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Abstract

The EU-Service-Directive will lead to big challenges for public administrations. The administrations have to offer a point of single contact supporting the customer. This point of single contacts needs an overview of the administrational processes to perform his task. As processes from different organizations and organizational units are relevant for the EU-Service-Directive they can only be captured by using a distributed approach. The contribution of this paper is to present a domain specific distributed modeling method which allows a fast, efficient, and consistent capturing of the information needed for the point of single contact..

1. Introduction

In December 2009 the EU-Service-Directive will become operative [8]. This leads to big challenges for all public administrations in Europe. The objective of the directive is to make service delivery in Europe easier and faster for people from all EU countries. Public administrations have to support the EU citizens by performing the administrational issues for offering services. The service directive leads to at least three different action items for public administrations: (1) screening of all norms and laws to come up with lean services; (2) automation of processes to offer all relevant services in a digital and online accessible form, and (3) to provide a point of single contact who helps EU citizens with their administrational issues.

The point of single contact needs an overview of the administrational processes. Only when he is able to see the complete processes with all inputs needed and the possible outputs, he can take the role of a consultant and partner for EU citizens who want to provide services in a specific EU country. Likewise, clarity about the process structures is needed to give complete and competent information to citizens. A comprehensive overview of all this information is only possible with lean and standardized process models.

The processes relevant for the EU-Service-Directive with information on all municipalities can only be captured with a distributed modeling approach. At least every municipality has to give an overview of its specific regulations and special contact persons. To give this information to the point of single contact, every municipality has to capture it in a structured way. To efficiently

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perform these efforts, a standardized, easy, and fast modeling method is necessary to support the municipalities. Due to the demand for standardization of the processes, a semantically standardized modeling approach is appropriate to capture the process information. Only such an approach allows for answering questions such as: does a process comply with the quality regulations of an organization [14], are there any substantial weaknesses or too many information needs because of locals laws in the process [4], or is a service in two different organizations performed by the same process [16].

The contribution of this paper is to present and evaluate a domain specific, distributed modeling method that allows for an easy and fast capturing of the relevant information for the single point of contact. Firstly, we will discuss the challenges for distributed modeling in this context. In the following, we will describe the previously published PICTURE-approach which allows for distributed modeling in public administrations, especially in the context of the EU-Service-Directive. In the subsequent section we evaluate the PICTURE-approach against the challenges of distributed modeling. The paper closes with a short summary of its main results and an outlook to further research.

2. Challenges of distributed process modeling

The modeling in a distributed environment poses special challenges for a modeling language. In the following, a number of problems which can occur in such a scenario are presented.

2.1. The ’semantics issue’ in business process modeling

Business process modeling means to use elements from two different languages, a modeling language and a domain language [15]. The modeling language provides *constructs*, i.e. categories or distinctions which give a structure to the problem domain. Examples for such constructs are ‘events’, ‘functions’, or ‘organizational units’ [19]. The domain language, on the other hand, is used to make statements about the problem domain [11]. Such a statement could e. g. be ‘building application is received’ or ‘issue passport’. To create a process model, a modeling language is applied together with a domain language. The results are model elements like a function ‘issue passport’.

The modeling language and the domain language define the *semantics* of the constructs or statements in different ways. The semantics of the constructs of a modeling language are at least specified semi-formally. Therefore, the modeling language has an exactly defined syntax and explicitly stated semantics. Contrary, the statements of a domain language only have an informal and partly implicit semantics. Theses semantics are defined by a linguistic community which controls the domain language and decides on the meaning of the domain statements. This is done on the basis of shared conventions which have been established implicitly by using the language. Only the linguistic community can judge the correctness of a domain statement.

The different specification of the semantics in modeling language and domain language has implications for a distributed way of modeling. The semantics of a process model are not only defined by the modeling language constructs. It is rather dominated by the domain statements used in the model. These domain statements are not formally defined but formulated in natural language. However, this can lead to a number of conflicts for models created in a distributed modeling scenario.

2.2. Distributed modeling conflicts

One important goal of a distributed modeling project is that the created processes models are consistent among each other and offer a uniform view of the process landscape of the problem domain. However, based on the considerations above, that part of the *semantics* of a process model are included into domain statements, problems for this consistent view on the processes arise. Such problems can be structured in the form of multiple conflicts. A *conflict* is syntactic or semantic variance between different process models that represent the same or a similar real world phenomenon. This can have to different reasons [23]: Firstly, the modelers creating the models can have varying mental representations of the real world phenomenon. Secondly, the conflict can be caused through different decisions during the explication of the mental representations.

Conflicts due to varying mental representations: The mental representations of two model creators are most likely not exactly the same. This means the model creators perceive or structure real world phenomena differently. Likewise, they can, consciously or unconsciously, consider deviating aspects of the phenomenon as relevant. This can lead to process models at diverse levels of abstraction. Likewise, in these models the sequence of activities can vary or the model elements can be annotated with different details.

Conflicts due to the explication: Even when the model creators share “the same” mental representation conflicts can arise. These conflicts result from a different explication of the mental representations. Domain and modeling languages offer certain degrees of freedom to express a given fact. Model creators can utilize this freedom in diverse ways. For example, different domain statements can be chosen to express a specific aspect of the mental representation. Similarly, a model creator may have the choice between multiple constructs to describe a given fact. Thus, even with equivalent mental representation, different process models with corresponding conflicts can emerge.

It is important to stress that conflicts are not necessarily unwanted and that conflicts are not domain specific but to generic purpose. In large modeling projects it is often helpful to start with an abstract model, to gradually decompose it, and, subsequently, to refine the emerging parts [22]. This leads to models with different levels of abstraction. Likewise, it can be reasonable to avoid presenting the same aspects of a model to all target groups [3]. Consequently, process models with a varying number of elements can emerge. However, even if conflicts sometimes have a certain purpose, they become a problem when a homogenous representation of a large number of processes is needed such as in a database for point of single contact in the context of the EU-Service-Directive.

Deviations between models have been investigated empirically especially in the context of structural models. UML Class Diagrams have been analyzed in multiple modeling experiments [12]. Other empirical studies have focused mainly on the advantages of specific constructs in comparison to alternative forms of representation, such as entity types and attributes [20], properties of relations [6], optional properties [5], or whole-part relations [21]. There are only a very few empirical studies that refer to variations in process models. Mendling et al. [13], for example, have analyzed the SAP Reference Model to identify errors and inconsistencies. Gruhn and Laue [10] have investigated the role of OR-connectors in EPC models.

Beneath these empirical studies, conflicts between models have theoretically been discussed in the database schema matching and integration literature [e.g., 1], in publications about metamodeling [e.g., 18], and ontology engineering [7]. In this paper we draw upon Pfeiffer [15] who has derived a comprehensive theoretical analysis of the conflicts in the context of business process modeling. The different semantic conflicts which can arise are described in Table 1. To get a consistent model of the process landscape, e. g. in the form of a knowledge base, these conflicts have to be avoided.

Table 1: Description of Distributed Modeling Conflicts [15]

Conflict name	Conflict description
Type conflict	Two model elements have the same meaning but a different construct (type) assigned, e. g. a function or an event, respectively.
Synonym conflict	Two model elements have the same meaning but different labels, e. g. 'receive application' or 'accept application'.
Homonym conflict	Two model elements have the same label but a different meaning. Consider for example the term 'accept application'. On the one hand it can have the meaning of receiving an application, like above, on the other it can mean that the application has be granted.
Abstraction conflict	Model elements in two different models have a deviating level of abstraction. While one model might contain a model element like 'sent notification' the other could contain the more specific elements 'package notification' and 'give document to mail room'.
Control flow conflict	The number of outgoing or incoming control flows of two corresponding model elements differs.
Annotation conflict	Model elements are annotated with different other model element. In an EPC, for example one modeler might annotate a application systems used in a function while another modeler annotates the position execution the function.
Order conflict	The order of the two model elements is permuted between two process models.
Separation conflict	There is a model element that has no corresponding model element in the second model with the same, a more general, or a more specific meaning. E. g. one modeler might include the clients actions in a model while the other does omit this.

In the next section a modeling language for public administrations is described that avoids most of these conflicts by offering specific language characteristics.

3. Distributed business process modeling with the PICTURE-approach

PICTURE is a domain specific modeling language, designed for the use in distributed business process modeling scenarios in public administrations. In this section, the core constructs of PICTURE and their contribution in the context of distributed modeling are presented. It is explained why PICTURE reduces the distributed process modeling conflicts and so can help to build up the necessary process base for the point of single contact.

PICTURE uses a view concept to structure the problem domain. The following views are part of the PICTURE method:

- Process View ("How is a service delivered?")
- Business Object View („What is processed/produced?")
- Organization View ("Who is involved in the modeling process?")
- Resource View („What resources are used?").

In a distributed modeling scenario this structure allows experts from different areas of a public administration to model the aspects they are familiar with. While officials from the personnel department have the required knowledge about the organizational structure, people from the IT department can model the IT-resources which are used within the administration. All this information is brought together by people with knowledge about the different processes, who consider the data from the other views when describing their tasks. In the following the elements of the *process view* are presented in detail. For a comprehensive description of the PICTURE method see [2, 4, 9].

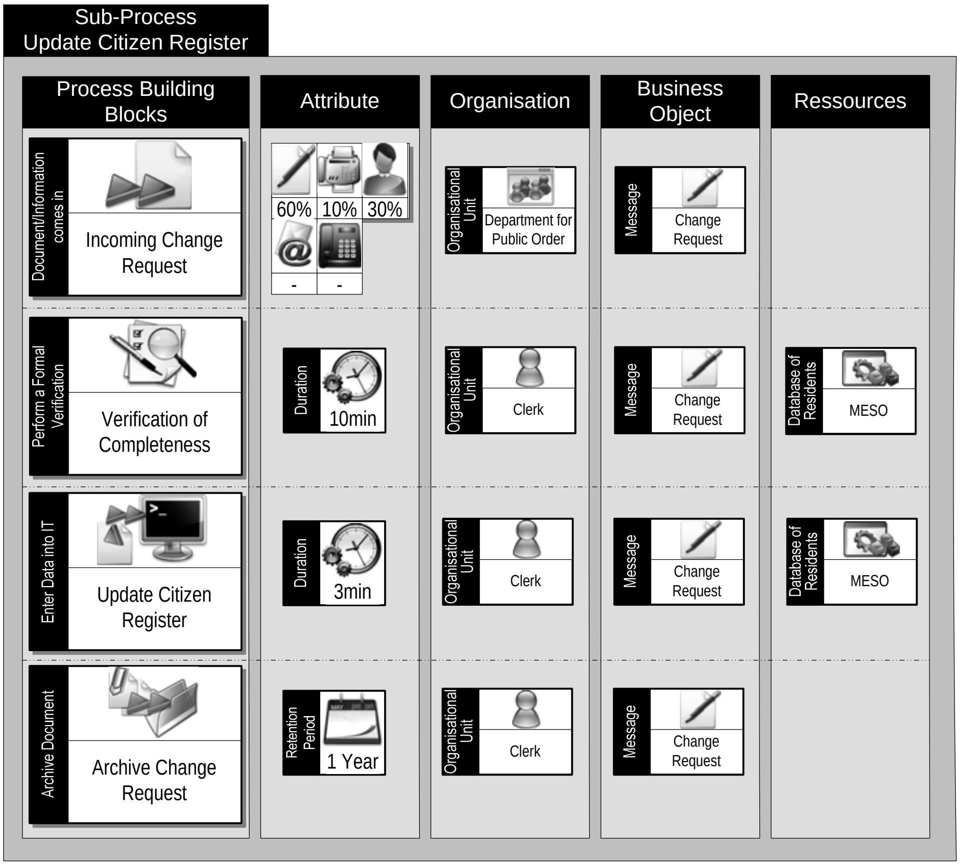

Figure 1: PICTURE local view

In the *process view* the actual processes of a public administration are described. Thereby elements from all other views are integrated into the process model to describe who carries out the process, what objects are produced, and what resources are used.

Process Building Blocks (PBB) are the core element of the PICTURE method. Each PBB stands for a typical activity from the public administration domain. PICTURE offers a set of 24 predefined PBBs like ‘Document/Information comes in’, ‘Record/Register’ or ‘Print’. These PBBs are the only way to model activities. This standardization of model elements leads to more similar models if applied in a distributed modeling scenario. Furthermore, the usage a domain specific vocabulary facilitates an easier modeling and understanding of the models by the domain experts. It allows a consistent view on the necessary activities through the points of single contact and so allows for a standardized work in these business units.

To capture the details how a certain activity is performed, each PBB has a set of corresponding attributes. For example, the PBB ‘Document/Information Comes In’ has the attributes ‘Incoming Channels’, ‘Received Document’, ‘Sending Organizational Unit’ and ‘Information Systems’. While the latter three attributes link to elements from the other views, 'Incoming Channels' is an attribute which has the distribution over different input channels as value (e. g. 75% by mail, 15% by fax, 10% personally).

A sequence of PBBs forms a sub processes. A *sub processes* is defined as the part of process which is performed by a single official from one organizational unit. Therefore PICTURE does not allow for parallel activities in one sub process as one person can only do one thing at one time. This definition of a sub process is furthermore important for the support of distributed modeling by the PICTURE method. The main idea of PICTURE is 'model what you do': each official of a public administration should model (directly or in an interview) the parts of the process which he executes by himself and, therefore, has the detailed knowledge of. These parts of a process are confined in a sub-process and are called the local view of process (cf. Figure 1).

Through the definition of a sub-process PICTURE does not need a construct to model parallel splits within sub-processes. However, there might be variations in a sub-process flow, e. g. as result of a decision. PICTURE offers here two possibilities to deal with those alternatives. The first one are attributes like the 'Incoming Channels' presented above. Here, different alternatives are modeled by using percentage values. This way, smaller variations can be modeled. The second option to represent larger variations is a so called *sub-process variant*. Each variant describes one alternative sub-process flow from the beginning to the end. Percentage values are annotated to capture the frequency of each variant.

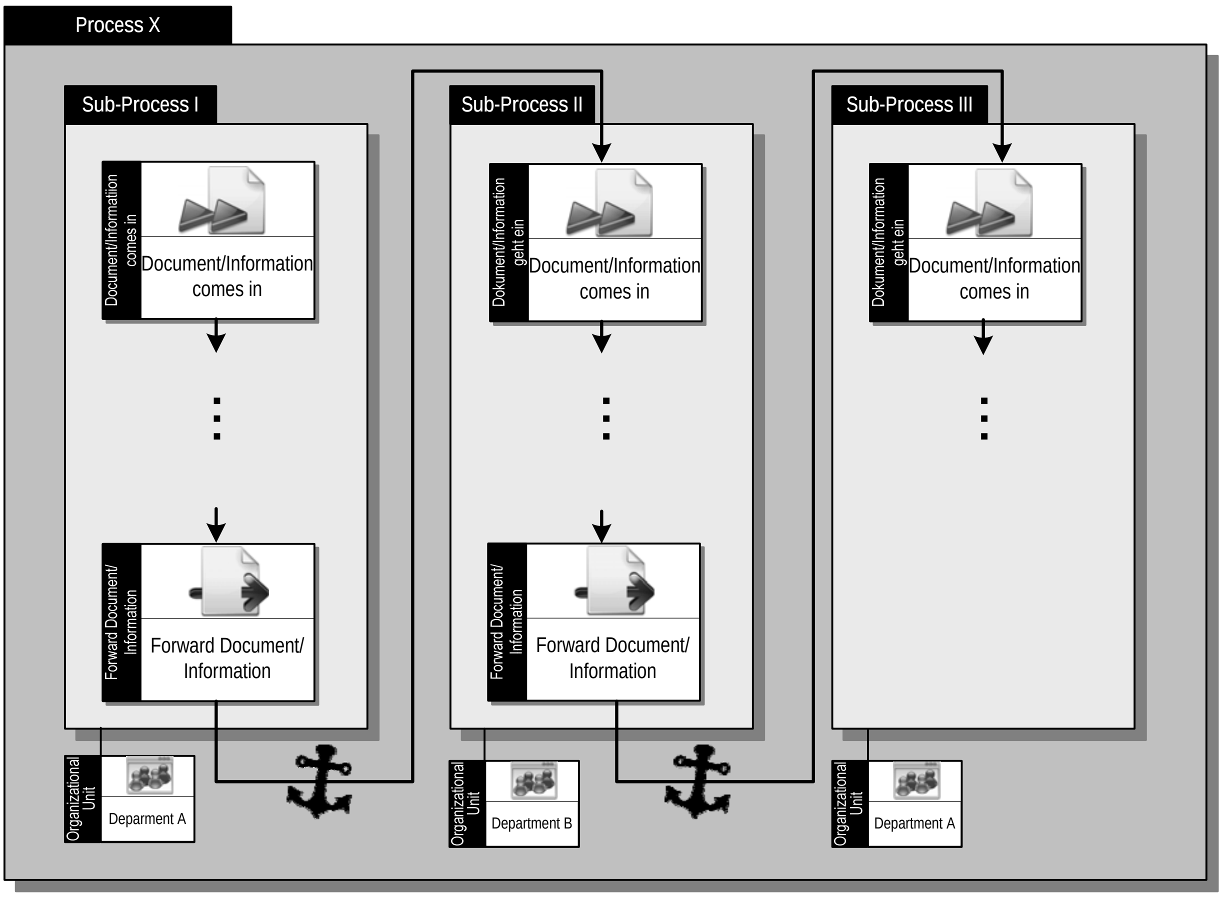

Figure 2: PICTURE global view

To obtain the global view on a process, sub-processes are assembled to processes. A *process* is defined as an atomic service to a customer of public administration, i. e. which is either consumed in total or not at all. Examples for processes are “extent resident parking permit” or “issue passport”.

The connection of sub-processes within one process is realized by using so called *anchors*, a concept especially developed to support distributed modeling. An anchor is created if one sub-process sends documents internally to another organizational unit within the public administration. According to the “model what you do” paradigm the modeler might not know what sub-process is triggered at the receiver. He just knows to whom he sends the information. If a corresponding process does not exist, the receiving organizational unit is responsible to create it. By this means, PICTURE allows for creating the global process view from several local sub-process views [25]. This is illustrated in Figure 2.

4. Evaluation of the PICTURE-approach for distributed modeling

The PICTURE-approach described in this paper is especially designed to support distributed modeling in public administrations. It is able to avoid most of the conflicts presented in Section 2. Furthermore, PICTURE facilitates the modeling of a large number of processes, to derive a knowledge base for the point of single contact. Besides this creation of the knowledge base it is very important to create a standardized way of modeling for various public administrations to foster consistency in the work of different points of single contact. To evaluate the characteristics of the PICTURE-language empirically testable propositions have to be derived. The first proposition refers to the question whether PICTURE is useful to model processes in the public administration domain:

PR1. The PICTURE method can be successfully applied to model a large number of processes of a public administration especially in a distributed modeling scenario.

To address this first proposition is crucial answer two questions: Firstly, whether the PICTURE-language is at all suitable to describe a significant number of processes in the public administration domain. Secondly, it also refers to the application of the method in a distributed environment. Both aspects relate to the general usefulness of the presented approach for distributed modeling.

A second proposition is concerned with getting a consistent view on the process landscape. It refers to the elimination of conflicts when applying the PICTURE-method.

PR2. Processes described with the PICTURE-method exhibit significantly fewer distributed modeling conflicts than models that are described by using traditional modeling languages.

The answer to PR2 is important to show that the PICTURE-method leads to more similar process models and, therefore, to a more consistent view of the process landscape. In the optimal case, two processes relating to the same real world process have to have an identical structure and must consist of syntactically equivalent domain statements. For this assumption to hold, all the eight conflicts presented in Section 2 have to be avoided or removed. However, to empirically support the usefulness of the PICTURE method it is sufficient to find evidence that it performs better than traditional modeling approaches

4.1. Applicability of the PICTURE-approach

So far the PICTURE-method has been applied in twelve public administrations in two federals states in Germany. Within these different projects a total number of 1,056 processes of different complexity and size have been modeled by using the PICTURE approach (cf. Table 2). The created process models have been used for different purposes, including process analysis for IT-investments and the deduction of reorganization proposals. For instance, the project with the University of Münster led to more than 40 suggestions for process improvement. The project with the Municipality of Altenberge provided decision support for the introduction of a document management system.

Table 2: Overview of the processes modeled in PICTURE-projects

Year	PICTURE-project	Number of processes
2005	Administration of the University of Münster (PICTURE@UNI)	209
2006	Examination Offices at the University of Münster (PICTURE TE@M)	28
2006	Municipality of the City of Hagen	162
2006	Municipality of the City of Münster (PICTURE@MS)	172
2007	Ministry of the Interior Baden-Württemberg	2
2007	Municipality of Altenberge (ProWiKom)	379
2007	Municipality of the City of Datteln	12
2007	Regional Board of Freiburg	9
2007	Regional Board of Karlsruhe	12
2007	Regional Board of Stuttgart	27
2007	Regional Board of Tübingen	9
2008	District of Ortenau in Offenburg	35
	Total number	**1,056**

The high overall number of successfully created process seems to support PR1. It provides evidence that the PICTURE-language is applicable to model process in public administrations. The examples of Altenberge, Münster, and Hagen also indicate that it is possible to capture quite a large number of processes by using this approach. Furthermore, the processes have been acquired by modeling teams of different sizes. For example, the project at the University of Münster employed a team of 12 method experts who captured the processes within interviews, while the project with the City of Münster had 14 team members [4]. Furthermore, here some processes were modeled by officials from the public administrations themselves as it was the case in Hagen. The results show that PICTURE can help to build up a knowledge base for points of single contact. The projects like in Münster [4] show, that the database can be created in short time which is important in the timeline of the EU service directive. These results further support PR1 as PICTURE has been successfully applied in projects with a distributed modeling scenario.

4.2. Reduction of distributed modeling conflicts

In order to show whether the PICTURE-method is able to reduce the number of conflicts in the process models it was compared with the modeling language EPC in a laboratory experiment. 13 graduate students were given a description of the process ‘issue resident parking permit’ in textual form. The participants, who were trained in applying both EPC and PICTURE, had the task to model the process in both languages. Afterwards the PICTURE models where transformed manually into EPCs first, to make them suitable for the metric of van Dongen et al [24].

Afterwards, the models in each group (PICTURE and EPC) were compared pair-wise by using the ProM-tool [17] which implements the metric of van Dongen et al. The results of this laboratory experiment are that PICTURE models achieve an average similarity score of 47.45% while EPCs could only score at a value of 0.43%. Therefore, it can be concluded that PICTURE avoids more conflicts than EPCs, at least for the process of this experiment. A detailed manual analysis of the conflicts within PICTURE-models showed that the remaining deviations are mainly separation and order conflicts. In contrast, EPC models showed various kinds of conflicts and in particular synonym and control flow conflicts. These results support proposition PR2 which states that models created with the PICTURE-language exhibit fewer distributed modeling conflicts than traditional modeling languages. This result also is important in the context of creating a knowledge base for the point of single contact. As points of single contacts will be introduced in several units in several (big) public administrations and as every municipality at least has to deliver information for these units (e.g. contact information for responsible persons at the minimum) comparability and standardization is a very important issue. Our experiment shows that PICTURE fosters these issues.

5. Conclusion

Public administrations are facing the challenge to implement a point of single contact in the context of the EU-Service-Directive. This point of single contact has the task to act as the one face to the customer of public administrations and to coordinate all steps that are necessary for setting up a service business. To accomplish this task he needs information about the involved administrational processes. Since these processes are spread over several organizations and organizational units they can only be capture in a distributed modeling scenario.

In this paper we presented PICTURE as an approach to capture the knowledge necessary for a point of single contact in a distributed manner. We have further evaluated the PICTURE-approach with respect to two propositions. Firstly, we showed that the PICTURE-method has been successfully applied to model large numbers of processes in distributed environments and, thereby, demonstrated that the PICTURE-method is in general applicable to build a knowledge base for a single point of contact. Furthermore, we showed that PICTURE models exhibit significantly fewer distributed modeling conflicts than EPCs as a representative of traditional modeling methods. Therefore, PICTURE is suited to acquire a consistent knowledge base for the point of single contact. In future research, we will analyze the ability of PICTURE to avoid conflicts in additional scenarios and will evaluate its applicability as knowledge base in a corresponding project.

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