

# A METHODOICAL INTEROPERABILITY FRAMEWORK FOR COLLABORATIVE BUSINESS PROCESS MANAGEMENT IN THE PUBLIC SECTOR

Matheis, Thomas, Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI), Stuhlsatzenhausweg 3, Building D3 2, 66123 Saarbrücken, Germany, thomas.matheis@iwi.dfki.de

Ziemann, Jörg, Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI), Stuhlsatzenhausweg 3, Building D3 2, 66123 Saarbrücken, Germany, joerg.ziemann@iwi.dfki.de

Loos, Peter, Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI), Stuhlsatzenhausweg 3, Building D3 2, 66123 Saarbrücken, Germany, peter.loos@iwi.dfki.de

## Abstract

*Nowadays, economic as well as public organizations are changing towards networked structures. An increasing level of cooperation between public administrations on national, regional and local levels requires methods to develop interoperable E-Government systems and leads to the necessity of an efficient modeling of collaborative business processes and their subsequent implementation. This is a complex task, since it includes modeling of processes from various perspectives - modeling of internal and collaborative processes - and on various technical levels to enable both conceptual modeling and the execution of processes that comply with the conceptual models. In this paper a methodical interoperability framework is described for the management of collaborative business processes in the public sector. Building on this, it is described how business process models can stepwise be transformed to technical process models in the form of Web Service protocols for implementing the collaborative processes. The methodology is motivated and explained on the basis of an E-Government reference model for the German Plan Approval Procedure. After a motivation for the need of interoperability frameworks, section 2 describes the R4eGov methodical interoperability framework. Based on this, the paper presents in section 3 a method that allows the creation of collaborative business processes on a conceptual level. Here, the requirements and single steps of the collaborative modeling method are illustrated on the on the E-Government case study. In section 4 we change from design time to run time and describe how to implement the modeling approach presented before with Web Service protocols. Finally, we draw a conclusion and give an outlook on future research in section 5.*

*Keywords: Interoperability, Framework, Collaborative Business Process, E-Government*

# 1 MOTIVATION

Due to the increasing heterogeneity and dynamics of the European Union, more and more public administrations within Europe are challenged to work together and to adapt continuously to rapid technological changes. New legal settings, modernization, the need for improved quality of service, the search for competitive advantages and innovations as well as rapid technological advances create a new dynamic and complex administration environment, which requires flexibility and mobility from European public administrations. For these reasons different governments have to cooperate in order to modernise and innovate public administrations, to provide citizens and industries with new service offers, to encounter the contemporary prevalent high cost pressure, to reduce the current administrative overheads as well as to stay globally competitive and keep Europe attractive as a place to live, work and invest. In this respect the opening of an organisation's borders is no longer regarded as a necessary evil, but rather as an opportunity with strategic importance within the European Union.

To enable a cooperation of public administrations and to cross-link the corresponding software systems the European Commission has launched several research and development programs in the area of interoperability. Examples are the Interchange of Data between Administrations, Businesses and Citizens (IDABC) (IDABC 2005) or the MODINIS program (MODINIS 2005).

The European Interoperability Framework (EIF) (European Commission 2004) was developed within the Interchange of Data between Administrations (IDA) program (eEurope 2005) of the European Commission and presents a framework for a common understanding of interoperability. The objective of the EIF is to support the delivery of pan-European E-Government services to citizens and enterprises. Based on general principles like accessibility, security or the use of open standards, EIF gives recommendations and guidelines for E-Government services in order to enable the interaction of administrations, enterprises and citizens across borders.

In order to fulfil the eEurope Action Plan the MODINIS program aims to analyse good practices all over Europe, to prepare the future structure for network and information security issues, to analyse the economical and societal consequences of the information society and to establish a common understanding of the single activities at national, regional and local level within the European member states. The identification of relevant and good practices in interoperability as well as the inclusion of the identified good practices in the European Commission's Good Practice Framework is the main objective of the study on interoperability at local and regional level (MODINIS 2006) which is developed with the support of the MODINIS program.

In this context, the term interoperability is defined by the European Commission as "the means by which the inter-linking of systems, information and ways of working, whether within or between administrations, nationally or across Europe, or with the enterprise sector, occurs" (European Commission 2004). To enable public administrations to open themselves towards other authorities as well to their customers and to collaborate with them, the public administrations have to be supported with E-Government interoperability frameworks and solutions which cover strategies, organizational concepts and information technology in order to link administrative business processes and to interconnect the corresponding application systems (Werth 2005). Such interoperability frameworks should consider three levels of interoperability: the organizational interoperability focus on the interoperability of business processes and information architectures beyond the borders of different administrations. The semantic interoperability aims to establish a common meaning of the exchanged data, process models or used procedures. The linking of systems and the definition of corresponding technical standards in order to enable a seamless communication is addressed by the technical interoperability (European Commission 2003).

Current interoperability frameworks mainly focus on the functional aspects of E-Government interoperability (e.g. standards or technical recommendations), but don't support the methodical aspects of the collaborative processes. These developments raise the necessity to extend the existing interoperability frameworks to methodical aspects to support the designing and implementation of collaborative processes in the public sector.

The section 2 introduces the methodical interoperability framework and approach of R4eGov<sup>1</sup>. Afterwards, the paper presents an example of a collaborative scenario demonstrating how the methodical interoperability framework can be used both on the design and the implementation level (section 3 and 4). Section 5 concludes with a summary and an outlook on future research. The concepts and scenario analysis were developed within the R4eGov research project.

## 2 FRAMEWORK

The objective of R4eGov is to enable E-Administration in the large, that is, to ensure the interoperability of the software systems used by public administrations in the European Union. A corresponding framework guiding the establishment of software systems in this environment should cover functional as well as methodical aspects. Functional aspects aim to describe for example which specific E-Government data specifications, interfaces, process models or open standards ought to be used on different local, regional and international public administrations. Methodical aspects describe on a more generic level the methods to be applied for creating interoperable software systems of public administrations. While the functional aspects describe static elements, e.g. a certain standard needed for the collaboration of two public administrations on the national level, the methodical aspects aim at describing the dynamics of establishing interoperable information systems, e.g. the various steps necessary to develop such a system. A framework covering functional aspects is described in Wimmer, Liehmann and Martin (2006). The methodical aspects are covered by the framework shown below (see figure 1).

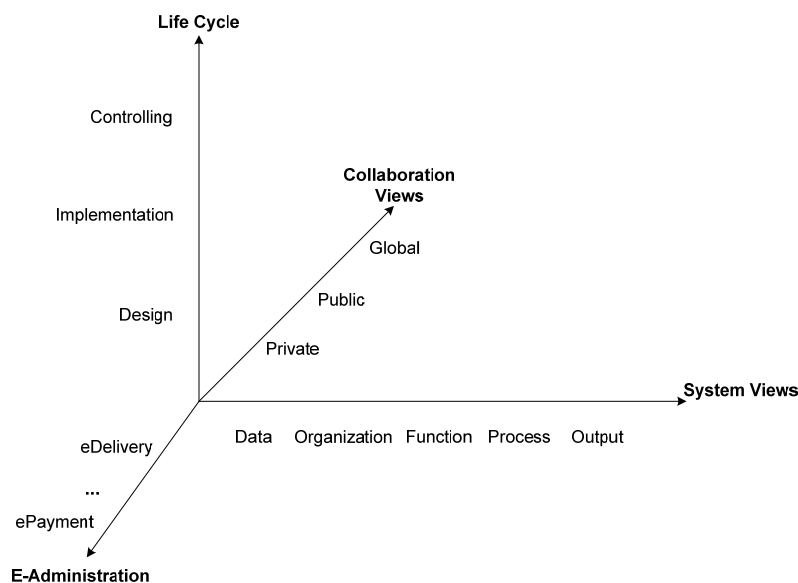


Figure 1. *R4eGov Methodical Interoperability Framework*

The framework is built on four well known and proven dimensions:

- **System Views:** The ARIS House (Scheer 1998) describes a concept to model different aspects of an enterprise. It covers five views of an organization that are necessary to model an integrated information system. The main goal of the different views is to reduce the complexity of a business process model and to simplify the development of an information system. Each view contains classes (e.g. functions or messages) with a similar semantic coherence. The messages that trigger functions or are produced by functions as well as the environmental data used by the functions is described by the data view. The organization view creates the organizational structure indicating the organizational units which execute the functions. The function view describes the processes that transform input into output. The output view contains all material and non-material input and

<sup>1</sup> <http://www.r4egov.info>

output. The structure of a system is described by the data, organization, function and output view whereas the dynamic aspect of the system is comprised by the process view (control view). The process view describes the relationships between the other views as well as the entire business process.

- **Collaboration Views:** Different views of collaboration are necessary to model and implement collaborative processes. They rely on the separation of internal processes running inside one organization, process models that describe direct interactions between partner organizations and process models describing the interactions between all partners involved in a joint collaboration (Greiner et al. 2006).
- **Life Cycle:** The business process management lifecycle covers the three broad phases of design, implementation and controlling of information systems (Scheer and Jost 2002). The design phase refers to the modeling of existing or intended processes by using modeling languages like the Event-driven Process Chain (EPC) (Keller, Nüttgens and Scheer 1992). Based on the processes the implementation phase aims at the execution of the modeled processes. The phase of controlling considers the performance measurement of the processes in order to reveal optimization potentials. These potentials can be used to restructure the process models and to adjust the corresponding systems.
- **E-Administration:** The fourth dimension is displaying specific administration procedures or services like E-Delivery, E-Payment or E-Workflow and thus represents the connection to the public sector. Even though the dimension displays specific processes or services, the dimension can be used to display more complex processes or services like E-procurement by combining basic processes or services.

To illustrate the presented framework, the paper presents in the following an example of a collaborative scenario demonstrating how public administrations can benefit of the methodical interoperability framework both on the design and implementation level in order to open themselves towards other authorities and their customers. The scenario is the German Plan Approval Procedure. Thus, E-Administration dimension of the framework described focuses on this procedure.

### 3 DESIGN LEVEL

#### 3.1 Different perspectives on collaborative processes: private, public and global processes

A business process is a continuous series of enterprise tasks, undertaken for the purpose of creating output. Both starting point and final product of a business process is the out-put requested and utilized by corporate or external customers. A collaborative business process (CBP) contains tasks that are undertaken by various organizations that are collaborating to reach a common objective. Business Process models are developed for the purpose of documentation, optimization and automation of business processes. Though models developed for establishing CBPs share these objectives, they differ in various aspects from the business processes used only inside one organization, e.g.:

- **Need for Information Hiding.** Though the information describing interactions between organizations should be visible, other parts of process model should remain inside one organization.
- **Need for exact description.** If elements are described ambiguously, this will lead to misinterpretations. Though this criterion is also relevant for corporate internal use, technical and cultural differences are usually bigger between organizations, increasing the probability for misunderstanding. Additionally, the distance between stakeholders is bigger, thus misunderstandings are harder to resolve.
- **Need for model usability focused on collaboration partner.** Since additional information increases model complexity, only interaction information required by the partner organization should be contained in the model. Nonetheless, the choice which information might be useful for the partner is subjective. For example, he might also be interested in a process activity that does not comprise an interaction with him, but still helps explaining interactions.

To describe and automate collaborative processes in the last years three different types of process models were established (e.g. Greiner et al. 2006, Andrews et al. 2003): Private, public and global process models. A **private process** model is described from the viewpoint of an individual organization. Though it may contain activities that represent interactions with other organizations, it is developed for internal use and thus may contain confidential information to be hidden from other organizations. A **public process** model is also described from the viewpoint of an individual organization. It describes the interaction of one organization (e.g. Organization A) with one (B) or more (C) partner organizations. It describes all activities of A being part of this interaction (e.g. “Send RFQ Message to B”, “Receive Quote Message from C”) and the sequence of these activities. One way to create a public process is to derive it from a corresponding private process by abstracting all information from it that should be hidden from partner organizations. A **global process** model describes interactions between two or more organizations from a global view point (cp. for example Khalaf and Leymann, 2003). It captures all allowed interactions between all partners involved in the collaboration. Thus, while a public process only captures the interactions between the organizations A and B as well as the organizations between A and C, a global process model could contain additionally the interactions between B and C.

While more technical definitions of public processes focus on digital message exchanges (e.g. Bussler 2002), on a more conceptual level interaction models can also describe material exchanges as well as the place and time of such exchanges (cp. Klein, Kupsch, Scheer 2004). A process can be seen as the combination of various organizational dimensions, e.g. the dimensions function, organization, data, output and control (Scheer 1998). A function represents a business activity, the organizational view describes departments and roles involved in the activity, data and output describe digital and material entities consumed and produced by functions and the control flow combines these views and puts the functions in a timely order (see figure 2).

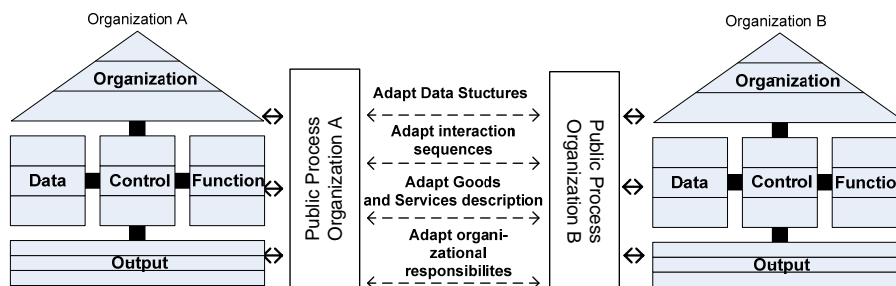


Figure 2: Dimensions of public processes on the design level

Public processes can be seen as interfaces of private processes and should contain all information necessary to enable the interaction of different private processes. Therefore, beside the sequence of functions contained in an interaction, public processes also have to display information regarding the exchanged data (e.g. which structure an exchanged message has), the goods and services exchanged as well as the organizational departments and roles involved in the interaction. For this kind of business process description the event-driven process chain (Keller, Nüttgens and Scheer 1992) found broad acceptance and also will be used in this paper.

Though all five views of the ARIS are relevant for collaborations, the process view is central since it combines the other views. In this paper, we focus on the process view while a more detailed description of the other views is left for future research.

### 3.2 A collaborative process in public administration: The Plan Approval Procedure

In the following, the CBP-concept will be shown on the basis of the scenario. A Plan Approval Procedure (PAP) is a special, formal administrative procedure, whose single regulations are described in detail in the §§ 72 et seqq. of the Administrative Procedures Law (VwVfG). The aim of the PAP is to achieve the obligatory official approval of a plan (OAP) by a so called Plan Approval Decision (Laubinger 1996). An OAP enables the matching of a number of public and private interests, which

are addressed by a plan. Thus, it represents a substitution of necessary official decisions, like for example administrative decisions or permissions by only one administrative act and at the same time eliminates possible further claims for omission (Becker et al. 2005). An OAP also determines exactly where the construction will be located later on. The regulations of VwVfG apply only if there is no prescription in a more specific law. These specific laws also determine for which procedures a PAP is necessary. An OAP is, for example, necessary for the construction of streets (according to the Federal Street Law (FStrG)) or the construction of airports (according to the Air-Traffic Law (LuftVG)) (Hoppe, Schlarmann and Buchner 2001). A PAP can roughly be divided into two main steps: a “hearing procedure“ and a “decision procedure”. Because a PAP is required for most of the construction projects and involves various partners like public administrations, businesses as well as citizens, it is a suitable procedure to illustrate the conceptual modeling and implementation of collaborative business process in the public sector. At the beginning of the PAP the project agency (e.g. a manufacturer) submits the plan for the construction project to the hearing agency. This plan is then checked and published by the hearing agency. After the plan has been published, the parties involved (e.g. the citizens and the retailer) have the right to have a look at the plan and, if necessary, raise objections. The hearing agency checks these objections and decides, in consultation with the parties involved, whether the plan has to be revised or not. In case of a necessary revision, the plan has to be revised by the project agency (e.g. the manufacturer). Afterwards, the revised plan is submitted to the hearing agency again, which then forwards the plan to the approval agency. The Plan approval agency has the assignment to check the procedure according to the rules, to accept the plan and to announce it.

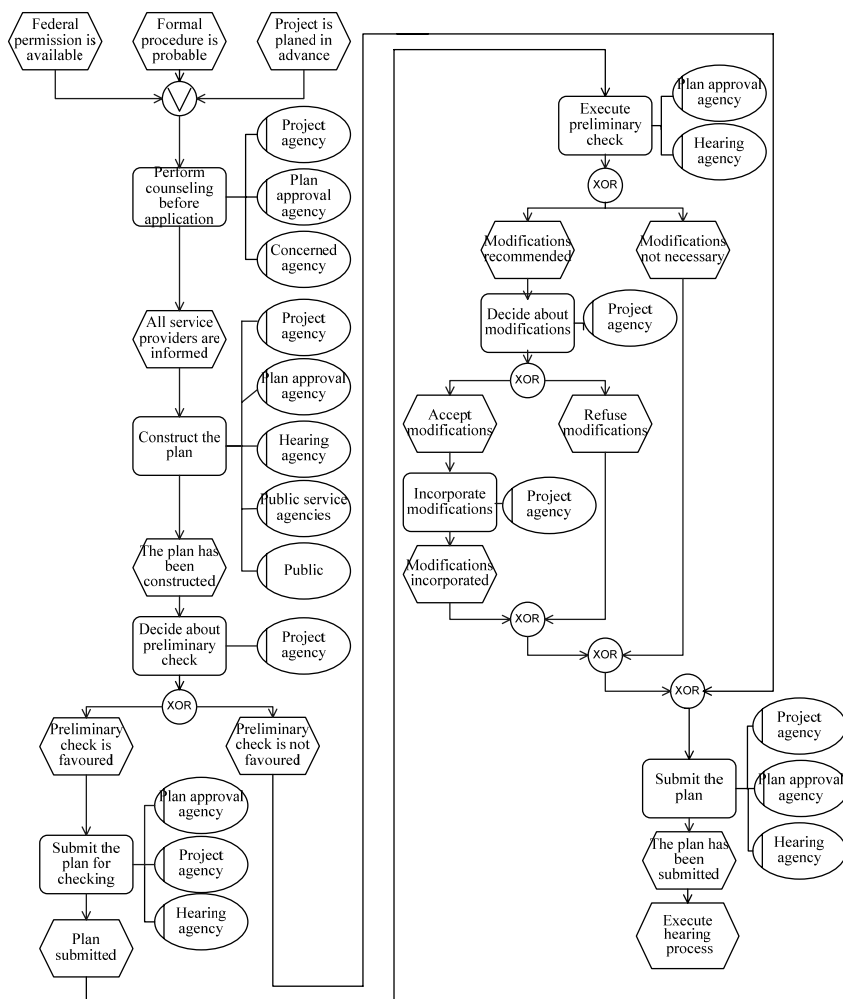


Figure 3: First part of the Plan Approval Procedure – Global process

In figure 3 the first part of the PAP is illustrated as a global process. Accordingly, the interactions between all parties involved in the scenarios are depicted. In general, for establishing CBP models, either a Top-Down procedure or a Bottom-Up procedure can be applied. A Bottom-Up procedure starts from existing private process, derives corresponding public processes and based on this establishes global processes. Since we start with a given global process, a Top-Down procedure is applied: From the global process of figure 3 public processes are derived.

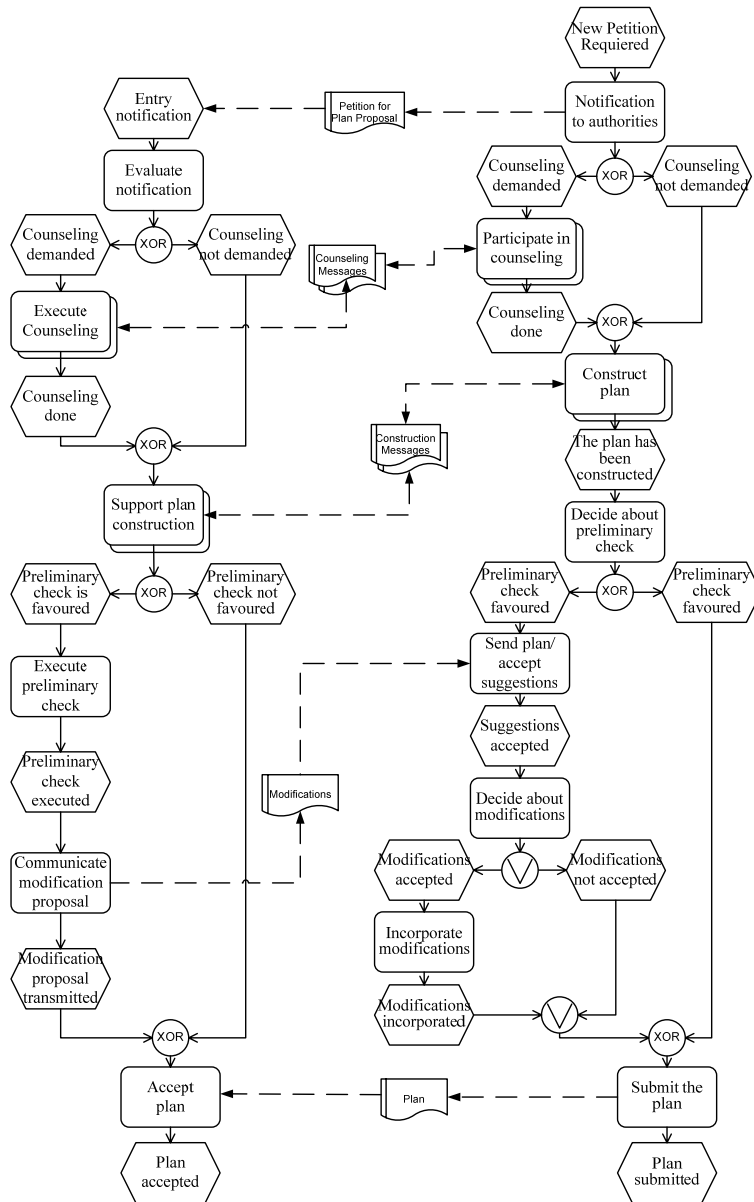


Figure 4: First part of the Plan Approval Procedure - Public Processes of Government and Project Agency

Figure 4 shows two corresponding public processes. The disassembly of the global process to public processes was guided by the following principles: First, the public process has to show the other party in which sequence which messages are exchanged. Nonetheless, since the global process is public anyway, no information hiding must be involved in developing the public processes, e.g. all information shown in the global process can be shown in the public processes also. For the sake of reducing complexity, these functions might be left out of the public process. On the other hand, even if functions are not directly involved in interactions, they might provide the collaboration partner with a

better understanding of the process and also allow their own party to adapt its private processes better to the public process. The function “Execute preliminary check” of the government public process is an example of such a function.

Second, to constrain complexity, the public processes show only interactions on the level of the global process. Interactions happening below that level are displayed in sub-protocols. For example, the function of “Counseling” of the government contains a communication with the function “participate in counseling” of the project agency. The symbol of the messages lying on each other indicates a finer grained exchange of messages. The corresponding sub protocols are displayed in sub public processes. Thus figure 5 illustrates the sub public process representing the interactions between the functions “execute counseling” and “participate in counseling” of the public process shown in figure 4. Note, that public processes on this level of granularity often display standard situations which are applicable in various contexts and thus can be seen as re-usable interaction patterns.

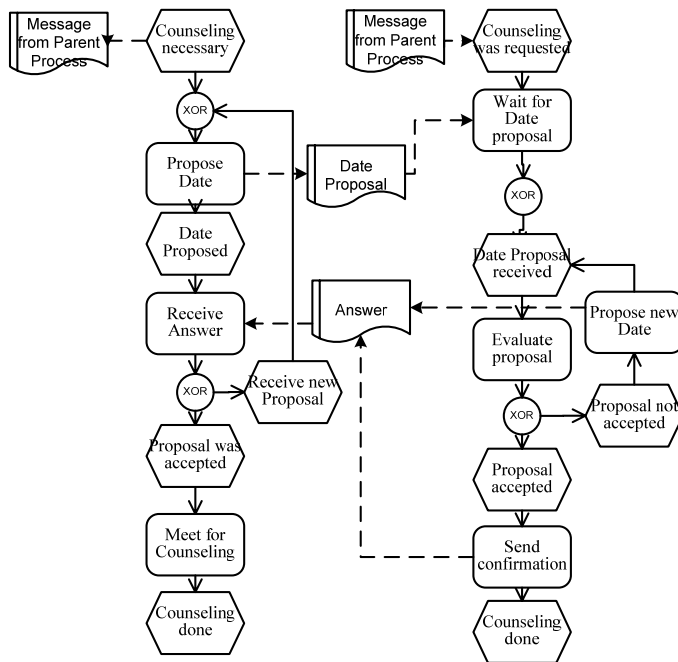


Figure 5: Sub Public Processes to agree on a Meeting Date between Government and Project Agency

Third, since the global process indicates the organizational units responsible for functions, the public process functions should be derived accordingly: Each function of a global process that is annotated with organization A must appear in the public process of organization A. If more parties have an organizational unit attached to this function, it has to be decided how this function is split up. Normally an exchange of messages between the parties must take place. An example is splitting of the function “Perform counseling before Application” from the global process to the two functions “Execute Counseling” and “Participate in Counseling” from the public processes of government and project agency.

## 4 IMPLEMENTATION LEVEL

### 4.1 Business Protocols based on Web Services

Various standards exist to describe protocols, including the Business Process Specification Schema (BPSS) of ebXML (Clark et al. 2001), the Partner Interface Processes (PIPs) of RosettaNet (<http://rosettanet.org>), WS-CDL and the abstract processes of BPEL, which are also called BPEL protocols (Andrews et al. 2003). To establish an E-Business conversation, several components are necessary: interfaces published in a network, interaction descriptions and partner roles, a standard

vocabulary and an environment of security and trust (Masud 2003). RosettaNet, being a prominent example for E-Business protocols, contains all of the components listed above, but comprises only a predefined list of interaction patterns (called Partner Interface Processes, PIP) described with UML activity diagrams, text tables and XML documents. To provide more specific and technical process descriptions, Masud (2003) and Khalaf (2005) propose to transform PIPs, which represent proven well established reference models for CBPs, to BPEL processes. Though the methodology described in this paper also aims on generating BPEL processes, it does not focus on pre-established interaction patterns (like PIPs do), but allows the development of individual CBPs. Since Web Service standards provide interface descriptions (WSDL) and interaction descriptions (e.g. abstract BPEL processes), they can be seen as complementary to established E-Business protocol standards like RosettaNet.

Similar to the different ways of describing conceptual CBPs, different methods exist to specify protocols: the first describes the interactions of all partners with the help of global models; the second only describes interactions of one partner with a so called abstract process (also called process skeleton, process stub or public process). Abstract Processes describe interactions from the viewpoint of one partner, thus they can only describe the interactions between this partner and one or more of its partners but not the interactions between his partners where this partner is not directly involved. In comparison to abstract processes, global models allow for better use of model checking techniques (Fu, Bultan and Jianwen 2003). WS-CDL seems to be the only Web Service based standard for describing global processes, but only a few prototypical tools are supporting this standard. While global models are valuable in the design and analysis of CBPs, for implementing them in general, abstract processes are to be preferred: They comply with organizations demands of a de-centralized process execution (e.g. no central engine is required) and show as little process information as possible and only to immediate collaboration partners. BPEL abstract processes can either be used during design-time to ensure that private BPEL processes of the collaborating partners are complementary, they also might be used on run-time as input to a protocol engines.

#### 4.2 Relating conceptual CBPs to Business Protocols

In order to execute collaborations between two or more partners apart from a modeling methods for CBPs a method is needed which allows companies to execute CBPs. Therefore, the concepts of Private Process, Public Process and CBP described above for the aim of modeling CBPs on a conceptual level, can be matched to the more technical, Web Service and protocol related terms of abstract process and global model to enable their execution by IT systems. The interactions between various parties (e.g. CBPs respectively global models) can be described with WS-CDL, interactions of one service with its partner services (e.g. public processes respectively abstract processes) can be described by BPEL. How private EPC processes can be transformed to executable BPEL processes was described in (cp. Ziemann and Mendling 2005).

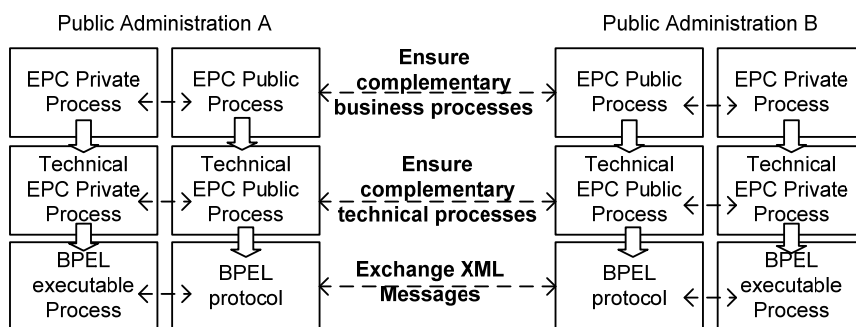


Figure 6: Process types involved in protocol development

Since the interactions realized by protocols should be controlled by business analysis, we propose an EPC based design of the (BPEL) protocols. As figure 6 illustrates, we propose a two step transformation from the EPC level to the Web Service level. On the upper level, private and public processes are modeled by business analysts as described in section 3. Afterwards these EPCs are

enriched with Web Service specific information and shaped according to conventions for compliance with BPEL processes. These models contain the Web Service invocations (also describing the message exchanged between collaborating administrations) and all control flow information relevant to specify the sequence of interactions. Note, that this type of EPC processes can also be used as a visualization of BPEL processes. In the second step these technical EPC processes are further enriched by BPEL programmers, e.g. with variables used in a BPEL process to realize the control flow specified by the technical EPC process, and annotated in XML.

In section 3 it was described how conceptual models are derived in a coherent way, ensuring that the public processes of collaborating parties are complementary. Following this model driven approach ensures that the implementation of the CBP is compliant to the conceptual model. Nonetheless, since the technical model contains further information (e.g. the name of Web Services to be invoked), the technical public process models have to be synchronized also.

### 4.3 Deriving Web Service Protocols for the Plan Approval Procedure

Based on the sub public processes shown in figure 5, now technical EPC models are derived that contain the BPEL syntax necessary to specify the interactions between both parties. Since BPEL can represent both a graph based and a block-oriented control flow (e.g. a containing a While Loop), nearly all control flow elements of EPC can be transformed to BPEL. If the EPC functions represent interactions (e.g. “receive message”, “send message” etc.) they can be transformed to corresponding BPEL orders, if an EPC functions represents activities not captured by the BPEL syntax (like “Evaluate proposal” in figure 5) an individual Web Service has to be created that will be invoked by the BPEL process. In Ziemann and Mendling (2005) further details regarding the transformation of EPCs to BPEL are described. The result of the transformation from the EPCs in figure 5 to the BPEL aligned EPCs is illustrated in figure 7.

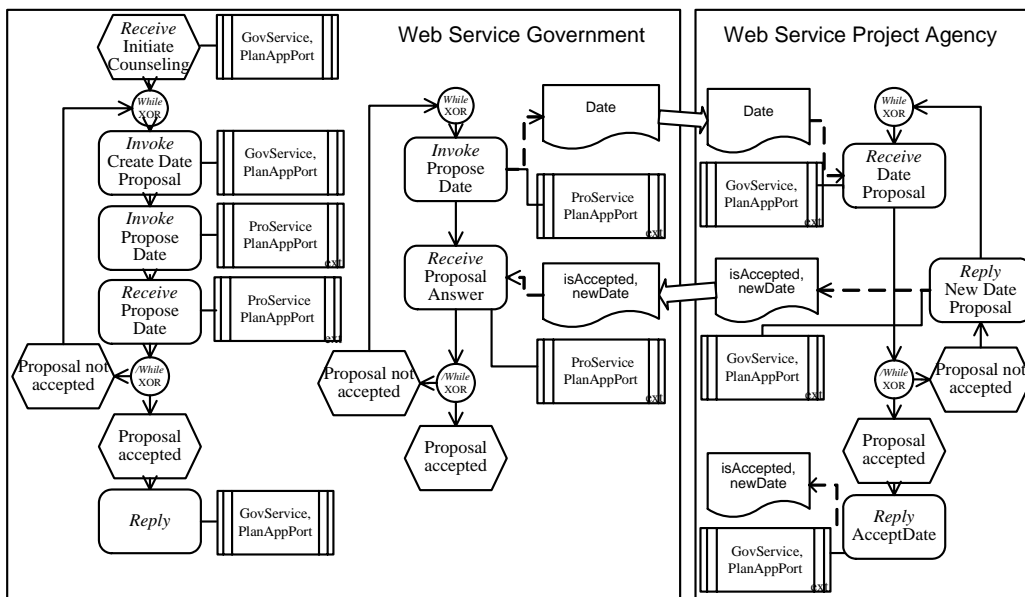


Figure 7: Technical EPC processes: Private, Public Process of Government and Public Process of Enterprise

The whole interaction takes place between two Web Services, one offered by the Government (“GovService”) and one by the Project Agency (“ProService”). The source and destination services are attached to the interaction activities, e.g. “Invoke propose Date” sends a message called “Date” to the Enterprise Service. The notation distinguishes between internal Web Services (e.g. “Receive initiate counseling” is invoked by a Web Service inside the public administration) and external Web Services, marked with the letters “ext”. The right side shows the abstract process of the Project Agency which interacts with the abstract processes of the government. On the right of the government public process,

the corresponding private process is shown, also. The abstract processes only contain the information necessary to describe the interaction with the other Web Service. Thus, the function “Evaluate Proposal” does not appear in the abstract process, though for illustrative reasons it was part of the conceptual public process. As the synchronous invocation of the “Create Date Proposal” function shows, these functions might be added again in the private processes. The private process also contains functions to interact with the top level process: It is called by its parent process and after the meeting was fixed, it replies the result to the parent process.

## 5 SUMMARY AND FUTURE RESEARCH

Rapid advancements in technologies and regular emergence of new legal settings raise new challenges for public administrations. Thus, in recent years the development of interoperability frameworks has gained importance due to the fact that more and more public administrations within Europe are challenged to work together and to adapt continuously to rapid technological changes. Without interoperable E-Government systems, today’s public administrations struggle to keep pace with rapid evolving economic alterations. In this context, we presented a methodical interoperability framework for the management of collaborative business processes in the public sector. We described how CBPs can be described by a combination of private, public and collaborative processes with EPCs. This concept was motivated and evaluated on the basis of an eGovernment reference model. In order to automate this collaborative process, we proposed a transformation to business protocols. Due to their close relationship to executable models of private process and the possibility to describe them in a machine readable format, the abstract processes of BPEL were chosen as the target protocol. Accordingly, we described a transformation of the EPC based concepts to model CBPs public processes to BPEL abstract processes and illustrated this transformation by the use case introduced before.

We described both the design and the implementation level of the life cycle dimension (see figure 1). Due to the fact that the controlling level is part of the life cycle dimension and enables public administrations to measure the efficiency of collaborative business processes, future research requires the development of concepts for the controlling of collaborative business processes considering public and private processes. Further on, future research should try to apply this approach for other case scenarios than PAPs and to analyse the use of supporting tools that ease the task of exchanging process models between different public administrations and to distinguish between the different model types used in CBPs. Another point that requires future research is the comparison and connection of the presented framework with other interoperability frameworks.

## Acknowledgements

The work published in this paper is (partly) funded by the E.C. through the R4eGov project. It does not represent the view of E.C. or the R4E-Gov consortium, and authors are solely responsible for the paper's content.

## References

- Andrews, T., Curbera, F., Dholakia, H., Golland, Y., Klein, J., Leymann, F., Liu, K., Roller, D., Smith, D., Thatte, S., Trickovic, I. and Weerawarana, S. (2003). Business Process Execution Language for Web Services – Version 1.1. 2003. URL: <http://dev2dev.bea.com/techtrack/BPEL4WS.jsp> (28th April 2006).
- Becker, L., Fügemann, M., Gerlach, A. and Theis, F.-J. (2005). Praxis Ausbildung – Verwaltungsverfahren und Verwaltungsprozess. Deutscher Anwaltverlag, Bonn.
- Bussler, C. (2002). Public Process Inheritance for Business-to-Business Integration. In Buchmann, A. P., Casati, F., Fiege, L. and Shan, M. C.: Technologies for E-Services – Third International Workshop TES 2002, Hong Kong.

- Clark, J., Casanave, C., Kanaskie, K., Harvey, B., Clark, J., Smith, N., Yunker, J. and Riemer, K. (2001). ebXML Business Process Specification Schema Version 1.01. UN/CEFACT and OASIS.
- eEurope (2005). An Information Society for all: E-Government. URL: [http://europa.eu.int/information\\_society/eeurope/2005/all\\_about/action\\_plan/index\\_en.htm](http://europa.eu.int/information_society/eeurope/2005/all_about/action_plan/index_en.htm) (14th August 2006).
- European Commission (2004). European Interoperability Framework for pan-European eGovernment Services. European Communities. <http://europa.eu.int/idabc>.
- European Commission (2003): Commission of the european communities. Linking-up europe: The importance of interoperability for e-government services. Staff Working Document.
- Fu, X., Bultan, T. and Jianwen, S. (2003). A top-down approach to modeling global behaviours of Web Services. Workshop on Requirements Engineering and Open Systems (REOS), Monterey, CA.
- Greiner, U., Lippe, S., Kahl, T., Ziemann, J. and Jaekel, F. (2006). Designing and Implementing Cross-Organizational Business Processes – Description and Application of a Modeling Framework. I-ESA Conference, France, Bordeaux.
- Hoppe, W., Schlarman, H. and Buchner, R. (2001). Rechtsschutz bei der Planung von Straßen und anderen Verkehrsanlagen. 3. edition, Beck, München.
- IDABC (2005). The IDABC program (2005-2009). URL: <http://europa.eu/scadplus/leg/en/lvb/l24147b.htm> (14th August 2006).
- Keller, G., Nüttgens, M. and Scheer, A.-W. (1992). Semantische Prozeßmodellierung auf der Grundlage Ereignisgesteuerter Prozessketten (EPK). In Scheer, A.-W. (ed.): Veröffentlichungen des Instituts für Wirtschaftsinformatik, Nr. 89, Universität des Saarlandes, Saarbrücken.
- Khalaf, R. (2005). From RosettaNet PIPs to BPEL Processes: A Three Level Approach for Business Protocols. 3rd International Conference, BPM 2005, Nancy, France.
- Khalaf, R., Leymann, F. (2003): On Web Services Aggregation. In: Benatallah, B., Shan, M. (eds.): Technologies for E-Services. Lecture Notes in Computer Sciences 2819, Springer, Heidelberg.
- Klein, R., Kupsch, F., Scheer, A.-W. (2004): Modellierung inter-organisationaler Prozesse mit Ereignisgesteuerten Prozessketten. In: Scheer, A.-W. (ed.): Veröffentlichungen des Instituts für Wirtschaftsinformatik, Heft 178, Saarbruecken.
- Laubinger, H. W. (1996): Verwaltungsverfahren. In Chmielewicz, K. and Eichhorn, P. (eds.): Handwörterbuch der Öffentlichen Betriebswirtschaft. Poeschel, pp. 1753-1760, Stuttgart.
- Masud, S. (2003). Use RosettaNet-based Web Services, Part 1: BPEL4WS and RosettaNet, 2003. URL: <http://www-128.ibm.com/developerworks/webservices/library/ws-rose1/> (28th April 2006).
- MODINIS (2005). MODINIS program: Follow-up of eEurope 2005 action plan. URL: <http://europa.eu/scadplus/leg/en/lvb/l24226c.htm> (14th August 2006).
- MODINIS (2006). MODINIS program: Study on interoperability at local and regional level. URL: <http://www.egov-iop.ifib.de/index.html> (14th August 2006).
- Scheer, A.-W. (1998). ARIS – Vom Geschäftsprozess zum Anwendungssystem. 3. edition. Springer, Berlin.
- Scheer, A.-W. and Jost, W. (2002). ARIS in der Praxis - Gestaltung, Optimierung und Implementierung von Geschäftsprozessen. Springer, Berlin.
- Werth, D. (2005). E-Government Interoperability. In Encyclopedia of Information Science and Technology (Khosrow-Pour, M. Ed.). Volume I-V. p. 985-989, Idea Group Inc., Hershey.
- Wimmer, M., Liehmann, M. and Martin, B. (2006). Offene Standards und abgestimmte Spezifikationen - das österreichische Interoperabilitätskonzept. In Proceedings MKWI 2006, Passau.
- Ziemann, J. and Mendling, J. (2005). Transformation of EPCs to BPEL – A pragmatic approach. 7th International Conference on the Modern Information Technology in the Innovation Processes of the industrial enterprises, Genoa.