Component-Based Distributed Modeling of Collaborative Service Processes –
A Methodology for the Identification of Reference Process Building Blocks

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Abstract
Documenting complex and collaborative business processes is time-consuming and cost-intensive. Reference modeling offers compositional mechanisms which provide the ability to overcome such challenges by supporting component-oriented procedural structures. This paper describes a methodology for the domain-independent development of components, in the following called reference process building blocks (RPBBs), which can be used for distributed, i.e. asynchronous collaborative, modeling of complex and cross-departmental process structures. Initially, fundamental requirements and the structuring of RPBBs into activities and information objects are discussed. The RPBB generation procedure consisting of identification, evaluation and revision is then applied using the public sector as an example and the resulting RPBB catalogue is presented. Finally, formal and contentual evaluations are described which both confirm the applicability of the identified RPBBs for distributed modeling of complex, collaborative processes as well as the usability of the designed methodology.

1. Introduction

Process modeling in practice is characterized by an enormous heterogeneity regarding notations, level of detail, level of generality, terminology, and tool support [1-4]. This heterogeneity increases within collaborative environments and industries where processes are only sparsely standardized [5-7]. The ability for process standardization depends on the grade of process complexity as well as on the autonomy of the involved organizational units (division and distribution of labor) [8]. Process complexity is related to the number of process fragments (e.g. sub-processes) and activities, the number of decisions (branching), and the number of involved parties [9].

By nature, collaborative processes (value chains) consist of several process fragments that different actors are responsible for (distributed knowledge). The number of involved parties and the degree of their autonomy varies for different industries and process types. The documentation of procedural structures in such environments is especially difficult when partner processes must be mutually transparent (in contrast to black box approaches) and distributed created model fragments have to be joined to complete processes. In such settings, partners have to agree on consistent conventions for the common use of notations (syntax and semantics), levels of detail and abstraction as well as on terminologies and tools (standardization of modeling techniques). This standardization is obviously the more challenging the less cooperative and influenceable partners are (coordination of networks vs. hierarchies).

An example for collaborative service production and complex decision processes is the public sector. Public service production is characterized by a high division of labor (function-oriented specialization) and distributed responsibilities (fragmentation of processes) with high numbers of intra-organizational and inter-organizational interfaces, redundant information management, use of inefficient and single user (e.g. paper-based) communication channels as well as – even within one administration – a high autonomy of process partners [10-12]. Coordination of these stakeholders – who are often inexperienced in process management and modeling issues – requires significant efforts. This results in large, expensive projects and respective project risks.
Therefore a methodology is proposed which enables distributed modeling (i.e. asynchronous collaborative modeling where involved actors can be distributed over time and place) supporting a high flexibility for depiction of complex processes, a high standardization for ensuring syntactic and semantic compatibility of process fragments and assuring a high quality of the resulting models. This paper describes a methodology for domain-independent identification and standardization of components – so called Reference Process Building Blocks (RPBBs) – that can be used for distributed modeling of complex, collaborative processes. For that purpose, Section 2 initially introduces the theoretical and methodological foundations of the conducted research. The construction of the methodology and its application are based on the design research paradigm and are being described in Section 3. Section 4 then discusses the evaluation results from a formal and a contextual perspective.

The developed methodology is intended for persons who are responsible for organizational engineering and modeling issues in collaborating organizations.

2. Basic Principles

2.1. Characteristics of Distributed Process Modeling

In order to depict real life situations in a model, several conditions and requirements have to be considered. During the recent years, researchers investigated the field of information and process modeling extensively and developed numerous guidelines and criteria [1, 3, 13, 14].

Distributed modeling of processes requires additional mechanisms of partner coordination and alignment in order to achieve comparable and compatible process fragments to be joined to complete processes. One prerequisite is a common understanding of processes which can be established by defining terminologies as well as common levels of detail and abstraction. Furthermore, modeling notations and tools used by the different related partners have to be compatible. Considering autonomy of and limited influence on involved parties, revolutionary approaches of business process reengineering (BPR) will be hardly applicable. Instead, a more evolutionary approach such as continuous process improvement (CPI) with respect to the current situation of each partner has to be supported by modeling methodologies in collaborative environments [12]. This implies high modeling flexibility which allows not only to communicate an optimized to-be state but also to depict the present condition and to analyze its change potentials primarily focusing on the needs of network partners. In order to minimize the efforts and to maximize the quality of results, the methodology has to support efficient and effective as well as intuitive modeling. The latter is important because extensive modeling knowledge cannot be expected by each of the various partners within a network.

A proven concept that targets such requirements and conditions by reusing (predefining and adapting) generic model structures is that of reference modeling. Thus, specific adaptation mechanisms of reference modeling will be briefly presented and evaluated in the subsequent section with respect to the above mentioned criteria.

2.2. Reference Modeling Potentials

The reference modeling approach [15] provides mechanisms of predefinition and adaptation to efficiently instantiate individual models from generic reference models or model components (reuse). The idea of predefining and adapting subdivide reference modeling activities into the phases of construction and application [16]. Although this contribution focuses on a construction methodology, different application mechanisms have to be supported and explicitly considered during the design phase. Such mechanisms of application respectively adaptation can be categorized into configurative [17-19] and compositional concepts [12, 14]. The configurative top-down mechanism requires extensive knowledge about all potentially occurring variants of a model on the one hand and on the other hand about the respective conditions for each variant which have to be described in configuration parameters. In contrast, compositional bottom-up approaches enable the adaption of standardized components for creating an individual model. Examples are the configuration of business processes within standard software applications [20] or the composition of independent software services to complete workflows [21, 22]. Differences between both mechanisms are described in Table 1 (following [12, 14]).

These differences imply concrete consequences concerning their applicability for distributed modeling of processes. The configurative top-down mechanism requires extensive knowledge about all potentially occurring variants of a model on the one hand and on the other hand about the respective conditions for each variant which have to be described in configuration parameters. On that foundation the construction effort is comparatively
high and the adaptation effort is considered moderate. As all variants have to be known in the construction phase, process innovation during adaptation phase is limited by the generality of the model (specialization for predefined situations). Thus, the configurative mechanism is suitable for highly standardized and well-structured processes and is currently for example applied for customizing of (standard) software processes. In addition, continuous process improvement which is considered appropriate to engineer collaborate processes is less supported by predefined model configurations as the current situation is not being considered sufficiently.

Table 1: Differences between configurative and compositional adaptation mechanisms

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Configuration</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptation Principle</td>
<td>Top-down</td>
<td>Bottom-up</td>
</tr>
<tr>
<td>Construction effort</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Adaptation effort</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Reusability/Generality</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Process Innovation</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>CPI-Support</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

In order to model collaborative processes in a distributed environment, compositional mechanisms of adaptation seem to be more suitable. Business processes typically consist of a sequence of activities (tasks) that produce a specific business outcome [23]. Especially in domains focusing on information management such as insurance, banking or public administration, process structures are very heterogeneous but basic activities (components) recur regularly. Bottom-up composition of modular activities promises – once identified and standardized – moderate effort for adaptation. Although composition supports restricting mechanisms (e.g. rules) to ensure model consistency and plausibility, the potential for process innovation and flexibility to depict both the as-is and the to-be situation are high. Accordingly, support of CPI and generality are high as well.

As a consequence, composition of activities is considered an appropriate adaptation mechanism for efficient, distributed modeling of collaborative processes. In the following a methodology is presented that describes the identification and standardization of such model components.

2.3. Research Approach

As the construction of innovative and sophisticated methodologies is a rather pertinent and practical issue, engaged research is needed in order to provide a rigorous solution for a relevant problem. A theoretical foundation that serves both relevancy and rigor is that of design research. The design research process aims at building and evaluating artifacts, in order to extend existing capability limitations [24]. Hence, it is considered a problem-oriented approach [25].

In this case a method artifact for domain-independent identification and standardization of model components has been developed. Starting point was the analysis of appropriate modeling mechanisms (such as the efficient adaptation of reference models). This served as basis for the construction and evaluation of the methodology. In the subsequent section the development of the methodology (construction of the artifact) is described by defining requirements to RPBBs, discussing the design of the methodology and applying the artifact in the public sector domain.

3. Construction of the Methodology

Distributed modeling of collaborative processes on the basis of standardized components (RPBBs) has to meet specific demands (cp. Section 2.1). Prior to the development of the methodology, the idea of distributed modeling will be explained, in order to derive concrete requirements to the RPBBs.

For this contribution, distributed modeling implies that each network partner is responsible to model his own parts of the process. Subsequently, such process fragments are conceived as interrelated compositions of RPBBs (sequence of activities). Hence, in collaborative environments a number of connected fragments constitute a complete business process. In turn, a business process consists of one or more fragments depending on the number of involved parties which can be whole organizations, organizational units, or even single people or roles. With this concept not only inter-organizational value chains but also collaboration within one highly specialized organization can be modeled.

The interfaces between fragments depict the exchange of information objects – such as messages and documents – between collaborating partners (information flows) by connecting activities of the individual partners which are depicted by one sending and one receiving RPBB in each fragment. Thus, different categories of RPBBs have to be considered by the methodology, e.g. one category contains RPBBs for communication. The depiction of inter-fragmental communication provides information about the output of a sending fragment that becomes the input for a receiving fragment.

The modeling of information flows can be applied to support distributed modeling. If an information
flow to a network partner is modeled, a new fragment can be created as container for modeling the activities carried out by the partner. Hence a modeling task for the receiver is being created and the network partner is enabled to carry out the modeling activity. This mechanism enables consistent use of information objects by different partners and allows further guidance of modelers for creation of consistent process models in support of collaborative modeling. A potential guidance is that an information object can only be used within a fragment if it has been received by another partner or newly created within the fragment by a “producing” RPBB. Thus, syntactic as well as semantic integrity of modeled fragments can be ensured.

3.1. Modeling Component Requirements

As the methodology described in this contribution aims at the identification of RPBBs to enable distributed process modeling, the requirements for these components have to be defined in order to adequately design and evaluate the artifact. The previously introduced concept of distributed modeling lays the foundation to complement and extend the generic properties (cp. Section 2.1) by deriving more specific requirements.

The ability to compose RPBBs was mentioned as the key feature for distributed modeling. Prerequisites are modularity and reusability of single components which means that RPBBs have to be self-contained elements that are generic enough to be used in different contexts and situations. Considering the distributed modeling knowledge in heterogeneous partner networks, comprehensibility, unambiguity and documentation are evident requirements. In order to facilitate transparency and intuitive access to the adequate RPBBs for each case, the number of components presented to the modeler should be as minimal as possible. This usually implies a higher level of generality which might conflict to the requirement of comprehensibility. The requirement of a minimized number of RPBBs implies the requirements relevancy and necessity for single RPBBs which will be used for individual evaluation in Section 4.1.

Especially in internationally collaborating networks, multilingualism is another requirement that also covers the ability to depict regional differences in terminology and use of synonyms which again facilitates comprehensibility. Uniformity and appropriateness of the level of generality as well as of the level of detail are considered further requirements. While uniformity allows for conjoining several process fragments to a complete model of collaborative service production, inappropriate standards result either in useless models (e.g. too generic or too aggregated) or in models that are very difficult to maintain (e.g. too specific or too detailed). These requirements are summarized in Table 6. They provide the foundation for designing the methodology which is described in the subsequent section.

3.2. Development of the Artifact

In order to specify typical components (relevancy) in an appropriate way (rigor), an inductive approach was chosen initially. Based on existing process models, usually recurring tasks should have been identified (RPBB candidates) and standardized (RPBBs). However, this approach failed as the high heterogeneity of evaluated models would have led to a similarly high heterogeneity and a high number of RPBBs – two conditions that have been excluded by the preliminary requirements definition. Consequently, characteristics of the model basis have been analyzed resulting in the finding that the various levels of detail and generality as well as used terminologies are the main issue. Thus, a concept was required to normalize this heterogeneity.

By taking a deeper look into the structure of model elements, it became clear that each task typically consists of an activity and an information object that is processed by the activity. Examples are “Send a letter” and “Print a document”. Hence, the concept of selecting only activities as RPBB candidates and relating separately documented information objects is considered a kind of generalization (1) and became starting point for further investigations. Subsequently, further information depicted in process models has been analyzed. As extensively investigated in research and practice, organizational responsibilities and used information systems (e.g. software application support) provide valuable information about the respective responsibilities, organizational interfaces and maturity of the service production especially in collaborative settings. Both elements can be documented in appropriate models such as organization chart and application landscape, and linked to a RPBB. Additionally, RPBBs can be described more specifically, e.g. by deductively adding individual attributes such as communication channel, receiver, and sender (for communication RPBBs), processing and idle times, or concerned legal restriction. This applies to information objects, too, and corresponds to the concept of specialization during the modeling process.
Summarizing, the design phase is realized by generalization and the adaptation phase is realized by specialization. The above mentioned elements of component-oriented process modeling are related to each other in Figure 1 [26].

![Diagram](image)

**Figure 1:** Conceptual model of elements for process modeling and their relations

An example instantiation of this conceptual model representing a part of a process model is shown in Figure 2.

![Diagram](image)

**Figure 2:** Example instantiation of the conceptual model

The methodology derived in this section focuses on the identification of activities and targets their standardization to RPBBs. According to common process definitions [23] and the concepts of Method Engineering [27], the methodology consists of design activities and respective design results (cp. Table 2).

![Table](image)

**Table 2:** Design activities and expected results of the methodology

<table>
<thead>
<tr>
<th>Design activities</th>
<th>Expected results</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Identification</td>
<td>Initial RPBB catalogue</td>
</tr>
<tr>
<td>(2) Initial evaluation</td>
<td>User feedback</td>
</tr>
<tr>
<td></td>
<td>Example process models</td>
</tr>
<tr>
<td>(3) Revision</td>
<td>Evaluated RPBB catalogue</td>
</tr>
<tr>
<td>(4) Final evaluation</td>
<td>User feedback</td>
</tr>
<tr>
<td></td>
<td>Example process models</td>
</tr>
<tr>
<td></td>
<td>Detailed RPBB documentation</td>
</tr>
</tbody>
</table>

The design activities are aligned with the two main phases of construction and evaluation proposed by the design research paradigm (cp. Section 2.3) and iterate twice. Subsequently, each design activity is specified in more detail. The first design activity (identification) consists of four sub-steps:

i. Search an activity, task, function, or similar
ii. Extract the activity (generalization)
iii. Check for duplicates and synonyms
iv. Decide about entry of the RPBB candidate
   a. Candidate not contained yet: → Incorporate as new RPBB
   b. Candidate already contained: → Reject because of double entry
   c. Similar candidate contained: → Incorporate as synonym

The above mentioned sub-steps have to be conducted sequentially for each new RPBB candidate, and iterated until no new activities are expected, respectively the RPBB catalogue is considered to be complete. The first sub-activity aims at identifying any contained activity, task, function, or similar within the underlying model basis. The result is used in order to extract potential RPBB candidates in sub-step 2. For a clear terminology, activities always should be (re-) phrased as a verb (e.g. “receive” instead of “reception”). In the third sub-step the identified verb needs to be compared against the catalogue of RPBB candidates which influences the decision in sub-step 4. Result of these design activities is a catalogue of RPBB candidates (including a number of synonyms) which has to be evaluated subsequently. Potential evaluation activities include:

- Analyze compliance with defined requirements
- Create concrete process models using the RPBBs
- Conduct expert interviews
- Gather feedback via questionnaires
- Conduct workshops with practitioners

Experiences and results from the first evaluations will be discussed in Section 4. Subsequently, the RPBB catalogue has to be revised focusing on the following issues:

- Reject RPBBs that are evaluated as unnecessary
- Add missing RPBBs
- Modify existing RPBBs (e.g. by adding or removing synonyms)
- Explain and exemplify each RPBB
- Translate RPBBs and their specifications

Subsequently, a second evaluation iteration should apply the previously described activities.
enhanced by explicit evaluation of explanations and examples (applicability of the RPBBs). If necessary, the specifications have to be revised a second time.

### 3.3. Application of the Artifact

This methodology has been applied exemplarily in the context of a research project [28] in the public sector which is characterized by collaborative service production (cp. Section 1) and, thus, is considered appropriate to test the constructed artifact. Within the project a total of 37 RPBBs have been specified by participating research partners and municipalities. Table 3 contains the example of the RPBB “Send”.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>RPBB-2</td>
</tr>
<tr>
<td>Name/Synonyms</td>
<td>Send</td>
</tr>
<tr>
<td>Definition</td>
<td>The RPBB describes an outgoing transfer of an information object to an external or internal network partner e.g. by mail, fax, e-mail, phone or personally</td>
</tr>
<tr>
<td>Category</td>
<td>Communication</td>
</tr>
<tr>
<td>Examples</td>
<td>Send an invoice</td>
</tr>
<tr>
<td>Overlapping</td>
<td>RPBB-33 [Forward/Delegate]</td>
</tr>
<tr>
<td>Status</td>
<td>Evaluated</td>
</tr>
<tr>
<td>Attributes</td>
<td>Processing time [0..1:time]</td>
</tr>
<tr>
<td></td>
<td>Transport time [0..1:time]</td>
</tr>
<tr>
<td></td>
<td>Communication channel [1:array]</td>
</tr>
</tbody>
</table>

Table 3: Specification of an example RPBB

Each identified RPBB has been individually specified and assigned to one or more categories. A complete list of categories and the related RPBBs is provided in Table 4 [following 29].

<table>
<thead>
<tr>
<th>Categories</th>
<th>RPBBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Send/Hand over, Receive, Take from, Take notice, Publish, Demand/Follow up, Forward/Delegate, Assign, Notify, Consult (externally), Discuss (internally)</td>
</tr>
<tr>
<td>Analysis</td>
<td>Retrieve/Enquire, Check/Verify, Decide, Examine/Analyze, Monitor/Obsserve, On-Site-Visit</td>
</tr>
<tr>
<td>Production</td>
<td>Change/Update/Complete, Create/Produce, Certify/Legalize, Calculate, Document</td>
</tr>
<tr>
<td>Transformation</td>
<td>Capture/Enter, Scan, Print, Copy</td>
</tr>
<tr>
<td>Administration</td>
<td>Start/Open, Close, Archive, Dispose/Delete, Invalidate, Coordinate, Register</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Reserve/Book, Pay, Encash, Sign</td>
</tr>
</tbody>
</table>

Table 4: Categories and related RPBBs

As the methodology solely concentrates on identification of RPBBs, attributes are not elaborated more extensively. The subsequent section discusses the evaluation of the designed methodology according to the design research paradigm.

### 4. Evaluation of RPBBs

The evaluation described in this paper focuses on RPBBs which are the results of applying the methodology (not the designed artifact itself). Findings about quality and applicability of RPBBs allow conclusions regarding the quality and applicability of the underlying methodology. In this contribution, a formal and a contentual evaluation are differentiated. While the formal part contains theoretical analyses of RPBBs regarding predefined requirements (cp. Section 3.1), the contentual part documents the practical (content-related) applicability of RPBBs.

#### 4.1. Formal Evaluation

As part of the research project, twelve workshops and several interviews in European municipalities have been conducted which involved domain experts and modeling specialists who had to benchmark each RPBB with regards to fulfillment of the defined design goals (cp. section 3.1) using a multilevel scale (+ completely fulfilled, +/- partially fulfilled, - not fulfilled, Ø not evaluated yet). The involved municipalities provided process models that were used to identify process activities and to design the RPBB. However they were not involved in the design process thus ensuring validity of the evaluation results through separation of data used to develop the method from evaluation data. As already mentioned in Section 3.1, the requirement of a minimal number
of RPBBs is replaced by relevancy/necessity. If all RPBBs are considered relevant and necessary, the number of RPBBs can be assumed minimal. Three RPBBs have not been evaluated, as they have just been identified during the prior evaluation period. Table 6 provides an overview of the results.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>No. of evaluated RPBBs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Modularity</td>
<td>24</td>
</tr>
<tr>
<td>Reusability</td>
<td>33</td>
</tr>
<tr>
<td>Comprehensibility</td>
<td>31</td>
</tr>
<tr>
<td>Unambiguity</td>
<td>20</td>
</tr>
<tr>
<td>Documentation</td>
<td>33</td>
</tr>
<tr>
<td>Relevancy/Necessity</td>
<td>27</td>
</tr>
<tr>
<td>Multilingualism</td>
<td>34</td>
</tr>
<tr>
<td>Level of Generality</td>
<td>33</td>
</tr>
<tr>
<td>Level of Detail</td>
<td>22</td>
</tr>
</tbody>
</table>

Altogether, the degree of accomplishment can be considered as high. There is no RPBB that does not meet the demands. However, deficiencies can be identified regarding modularity, unambiguity and level of detail. Examples for deficits concerning the level of detail are the RPBBs “send” and “archive”. Especially archiving can be understood as a modular activity or separate process fragment. Weaknesses regarding modularity and unambiguity are closely related to the demand that only minimal overlapping should occur. Although overlapping could not be prevented completely, the evaluators’ feedback initiated extensive revisions on names, synonyms, examples and explanations of RPBBs. A list of the most deficient RPBBs is presented in Table 7. These RPBBs have to be carefully analyzed during further modeling activities in order to be improved or rejected.

<table>
<thead>
<tr>
<th>RPBB</th>
<th>No. of Deficiencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinate</td>
<td>10</td>
</tr>
<tr>
<td>Assign</td>
<td>3</td>
</tr>
<tr>
<td>Take from</td>
<td>3</td>
</tr>
<tr>
<td>Change/Update/Complete</td>
<td>3</td>
</tr>
</tbody>
</table>

Summarizing, suitability of RPBBs for distributed modeling of collaborative processes can be confirmed on the basis of the formal evaluation. However, evaluation from a content-based perspective provides more experience-driven and, thus, practice-related feedback.

### 4.2. Contentual Evaluation

For contentual, practice-oriented evaluation, a number of 200 processes have been modeled with five municipalities that are involved in the project to prove practical applicability. Using a prototypical web-based tool implementation, the modeling was carried out in a distributed manner by public administration officials. The procedure for distributed collaborative modeling required each official to depict the present status of their process fragments as well as the information flow with other process participants (whom themselves modeled their activities). An example process fragment which points out the basic principle of differentiating RPBBs and information objects is presented in Figure 3 using the Business Process Modeling Notation [30].

This fragment depicts the involvement of another collaborating unit within a municipal approval process which the building authority is basically responsible for. This unit participates in the service production by providing a statement. Although specific attributes have been annotated for RPBBs and information objects, they are not visible in the presented view. Examples are the number of pages and medium of information objects as well as communication channel, number of copies, and template support (cp. Table 5).

Documenting 200 real processes of diverse public administrations proved to be very valuable because both, the various issues as well as the perceived advantages of the component-based modeling approach emerged. Most important advantages mentioned by evaluators from public administrations are the standardization and flexibility of process modeling (consistent levels of detail and generality as well as terminological pre-definitions), extensive specifications that enable modeling also for inexperienced people, and the transparent modeling approach (combination of RPBBs and information objects). These advantages demonstrate that the methodology meets the basic requirements for distributed modeling of collaborative processes discussed in Section 2.1.

Perceived issues to be addressed are a lack of awareness about some self-evident activities, uncertainties regarding overlapping (which should have been eliminated to a large extent), and the high level of detail which causes relatively high modeling efforts. Issues and advantages have to be considered by further research as the discussed findings only represent perception in the public sector domain.
5. Summary and Outlook

This paper describes the development of a methodology for the domain-independent identification of Reference Process Building Blocks which can be used for distributed modeling in collaborative process environments. Based on an initial evaluation of adaptation mechanisms from the area of reference modeling, suitability of a compositional (building block-based) approach was derived. This contribution describes both the construction as well as the evaluation of the methodology in the public sector where the identified RPBBs have been used exemplarily for modeling of about 200 municipal processes.

Summarizing, the RPBB-based modeling is considered to be suitable to model collaborative processes in a distributed way. A number of advantages can be exploited from the described component-based modeling approach such as the reduction of model heterogeneity and the diffusion of a common understanding (through standardization of terminology, level of detail and level of abstraction), the distributed modeling of process fragments by responsible domain experts as well as the consistent consolidation of the process fragments to complete process models based on their standardized components.

The actual methodology for RPBB identification provides a valuable basis for targeted users (cp. Section 1) to develop their own building blocks for individual domains and purposes. Although this contribution is limited to an analysis of the suitability for the public sector domain, the specified RPBBs can be evaluated for the use in other industries that focus on information management and collaborative service production (e.g. finance or insurance sectors) as well.

However, the claimed generality of the actual methodology for domain-independent identification of RPBBs has not been proven yet. For that purpose, current research is concentrating on applying the methodology to other industries. Due to the collaborative character of medical treatment processes and the highly specialized and distributed knowledge of involved actors, the health care domain was selected for a follow-up project. The expected findings will provide valuable information to improve the methodology described in this paper.

Further challenges and potential fields for research arose during the evaluation. First, guidance (rules) and a procedure model for RPBB composition should be developed in order to implement capable plausibility and consistency checks not only from a syntactic but especially from a semantic point of
Additional evaluation of the methodology itself (which is the actual artifact) can be applied e.g. by using the methodology in other domains, in order to refine and complete the design activities. A potential disadvantage identified during evaluation is related to the high level of detail which has to be managed. Although the provided methodology is flexible with respect to the level of detail, the decision to develop highly detailed RPBBs causes higher efforts for documenting processes. Further refinements of the methodology could address this issue by identifying typical sequences of components (patterns). This can be for example realized on the basis of a semantic standardization of RPBBs using the comprehensive basis of 200 process models for the public sector. Consequently, such patterns will enable standardization of process fragments, too, and support a more efficient modeling (cp. analogy-based construction [14]). Hence, a methodology for identification of typical process patterns is required. Concluding previous discussions, the main strength of RPBB-based process documentation is the semantic standardization of models. This not only enables distributed modeling by heterogeneous user groups but also allows for the automation of analyses such as pattern-based mechanisms for plausibility and consistency check, performance measurement, identification of organizational weaknesses and potentials for optimization (organizational, technology-driven, etc.) as well as for transformation into other (e.g. more technical or user-dependent) notations and views [26]. However, automation approaches obviously require technical support. Hence, a realization in form of a web-based prototype is currently progressing. On the one hand this prototype supports distributed process modeling with RPBBs implementing the idea of stepwise specialization via dynamic dialogues (guided modeling). On the other hand, using ontologies and semantic reasoning enables the pattern-based identification of organizational deficiencies (weaknesses) and potential supporting information technologies.

The prototypical implementation allows for flexible modifications of existing RPBBs and for the extension with additional RPBBs and weakness patterns. It enables comprehensive testing and evaluation of the described approaches. Furthermore, it supports the transfer of the developed methodologies to other domains and further associated adaptations and refinements. The underlying methodological foundation and the prototypical implementation thereby represent a rigorous as well as relevant contribution to the field of collaborative process modeling.

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7. Bibliography


