage Publications.
Open Government Partnership, [Online], Available: http://www.opengovpartnership.org/ [28 jun 2014].
Prates R. De Souza, C. S. and Barbosa, S. (2000) 'A Method for Evaluation the Communicability of User Interfaces. Interactions', *ACM Interactions,* v. 7, n. 1, 31-38.
Recker, J. and Dreiling, A. (2007) 'Does it matter which process modelling language we teach or use? an experimental study on understanding process modeling languages without formal education' *In 18th Australasian Conference on Information Systems*, pp 356-366, Toowoomba, Australia.
Sharp A. and Mcdermott P. (2010) *Workflow Modeling: Tools For Process Improvement And Application Development,* Norwood, Ma, USA: Artech House,
Shirky, C. (1998) *Here comes everybody. the power of organizing without organization*, New York: The Penguim Press.
Silva, S. (2005) *Graus de participação democrática no uso da internet pelos governos das capitais brasileiras*Brasil:Opinião Pública vXI, n2, pp450-469.
Smith, H and Fingar, P. (2006) *Business Process Management: The Third Wave*, USA: Meghan Kiffer Press Florida.
Sarbanes-Oxley Act of 2002 (2002) Pub. L. No. 107-204, 116 Stat. 745 (codified as amended in scattered sections of 15 U.S.C.).
Tregear, R. and Jenkins, T (2007) *Government Process Management: a review of key differences between the public and private sectors and their influence on the achievement of public sector process management* BPTrends [Online] Available: www.bptrends.com.[5 Jan 2013].
W3C, Improving access to the government with the best use of web (2009) [Online] Available: <http://www.w3c.br/divulgacao/pdf/gov-web.pdf> [28 jun 2014].
Yin, R K. (2013) *Case Study Research – Design and Methods*. SAGE Publications.

