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Operations and Tool Support for Public View Transformations of Business Processes

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Abstract

This paper shows operations on models to derive Collaborative Business Processes models on a conceptual level that satisfy the requirements of information hiding and furthermore to use these reduced models for a configuration of executing information systems.

1 INTRODUCTION

The concept of business processes is established in enterprises since several decades. It is used to plan and control the activities of an enterprise in a holistic and integrated way. Business process management is nowadays a core management task. To support and enhance this task, business process models are created, designed and adapted. Often, business process models offer a large range of possibilities to better handle real business processes. Above others, this comprises the creation of operational transparency through the different activities of a business process and the possibility to use them to configure standard software.

However, current enterprises trend to reduce their own value generation in favour of transferring non-core activities to partner enterprises. Thus, independent organizational units or entire organizations build temporary or permanent collaborations, which pool resources, capabilities, and information to achieve a common objective (Sydow 1993). New business models are emerging and existing ways of working are redesigned forming long running processes between various (external) partners – so called Collaborative Business Processes (CBPs, cp. (Werth 2007)).

In analogy to the conventional business process, these CBPs can be used in collaborative scenarios to foster efficiency and effectiveness. Therefore, it is necessary to design, manage and optimize CBPs on a global level. Referring to the experiences within a single enterprise, these tasks can be adequately supported by models, in this case collaborative business process models. However, whereas in single enterprises, it is the intention of business process models to fully disclose all details and relationships of all activities within the scope of a particular business process, there is no interest for enterprises within collaborative scenarios to reveal all details how there are working internally to their partners. On the other hand, in order to

support an operational process execution with ICT systems, CBP models can be used to configure the interacting systems.

In summary, there is a discrepancy spanning between the information hiding demand to secure an enterprise and the information need to improve the ICT interaction of an enterprise. This paper shows operations on models to derive CBP models on a conceptual level that satisfy the requirements of information hiding and furthermore to use these reduced models for a configuration of executing information systems.

2 BUSINESS PROCESS MODELS IN COLLABORATIVE ENVIRONMENTS

Originally (Hammer and Champy 1993) defined the business process as a collection of functions that transform inputs into an output for the benefit of the customer. (Scheer 1999) defines the business process as "a coherent sequencing of business tasks in order to provide an output. The result of the business process is an output that is requested or ordered from an internal or external customer." The main characteristic is that a business process comprises a set of correlated business activities and that they all contribute to a common goal, namely the output generation. Different modelling languages have been defined for business process modelling, prominent examples include BPMN or EPCs. They are languages that are designed for modelling intra-enterprise business processes and produce a high degree of transparency of the modelled business process.

In collaborative scenarios, this is not the primary intention. Moreover in practice, the following requirements for modelling and implementing collaborative business processes were observed (cp. (Lippe at al. 2005):

- It is necessary to provide a level of abstraction on which the partners first agree on the business goals of their collaboration. To implement the collaboration with ICT systems the involvement of technical staff is necessary.
- The internal business processes of each partner have to be linked into a CBP without revealing confidential or private information. Depending on the level of trust between the collaborating partners, a scaleable exposition of internal processes should be possible.
- Simplified process adoption has to be achieved. E.g. a company interacting with other different companies should not require different private processes for each collaboration.
- The user should be supported in automation of CBPs.

In the last years, extensions to modelling languages were made in order to enable them for collaborative scenarios (cp. (Klein et al. 2004); (Greiner et al. 2006)). In order to better separate the information density of different areas of concern, three different concepts are defined: Private, View and Collaborative Business Processes. Private business processes (PBP) refer to a specific enterprise and describe in detail the business processes of this organization. In fact, they comply to the "classical" intra-enterprise business process. The hiding of information is achieved by the introduction of Process Views. They act as an additional filter and an abstracting layer between the PBPs and the CBP model (as proposed in (Schulz 2002) and (Schulz and Orlowska 2004)). Process views provide a process-oriented interface toward business partners and are only known to their owning organization, not exposed to the outside world. They are an abstraction of the private processes, containing

information that needs to be published for the purpose of an interaction. This leads to the following definition:

A View Business Process (VBP) abstracts information from one or more PBPs and thus enables companies to hide critical information from unauthorized partners. It is an interface to the outside world which extracts only that kind of information which is necessary for interaction with one or more potential partners. Thus a VBP can be seen as general interaction description of one or more PBPs from the perspective of one partner.

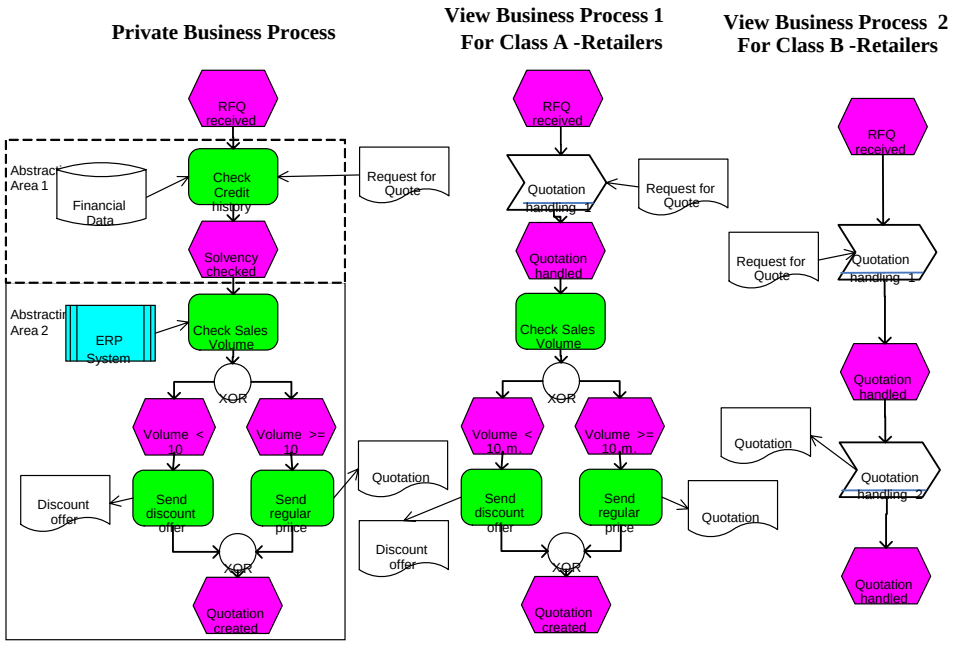

Figure 1: Modelling Private Business Processes and View Business Processes with Event-driven Process Chains

Figure 1 illustrates how to model VBPs with EPCs. On the left side of the figure, the RFQ-handling process of a manufacturing company is shown. This process contains two sensitive sub-processes: the checking of the solvency of the retailer and the calculation of a price discount. If the retailer orders more than 10 products a month, a 10% discount is given, in all other cases the retailer gets no discount. This process has to be distributed to several retailers in order to show them the sequence of the order processing so that they can inform their staff and configure their workflow engines. The manufacturer wants to hide his discount system from certain customers; the solvency check should be always hidden. Thus he creates two different views of the same internal process for two classes of retailers by subsuming the area labelled as “abstraction area 1” and “abstraction area 2” into process modules. In the following we will describe in more detail what it means to abstract internal information with views.

While a VBP describes allowed interactions from the perspective of one partner, a CBP describes these interactions from a neutral, supervising perspective, capturing all allowed interactions between all partners. One VBP can contain interactions with different partners. Note that sometimes a VBP suffices to describe all allowed interactions of various collaborating enterprises: if all interactions of the CPB happen only between the partners and the enterprise

that provides the VBP. While more technical definitions of view processes reduce them to descriptions of digital message exchanges (cp. (Bussler 2002)), on the conceptual level also partner interactions regarding money ("Payment received") or material (e.g. "Deliver Container") can be described in a view process. Figure 2 shows the relation of PBP, VBP and CBP in a three-enterprise-scenario.

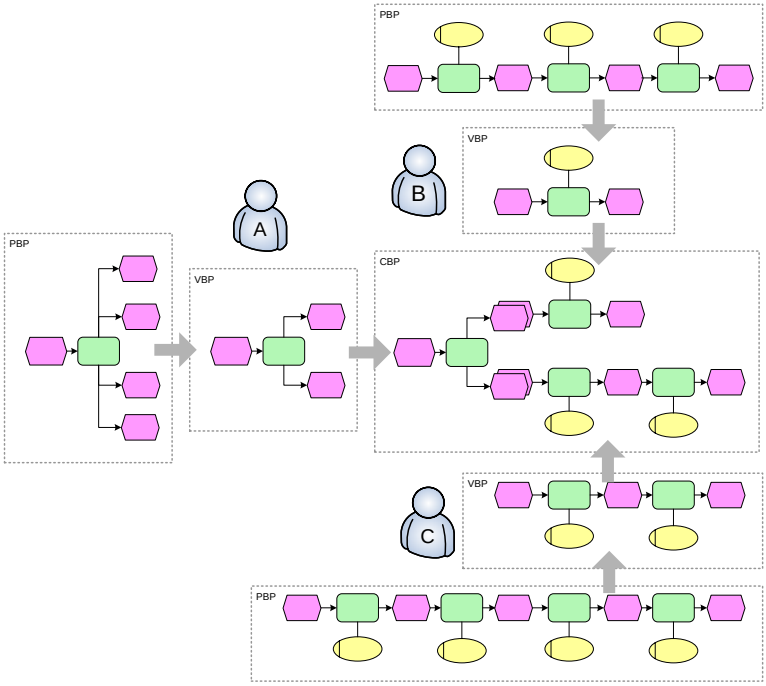

Figure 2: Relationship between PBP, VBP and CBP

3 VBP CREATION OPERATIONS

The main rationale behind VBPs is the protection of knowledge included in the process models. This protection of process knowledge can be performed by hiding specific information (Kramler and Retschitzegger 2002). Consequently, certain information is completely removed or replaced by non-critical substitutes. However, this "alienation" of the business process should not change the process-logical basic relations. Essentially there are two kinds of information to be alienated: processural and functional information. Consequently, the

- **Processural Alienation** describes circumstances in which the Process Owner wants to limit information about the structure of parts of its process. The structure in this respect means the time and fact-logical relationships between process functions. On the one hand this can be achieved by the shortening of processing parts. Thereby functions and function relations are removed before externalizing the process model. The model extent is reduced, without any modification of the granularity of the description. On the other hand it can be alienated by shrinking. In this case a part of the real process is reduced to a single function. Such an alienated process model summarizes sub-processes in a single function.

- **Functional alienation** is the non-disclosure of the exact operational activities, which are operated in the context of the process execution. The presence of a specific task is not concealed; however specific details of the activity are masked. The process structure remains unchanged. In literature there exits multiple approaches to such alienation operations on process models (e.g. (Schulz 2002); (Angelov et al. 2003)). They talk about abstractions of private business processes (Schulz and Orlowska 2004) or about abstract processes (Andrews et al. 2003). Other sources usually speak of a generalization on business processes or of public process interfaces as aggregated functional modules. However there is no systematic differentiation of the kind of alienation or its effect. In model theory, we can differentiate three operations (Werth 2006):
- **Generalization:** A generalization serves to summarize homogeneous objects. Accordingly the generalization is based on the comparison and requires the intercommunity (Rothschuh 1959). Generally the generalization is based on summarizing the same attributes and neglecting attributes with different specifities. Thus the generalization reduces the attribute quantity. As in process models the substantial attributes are the functions and their relations, a generalization on processing concepts conduct to a decrease of the function and number of relations by maintaining the special logical requirements of integration. A generalization thus makes the degree of details of a process model smaller. Thus, generalization is able to achieve processural alienation.
- **Aggregation:** The aggregation describes the pooling of attributes in order to create new attributes. In doing so, the order of these attributes changes, because the whole number of occurrences of attributes is mapped to a single attribute. Thus, an aggregating object includes classes of other objects. Inversely an aggregated object is comprised in another as an occurrence of an attribute. In respect to process models, a complete process model can be considered as an attribute of the aggregating model. To follow this understanding, only functions are appropriate model elements. Therefore the aggregation can be regarded as maximum summary of a process models, as it reduces a whole model into a single function. Consequently, aggregation serves to processurally alienate process models.
- **Abstraction:** Abstraction is often used in literature for view concepts. Thereby the abstraction is omitting of characteristics. But this contradicts to the common understanding of abstraction in model theory. E.g. (Klaus 1963) argues that with abstraction individual attributes are not ignored, but rather these are made variable. Thus, the abstraction is not shortening a model. This means that an abstracted model includes all attributes of its original model. (Stachowiak 1973) speaks of a parameterization of attributes. An abstract model is a mental construct without real equivalent. Therefore, it cannot be instantiated. Contrary an abstract process model results from the abstraction of some characteristics, i.e. from variabilisation of some elements of the process model. This mainly concerns the functions, which are suitable for abstraction. An abstract process model describes the possibility for process models by making several attribute values possible for some model elements. The effect is that it closures details of process functions by allowing them to take different designs. Therefore, abstraction is suitable to create functionally alienated process models.

In summary, view concepts serves for information hiding of process information. Hiding means the alienation of process models by removal or adaptation. Generalization, aggregation and abstraction are suitable operations to execute such alienation. Hereby it permits to modeller to form views on a processing part for third parties.

4 VIEW USAGE OPERATIONS

While the modelling of CBPs on the business level is a comparably new field for science, CBPs have been implemented with Electronic Data Interchange (EDI) over Value Added Networks (VANs) for more than two decades (cp. (Unitt and Jones 1999)), along with standards for defining interchange and message structures like UN/EDIFACT (ISO 9735). This kind of interchange description is also called protocol, or (e-) business protocol. (Leymann and Roller 2004) state that "a business protocol specifies the potential sequencing of messages exchanged by on particular partner with its other partners to achieve a business goal. I.e. a business protocol defines the ordering in which a particular partner sends messages to and expects messages from its partners based on actual business context". (Alonso et al. 2004) use the term conversation protocol for a similar definition, describing a "conversation as sequences of operations (i.e., message exchanges) that could occur between a client and a service as part of the invocation of a Web service". In this context, coordination protocol is defined as a specification of a set containing all correct and acknowledged conversations. The term business protocol is closely related to the concept of choreography, defined by (Austin et al. 2004) as follows: "A choreography description is a multi-party contract that describes from a global view point the external observable behaviour across multiple clients (which are generally Web Services but not exclusively so) in which external observable behaviour is defined as the presence or absence of messages that are exchanged between a Web Service and it's clients".

Various standards exist to describe protocols, including the Business Process Specification Schema (BPSS) of ebXML (Clark 2001), the Partner Interface Processes (PIPs) of RosettaNet (http://rosettanet.org), the Business Process Execution Language for Web Services (BPEL4WS or WS-BPEL, (Andrews et al. 2003)) and the Web Service Choreography Description Language (WS-CDL, (Kavantaz et al. 2004)). There are different methods of how to specify such protocols; one is represented by the creation of an abstract business process, also called a process skeleton, process stub or public process. An abstract business process abstracts from the description of an executable process by describing just those parts, that a business counterpart could make use of while undertaking interaction. Since they describe interactions from the viewpoint of just one partner, 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. Protocols describing not only such "1:n" relationships but also "n:n" relationships can be specified by means of so-called global models. While abstract business processes are describing a conversation protocol from the perspective of one participant, global models do this from a global point of view, capturing interactions between all participants of the collaboration in one model. Nonetheless, all abstract processes participating in a collaboration plugged together also display the information contained in the global model of this collaboration. In comparison to abstract processes, global models allow for better use of model checking techniques (cp. (Fu et al. 2003)). Apart from providing better information hiding, abstract processes allow for a de-centralized (peer-to-peer) execution without intervention of a centralized party.

In order to establish collaboration, different model types have to be transformed. Depending on the procedure model to establish the collaboration, certain transformations sequences have to be executed. For example, in a bottom-up procedure model that establishes a CBP based on existing private processes, view processes have to be derived from the private processes. Top-Down approaches, that establish a global model of the CBP first, allow for easier model checking (cp. also (Fu et al. 2003); (Weber et al. 2006)).

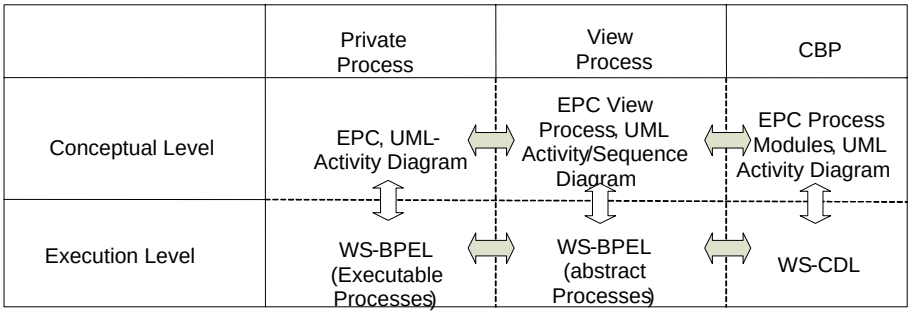

Figure 3: Selection of standards for conceptual and technical CBP modelling

Accordingly, figure 3 shows different directions of model transformations. The horizontal arrows correspond to the operations of generalization, aggregation and abstraction, e.g. to transform a private process to a view process or a view process to a CBP etc. Examples for transformation descriptions in the opposite directions include WS-CDL to BPEL abstract process transformation (cp. (Mendling and Hafner 2005)) and from WS-CDL to BPEL private process (cp. (Weber et al. 2006)). The vertical transformation in the downward direction corresponds to process automation approaches where conceptual models are transformed to executable processes. For Re-Engineering purposes, but also for process monitoring, transformation in the upward direction are useful. The concepts of View Process and CBP described above for the aim of modelling collaborative business processes 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. For example, the interactions between various parties (e.g. CBPs) can be displayed by WS-CDL (Kavantzas 2004), the abstract processes of WS-BPEL (Angelov et al. 2003) display the possible interactions of one service with other services (implementing view processes) and the "executable" processes of WS-BPEL can be matched to Private Process as displayed by common EPCs (cp. (Ziemann and Mendling 2005)). This can be done for all three process types; an automation of EPC View Processes to BPEL abstract processes is provided by (Kahl et al. 2006). Thus, the left hand side of figure 4 shows how the "View Process 1" from figure 3 is realized as a BPEL abstract process, while the right hand side show the complementary abstract process of the retailer web service.

To establish an E-Business conversation, several components are necessary: interfaces published in a network, choreography description and partner roles, a standard vocabulary and an environment of security and trust (cp. (Masud 2003)). Abstract processes described with WS-BPEL provide WSDL Interfaces that define the "static interface" of a private process, e.g. available operations including input/output parameters. They also describe the "dynamic interface", describing the sequence of messages the private process accepts and sends as well as a role concept. Thus BPEL can be used as complementary to established E-Business protocol standards like RosettaNet. It contains all components listed above, but its process interfaces are only described with UML activity diagrams, text tables and XML documents. Accordingly, (Masud 2003) and (Khalaf 2005) propose to use PIPs, representing proven, well established reference models for cross-organisational processes, as a base for similar BPEL processes.

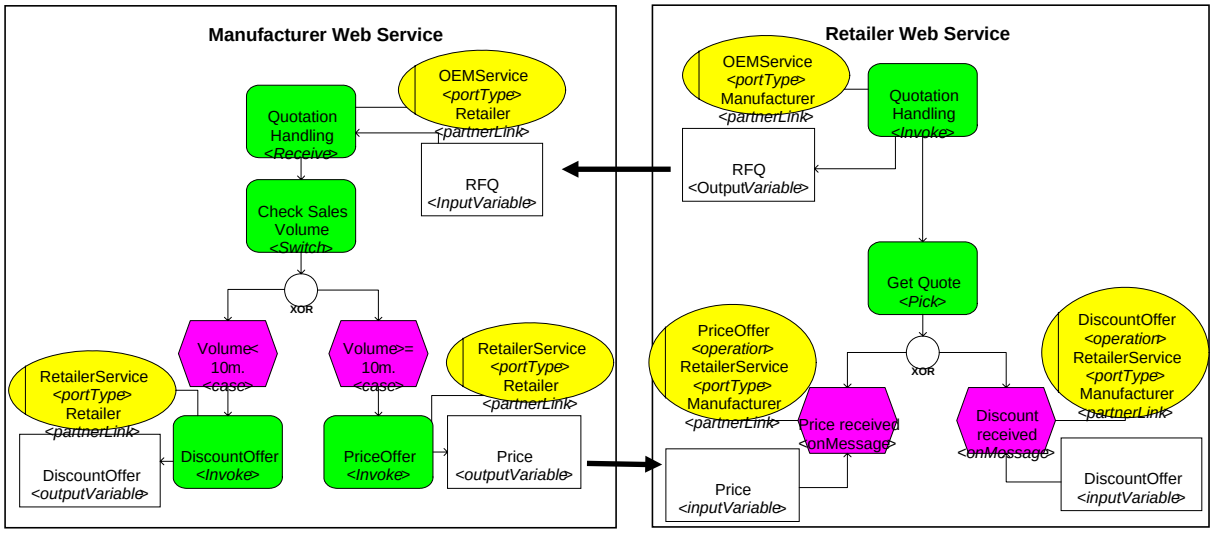

Figure 4: WS-BPEL abstract processes from Manufacturer and Retailer derived from View processes

5 Prototype

To master the complexity of developing, adapting and synchronizing the great number of model types involved in PBPs, VBPs and CBPs, tool support is essential. In the following the concept and the implementation of a tool (called “View Process Demonstrator”, VPD) for developing and connecting such model types is presented. This tool supports the manual annotation of private and view business processes and corresponding concepts for automatic derivation of view business processes from private business processes. As a first step, the tool concentrates on the relationship between private and view business processes. As stated above, view concepts serve for information hiding of process information, in the sense of alienation of process models by removal or adaptation.

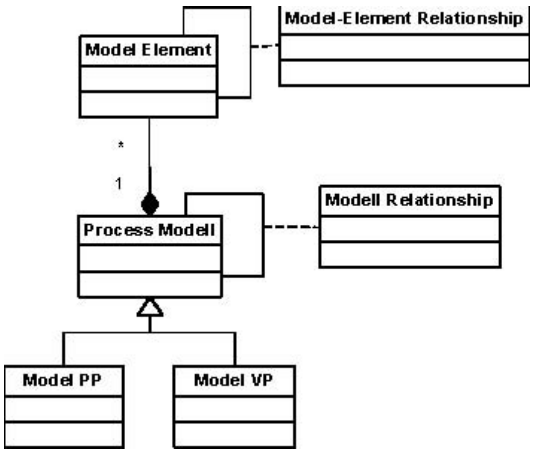

Figure 5: Class Diagram for storing different model types, elements and their relationships in the VPD

The VPD tool supports Inside-Out creation of CBPs which can be divided in four steps: Creation of the PBP model, annotation of PBP model for use in CBP, derivation of VBP and synchronization between PBP and VBP using the operations described above. Although the tool offers basic modeling functionalities, these are aimed for annotation rather than creating new models. Instead, existing private processes in form of EPML (Mendling and Nüttgens 2006) can be imported and exported. EPML is used mostly in the scientific community but can be transformed into the more expressive ARIS Markup Language used by the ARIS Toolset. Figure 5 illustrates how models are stored in the VPD. Process models display either private or view business processes and are made of various elements including functions, connectors and events. These process models can be related to each other, e.g. by the "is view process of" relationship. Since relationships like "is abstraction of" (resulting from the application of the abstraction operation) have to be displayed also between individual model elements, a class "Model-Element Relationship" was implemented. The objective of this design was to allow for describing and synchronizing relationships on the process model level (e.g. the VBP models "Retailer" and VBP "Supplier" have the relationship "is view process of" the PBP model "Production") as well as on the process element level (e.g. describing that the function "Send price offer" contained in the VBP models "Manufacturer" has the relationship "is aggregation of" the elements "Ask marketing for price proposal", "Consolidate price with purchasing department" and "Communicate offer" contained in the PBP model "Production").

Process model elements currently supported are functions, events, XML-documents, Web Service representations, connectors and directed edges (connectors and directed edges represent the control flow of the processes). Next versions of the tool will contain further elements for representing the organizational, data and output view of ARIS. For example organizational units attached to functions, enabling deriving view processes based on organisational dependencies (e.g. "hide all functions controlled by the book keeping unit").

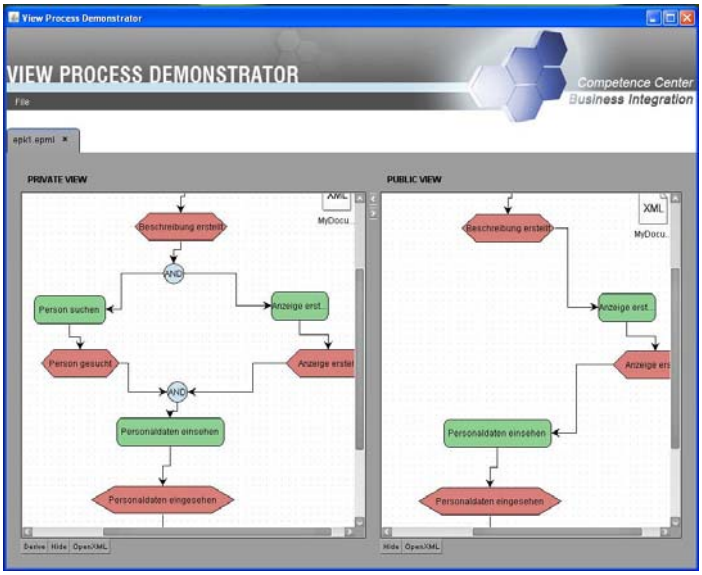

Figure 6: Deriving View Processes from Private Processes – Screenshot of the prototype

The three operations explained above, in particular generalization, aggregation and abstraction as well as their inversion (specialization, de-aggregation and initialization) can be used to derive view business processes form private business processes. In figure 6, the function and the event

on the left hand side of the AND split are annotated as being “abstract”. As result, they are not visible in the public view of the business process on the right hand side. Note, that since the AND fork is now redundant, the AND split as well as AND join were automatically hidden.
Although the tool is focused on the horizontal transformation of models (e.g. from private to view business process), it also contains the possibility to annotate processes technically and thus can be used as a basis for transformation to BPEL protocols. The implementation of this transformation operations and the possibility to integrate further model types, e.g. global models, is currently ongoing.

6 Conclusions

In this article a method was developed, that provide a generic solution concept, which transfers business recommendations into ICT-solutions in a collaborative environment. It was shown that in a first step CBPs should be defined conceptually under consideration of the requirements which result from a collaborative environment (information hiding, flexible externalisation of one or more PBPs). Thus we introduced a concept that allows the externalization of internal process information by using process views. In order to automate the CBPs defined on a conceptual level, we proposed a transformation to protocols.

The greatest demand for further research can be seen in closing the gap between conceptual and technical models. This requires a formulation of transformation methods especially in a methodologically sound transfer of process models into ICT-configurations. Another aspect that requires further research is the use of supporting tools that ease the task of exchanging process models between different enterprises and to distinguish between private and public knowledge. User-specific views on the business process models will enable new user groups to use BP-models, as the example of intuitive metaphor based process modelling points out. Moreover ICT can actively support business process management by checking, verifying or even automatically negotiating consistency and interoperability of models.

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