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Martin Matzner  
*University of Muenster*, martin.matzner@ercis.uni-muenster.de

Fabio Alexandrini  
*UNIDAVI*, fabalex@unidavi.edu.br

Thiago Souza Araujo  
*UNIDAVI*, araujo.thiago.souza@gmail.com

Joerg Becker  
*ERCIS*, becker@ercis.uni-muenster.de

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Process Modeling in Brazilian Public Administrations: The domain-specific PICTURE approach

Martin Matzner  
University of Muenster, ERCIS, Germany  
martin.matzner@ercis.uni-muenster.de

Matthias Voigt  
University of Muenster, ERCIS, Germany  
matthias.voigt@ercis.uni-muenster.de

Fábio Alexandrini  
Department of Education, Sate Dep. Santa Catarina, Brazil  
University center UNIDAVI, Rio do Sul, SC, Brazil  
fabalex@unidavi.edu.br

Thiago Souza Araujo  
Department of Administration, State Dep. Santa Catarina, Brazil  
University center UNIDAVI, Rio do Sul, SC, Brazil  
araujo.thiago.souza@gmail.com

Jörg Becker  
University of Muenster, ERCIS, Germany  
becker@ercis.uni-muenster.de

ABSTRACT
This paper discusses a process modeling case, which applies a semantic building block-based approach as a means for business process modeling in Brazilian municipal public administrations (MPA). It derives a set of distinctive requirements to process modeling methods that are refined to the specific demands of Brazilian MPAs. We introduce the modeling method PICTURE and discuss whether and why its application in Brazilian MPAs is appropriate. We evaluate it against the before mentioned set of requirements. It could be shown that PICTURE delivers valuable support for Brazilian MPA process modeling projects.

Keywords  
Process Modeling, Municipal Public Administrations, Brazil

INTRODUCTION
The more than 5,000 Brazilian municipal public administrations (MPA) are nowadays faced with an urgent reform demand, which results in the necessity to think over the administrations’ organizational structures. There are three key motivators: (a) Constitutional change of 1988 overcame a period of more than 500 years in which Brazil has mostly been dominated by some form of authoritarian and central government – being monarchy, empire or military dictatorship (Speier 2009). Brazilian’s governmental institution design was constituted fundamentally differently as “weak federal power and strong subnational governments” (Martell 2007), which especially counts for the municipal level. (b) Likewise (and drawing back to the same origins), Brazilian public administrations are required to establish rules for transparency (Fiscal Responsibility Law). Therefore, a mandatory reporting on fiscal targets for receipts, expenses, nominal balance, primary balance, public debt, and estimates of state enterprises, pension systems, and other obligations has to be established by each public administration (Schneider 2007). (c) ICT allows for higher quality Public Administration (PA) services with higher effectiveness of provision (Joia 2003). From a specific public administration’s point of view this implies: (a) reporting obligations and thereby improved transparency increases competition amongst MPAs and claims from politicians and citizens to think over and improve an effective public services provision, and (b) reform activities can be conducted rather autonomously and independently by each institution.
As key-lever for analyzing and finally improving MPAs’ service provision serves the analysis of those processes that are required for fulfillment. Thus, we found that presently administrations are regularly lacking a sufficient methodological support for analyzing and (re-) designing these processes. To the authors’ best knowledge there today exists no academic reflection on requirements for a methodological support by using conceptual modeling approaches to analyze Brazilian PAs processes. Activities illustrated in this paper are embedded into a comprehensive research project comprising the bilateral transfer of three software artifacts for MPAs and their adaptation to the Brazilian’ requirements.

This research elaborates requirements from IS body of knowledge for conceptual modeling in MPAs. We refine those aspects and adapt them to Brazilian municipal public administrations‘ distinctive demands. Subsequently, we introduce the domain-specific conceptual modeling approach PICTURE. It allows for analyzing distinctive processes and particularly their interrelations and dependencies in entire process landscapes. There exists a web-based software tool for modeling and maintaining MPAs’ processes. Analyzing functionalities assist in estimating process improvements, e.g. by extended IT support. We depict its application within the process modeling case of Rio Dolce. We then illustrate how Brazilian MPAs’ requirements can be addressed by sufficient methodological support.

REQUIREMENTS ON PROCESS MODELING METHODS FOR BRAZILIAN MUNICIPAL PUBLIC ADMINISTRATIONS

We argued that conceptual models (here: business process models) serve as a basis for process analysis and re-design intended to increase process performance. Constructing such process models requires methodological support and guidance. *Modeling techniques* (Strahringer 1996) provide such support to process modelers.

Modeling techniques consist of two components: first a *modeling language*, in which the provided language constructs and their relationships are defined. A language has a *representational aspect* addressed by modeling notations and a *conceptual aspect* which is the constituting part of the language. Secondly modeling techniques consist of a *construction guideline* that defines a modeling process for this language. A *modeling method* stays on top of a modeling technique. It describes the different phases of the overall modeling process incorporating structuring approaches for different modeling layers and views (Strahringer 1996). The method should address project management requirements for a continuous process management (Becker, Kugler and Rosemann 2007).

So what are the distinctive requirements from MPAs’ point of view to such methodological support? We acknowledge that there exists an established body of knowledge in IS research addressing these questions. We subsequently subsume stated demands in literature and aggregate them to a set of distinctive requirements (for a more detailed discussion, cf. Becker et al. 2007a).

Requirements for process modeling in public administration

A domain-specific modeling method representing a PAs process landscape and making it transparent for the model users has to regard and address specific characteristics of the public administrations (Bretschneider 1990; Navarra and Cornford 2005; Scott et al. 2004).

The method shall permit an efficient modeling of the process landscape with justifiable efforts, allowing for the analysis not only of certain processes, but an entire process landscape. The interdependencies between organizational units are to be represented in a simple manner (Bretschneider 1990; Palkovits, Woitsch and Karagiannis 2003). Furthermore the method should represent all aspects of the process, like the performing organization and the utilized resources (Scheer 2001), and ensure a description at a convenient level of abstraction.

*Requirement 1: A simple representation of the PA’s process landscape should be facilitated.*

The models and their corresponding methods should be easily understandable for public officials. The modeling language should therefore incorporate language constructs from the domain vocabulary (Guizzardi, Pires and Sinderen 2002). This is a major incentive for continuous process documentation.

*Requirement 2: The created process models should be easily maintainable.*

A comparison of different organizational units as well as between different occurrences of a single process over time should be supported by the modeling method. Therefore the modeler’s degrees of freedom must be strongly constrained. Usage of the same language constructs to describe an identical aspect of real-world should be supported (Becker, Rosemann and Uthmann 2000).

*Requirement 3: The created process models should be comparable to each other.*

The analysis of a process landscape in a PA, usually consisting of a huge amount of processes, is difficult to conduct manually. Thus, process analyses and evaluation should be tool supported. Prerequisites for analysis are a convenient level
of abstraction and language constructs which are closely related to the domain. Additionally, the above mentioned requirement of comparability is a necessary requirement for evaluability (Pfeiffer 2007).

**Requirement 4:** The created process models should be analyzable automatically or semi-automatically.

Considering the limited resources of public administrations, a modeling project should avoid extensive efforts for the employees, if engaged in the modeling project or responsible for continuous process maintenance.

**Requirement 5:** The modeling method should facilitate efficient modeling and maintenance.

**Requirements discussion in the context of Brazilian MPAs**

We conducted expert interviews to explore local characteristics of the Brazilian public administration. We interviewed politicians in leading positions, e.g. state delegates, ministers and ministerial directors as well as majors, and departmental executives of the public administration on municipal level. Brazilian scientists in the area of E-Government provided further input. The results of our interviews have been incorporated into the before mentioned requirements, depicting their relevance in the context of Brazilian MPA. Furthermore, they led to new requirements.

Brazilian MPAs are faced with high fluctuation of personnel, originating from two sources. Executive staffers are not paid well and employed on fixed-term work-contract base. PAs mid-level employees (secretaries), who are responsible for the management of the town’s different service departments, are dependent on political patronage. After a four-years legislation period they are frequently substituted by the majors. Implications are twofold. Methodological ease-of-use is required allowing new employees to become rapidly productive in applying the method (Req. 5). Well maintained process models support process-knowledge transfer to new staffers for gaining insights into processes in their area of responsibility (Req. 2).

We outlined before, that our project was set up as a transnational transfer project for E-Government artifacts. Therefore, a language adoption of all project relevant aspects was a major prerequisite for project success. This requirement targets especially the project management aspect of method application. Interview partners stressed that understanding and acceptance of new approaches for advances of public administration would be significantly increased, if they were locally adapted. For the research project this required the translation of the modeling methodology as well as project planning documents such as goal definitions and interview questionnaires. Furthermore, people who conduct the modeling project need to have a common language to communicate in. If there is no common language spoken by all relevant project members, qualified interpreter personnel has to be foreseen.

**Requirement 6:** All project relevant documents and tools should be available in the domestic language. A common communication language has to be agreed upon.

For an efficient application of modeling techniques appropriate modeling tools are indispensable (Becker, Kugeler and Rosemann 2007b). Modeling an entire process landscape requires a collaborative modeling approach. Therefore we suggest, the modeling tool should be build upon a central model data base with multiple users working with those models, e.g. realized within a client-server based architecture. This central database acts as an integration point for the process models developed by different modelers. The IT infrastructure in Brazilian MPA is regularly low-level, esp. in small MPAs. According to a study of Robert (2007) an average of five employees in public administrations of the pilot region share access to one computer workstation and potential access to the internet.

**Requirement 7:** Regarding the tools applied in the project, performance constraints of the existing IT infrastructure of the organization to analyze should be taken into account.

In the course of decentralization in Brazil, municipalities gained a lot of new competences. This includes care for basic education and the implementation of the Brazilian Unitary Health System (SUS) for providing medical care to the Brazilian population. The municipal public administration is responsible for all administrative processes that accompany the realization of these services that in parts extends “traditional” PA administrative tasks. This causes a high variety of those tasks that have to be performed within the processes and requires the modeling method to be sufficiently expressive to represent all types of tasks.
THE PICTURE METHOD

The PICTURE method has been developed with regard to the aforementioned Req. 1-5 and a comparison with established process modeling approaches (Becker, Kugeler and Rosemann 2007a), e.g. ARIS (Scheer 2001), BPMN (Object Management Group 2009) and IDEF3 (Mayer et al. 1995).

PICTURE is a building block-based, domain specific modeling language (Pfeiffer 2008). It has been specifically developed for use in public administrations. 24 building blocks represent information processing activities repetitively conducted in public administrations. These blocks are grouped sequentially to represent processes. To guarantee process simplicity branches in the flow of the process building blocks as well as iterations are not foreseen (Becker et al. 2007a).

We previously tested the method in the project “Moderne Verwaltung” (MoVe)” with the administration of the University of Münster. PICTURE was applied with the goal to increase process transparency in the public administration and, thereupon, identify potential for reorganization to increase process performance. 168 processes have been captured. The application of PICTURE was compared with another modeling project in public administration, named Regio@KomM. The latter applied the non building block-based process language EPC. It could be demonstrated that the efficiency in applying PICTURE was much higher. The time needed for modeling a single process in Regio@KomM was nearly six times higher (Becker et al. 2007a), thus dealing with a much lower number of 22 modeled processes.

Within the case we strive to show that characteristics of PICTURE do meet the specific requirements to a modeling method that allows for processes modeling in the municipal public administrations in Brazil.

RESEARCH METHODOLOGY

Case Setting

Here, we refer to the city that was subject of our investigation by the pseudonymous name Rio Dolce. Rio Dolce, located in the Brazilian Federal State of Santa Catarina, is a city counting 57,000 inhabitants. Rio Dolce is rather well-developed, being under the Brazilian “Top-50” cities following the UN Human Development Index (HDI).

At present, the city of Rio Dolce has an overall staff of 1,300 people for providing its entire services (education, health, social care). The core MPA that deals with the administrational processes employs 115 staffers. The municipal administration of Rio Dolce is divided into ten departments (“secretarias”) with topical focus. The presented research was mainly undertaken with employees of the health department of Rio Dolce being involved.

The health department is organized in ten subdivisions, addressing either administrative tasks or medical-service provision. It is part of the Brazilian Unitary Health System (Sistema Único de Saúde - SUS) (Giovanella and de Souza Porto 2004), a national tax paid system that provides medical treatment to every Brazilian citizen, as granted by the Brazilian constitution of 1988. The municipal health department is responsible for the implementation of the SUS in Rio Dolce. The department has one leading secretary (“secretario”) and employs an overall staff of about 400 employees. It consists of a central administration, a policlinic and local medical service stations, called PSFs, for basic medical attendance in each suburb of the town.

Data Collection and Presentation

The research presented in this paper was intended to evaluate the PICTURE method on its eligibility for managing and improving processes in Brazilian municipal administrations. Therefore, we tested the method against the aforementioned set of requirements. The case study presented in this paper has been conducted by an international researcher team, consisting of four Brazilian and two German researchers.

Process knowledge was collected in semi-structured interviews within five workshops, having four participants each and lasting an average time of three hours. The interviews have been conducted by mixed groups consisting of two researchers and process responsible officials from the municipal administration. Subsequently, explicated process knowledge has been transferred into process models by method experts from the research team. The models have later on been checked, reformulated and finally approved by the interviewees as well as executive officers.

In total, we identified and modeled nine (partly very complex) processes consisting of 30 sub-processes, an organizational model including seven departments with 46 sub-departments and roughly 30 resources representing forms, documents and software applications applied within processes.
In this case we outline our project experiences in introducing PICTURE in the MPA Rio Dolce. We depict how and why the aforementioned requirements for a conceptual modeling method have been addressed within the project. By stating the administrative staffs’ experience we critically reflect on the methods capabilities.

**APPLYING A BUILDING-BLOCK BASED CONCEPTUAL MODELING APPROACH IN BRAZILIAN MUNICIPAL PUBLIC ADMINISTRATION - THE CASE OF RIO DOLCE**

Within the ten departments of the MPA of Rio Dolce the health department was chosen, because it has to realize a high number of services within the Unified Health System (SUS). Therefore the expressiveness of PICTURE, regarding Req. 8, could be investigated. Furthermore, there was a high motivation of the department’s management to contribute to the project for increasing transparency of existing processes. The department started several approaches for reform projects, but told us that it was lacking methodological expertise in-house. Selected processes were mainly high structured, in parts semi-structured, and merely high repetitive which promised good improvements by process reengineering.

Figure 1 illustrates the project plan we applied in the health department for the transfer of PICTURE to the MPA of Rio Dolce. This plan was elaborated in cooperation with the management of the health department. The PICTURE method also provides a procedure model. Within the given amount of time and due to the novelty of PICTURE to our cooperation partners we decided to simplify it in the given form. The project plan explicates the three project steps which are subsequently presented in detail.

![Figure 1. Project Plan for the process modeling case Rio Dolce](image)

**Project organization**

In step one strategic aspects of the project had to be planned in cooperation with the management of the health department. Here, we had to discuss and record the goals of the modeling project. Interviews had been semi-structured by applying a goal definition form that is part of the PICTURE procedure method. It provides an overview of numerous, categorized goals that can be pursued by the process modeling with PICTURE. For each goal a priority ranking has to be defined. The goal definition form was translated into Portuguese. Goal rankings of all interviewees were brought into a goal workshop that was conducted with the help of translators. So we met Req.6. It turned out to be essential to use Brazilian mother tongue as project language.

As a first step into a comprehensive modeling project, we limited our analysis to processes dealing with the Health Program for Families (Programa Saúde da Família (PSF)), which is providing the basic medical care in the health department. However, the interconnection of processes required for also considering other subdepartments’ activities in parts. We first had doubts about the appropriateness of PICTURE to model the processes in those areas. Many processes involved activities that conduct actual medical care, rather than the administrative perspective. PICTURE is designed for modeling the informational part of processes. Within the pre-analysis we found out that every medical process in Rio Dolce has a huge amount of accompanying informational activities. Furthermore there are numerous administration only processes. This
includes the registration and surveillance of the health status of residents in the PSF areas, ordering of medicaments or accounting activities.

Within the pre-study we explored, if there are basic structural specifics that would demand us to adapt the building blocks (representing processes of standard administration acting) of the PICTURE method. We conducted only minor changes due to technical requirements. These affected especially activities coping with financial transactions (e.g., separate activities for creating an order for reimbursement and conducting a reimbursement). Though, these changes don’t affect the principal modeling method’s structure and therefore are not displayed here in detail. The slightly modified set of building-blocks for the Brazilian context then showed to be sufficient to describe processes in the illustrated domain and therefore met Req. 8.

**Process modeling**

Subsequently (step two) the PSF staff was informed about the planned activities. A short introductory PICTURE presentation was held to the coordinators of the 12 distributed health centers that realize the basic health care program PSF. Then, in project step three, the specific PSF Santa Clara was selected for conducting the modeling project. We conducted five workshops to interview the personnel in the local service station about processes they are responsible for. Afterwards the processes were modeled in cooperation of one method expert and one process expert, both attendances of the aforementioned workshops. Therefore the PICTURE tool was applied. In this phase we could collect the most experience for the appropriateness of PICTURE in the modeling context.

During molding the process landscape we found the processes of Santa Clara to be very “paper intensive”. Many forms are used within the process. The collected data afterwards had to be transferred manually into application systems which finally generate statistics to document the work done in the PSF. This transfer also provokes known problems in the context of media changes. We documented who of personnel in the PSF is responsible for which process activities. All this information could be modeled in PICTURE. Beside the process perspective the tool implements sections to register the whole organizational structure as well as different types and instances of resources as applied software or documents. This addresses Req. 1 and was appreciated by PSF staff and the management.

Figure 2 shows a screenshot of the PICTURE tool’s process perspective. It shows the process of registration of residents (Cadastramento de Familia) and the resource “form A” (Ficha A) linked to the process activity of information capturing (Registrar informações).
After the process models for the PSF had been created they had been validated by the process experts and the health management. We perceived a fast understanding of the PSF’s processes in the PICTURE representation by the department’s staff. This was a tripping device for both the discussions on the correctness of the models and the appropriateness and quality of the processes themselves. Thereby we addressed another aspect of formulated Req.1. Model understanding by the intended users is an essential prerequisite for a further comparison of the processes between the different PSFs or to health processes of other municipals than Rio Dolce, which in parts covers Req. 3.

Though, manual process analysis could be facilitated using the PICTURE method, whereas fully- or semi automated process analysis functionality of the tool was out of scope of the project. As revealed in the goal finding workshops, the focus was on the augmentation of process transparency and training of new staffers using the process models. Therefore Req. 4 could not be assessed. We plan to later on extend our analysis by including these aspects.

However, in about two weeks modeling activities and by the help of one method expert we could capture 9 (partly very complex) processes consisting of 30 sub-processes, an organizational model including seven subdepartments with 46 further sectors and roughly 30 resources representing forms, documents and software applications applied within processes. This speaks in favor of the efficiency of modeling with PICTURE and therefore goes along with Req. 5.

The PICTURE tool is a client-server based tool providing a web interface to conduct the modeling and process analyses. The central sever infrastructure was provided by a regional IT service provider that is operated by a consortium of several MPAs. This was the prerequisite to further modeling activities. Due to the weak IT infrastructure and lacking internet access in the PSF, a local installation of the entire application had to be used for modeling purposes. Though, the requirement for an adequate IT support regarding the existing IT environment (Req. 7) could be covered only in parts.

The modeling of the process landscape is going to be continued by Rio Dolce after researchers left the transfer project. A trained process expert, staff of the health department and formerly involved in the modeling project, continuously registers and models new processes identified in the department. Processes are subsequently approved by responsible process experts and the management. This is a compelling prove for the fulfillment of Req.2.

Our findings on the requirements fulfillment of PICTURE in the context of the Brazilian public administration are condensed in Table 1.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>PICTURE Method Experience</th>
<th>Fulfillment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Req. 1: Simple representation</td>
<td>Process model, Organizational model, Resource Model; Staff’s fast recognition of the processes</td>
<td>Complete</td>
</tr>
<tr>
<td>Req. 2: Easy maintenance</td>
<td>Continuation of process modeling after the transfer project</td>
<td>Complete</td>
</tr>
<tr>
<td>Req. 3: Comparability</td>
<td>Supported by staff’s fast recognition of the processes</td>
<td>Could not be assessed</td>
</tr>
<tr>
<td>Req. 4: Automated Analyzability</td>
<td>Foreseen in the method’s tool but not applied</td>
<td>Could not be assessed</td>
</tr>
<tr>
<td>Req. 5: Efficient Modeling</td>
<td>High number of resulting modeling artifacts</td>
<td>Complete</td>
</tr>
<tr>
<td>Req. 6: Language adoption</td>
<td>Translation of planning documents and tool</td>
<td>Complete</td>
</tr>
<tr>
<td>Req. 7: Regard IT infrastructure</td>
<td>Client-server based tool not always applicable in the given IT environment</td>
<td>In parts</td>
</tr>
<tr>
<td>Req. 8: Expressiveness</td>
<td>Modified building-blocks showed to be sufficient</td>
<td>Complete</td>
</tr>
</tbody>
</table>

Table 1: Requirements fulfillment of PICTURE to a process modeling method in the context of the Brazilian public administrations
SUMMARY, LIMITATIONS AND OUTLOOK

We postponed a set of requirements on a process modeling method that addresses the needs of public administrations, stemming from previous work, which reflects an established knowledge of IS research. We subsequently discussed, in parts refined and extended those requirements with respect to the specific demands of Brazilian MPAs. Within the process modeling case Rio Dolce, we depicted our experiences in applying the method. We evaluated the method’s power and appropriateness with regard to the aforementioned set of requirements. Finally, PICTURE turned out to be useful and suiting support for Brazilian MPAs to model and administrate their process landscape.

Limitations of the research presented are twofold. Regarding the specific case, the modeling project itself was limited by not investigating the entire tool-functionality and could thereby be refined in subsequent research activities. From the perspective of general applicability, certain influences can’t be finally assessed, esp.: How successful can modeling projects be conducted without method experts’ support? How successful can PICTURE be applied in other regions and on different PA level (state, federal). Furthermore, lacking IT-infrastructure in the Brazilian MPAs is an obstacle for the application of the PICTURE tool.

The modeling case “Rio Dolce” was successful as it allowed for a testing of the method against the requirement set. Staffers accepted tool usage and supported the project by their engagement. The modeling case will be continued. Therefore, Rio Dolce claimed a process expert, staff of the health department and formerly involved in the modeling project, for being responsible to continuously register and model new processes identified in the department. The authors are going to follow the further project development. We want to gain further insights on the MPA’s experience in applying PICTURE for rethinking our requirements and for comparing those experiences to modeling projects conducted in other nation’s MPAs.

The introduction of PICTURE to further MPAs in the pilot-region and on state-level is planned.

REFERENCES


