A Survey on State of the Art to Facilitate Modelling of Cross-Organisational Business Processes

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Abstract: Interoperability is one of the current key challenges addressed by research and industry. Tools and methodologies are emerging to enable modelling and execution of cross-organisational business processes, and standards are being defined using guidelines and best practice approaches. In this context we observe the shortcoming of a comprehensive and structured state-of-the-art analysis. We therefore define modelling requirements that derive from an analysis of various collaborative business scenarios. Based on these requirements we evaluate and measure relevant work in modelling of cross-organisational business processes. Thereby we focus on the strength and weaknesses of the different approaches.

1 Introduction

For systems interoperability and execution of long running end-to-end processes, analysts strongly argue in favour of Business Process Management (BPM) as an emerging layer of software for building applications [Sm01][Ph03]. BPM is about modelling, managing, and executing processes [De03]. It offers a set of technologies, services, tools, and standards that provide for explicit process modelling and management, and aim to integrate applications and automation. BPM is not only relevant for inter-application integration, but also focuses on successfully managing and executing cross-organisational business processes (CBPs). In this context, this paper focuses especially on modelling aspects of cross-organisational business processes.

For the design and analysis of CBPs it is necessary to consider that processes are modelled with different perspectives, e.g., from a business point of view where a CBP is negotiated between partners or for the execution level dealing with the actual enactment of a CBP. Existing business process modelling languages are typically limited to one perspective. For instance, executable languages are often not comprehensible for managers and they lack facilities for a high-level analysis of CBPs. On the other hand CBPs modelled with languages that support analysis on business level cannot directly be executed as they may contain non-executable information, e.g. the transportation of goods by a truck. Furthermore the successful modelling of CBPs requires that partners link their existing internal processes and resources to achieve an agreed interaction model. However, white-box exposition of internal processes cannot be expected. CBP

modelling tools and languages need to support a mechanism that selectively hides details of private processes, whilst providing a process-oriented interface to the outside world, facilitating interweaving into partner processes.

Various methodologies, languages, tools, and standards are emerging to support CBP modelling and existing approaches have been expanded to meet CBP specific modelling requirements. However, we failed to identify an extensive analysis specifically on the requirements associated with modelling cross-organisational interactions. Also a state of the art analysis is required, that lists relevant topics in this area as well as evaluates how well CBP requirements are met. This shortcoming is overcome in this paper. Existing surveys such as [Me04] also compare business process modelling languages but in comparison to this paper they focus on identifying a common set of metamodel concepts contained in the languages.

In Section 2 we start with the development of a set of requirements that result from modelling processes running not within a company, but enacting cross-organisational interactions. The identification of those CBP specific modelling requirements is based on the assessment of various cross-organisational business scenarios. Based on these requirements we describe and analyse relevant state of the art work in section 3. In section 4 we discuss the evaluation and propose a 3-level modelling approach and the use of views to model CBPs. We conclude with a summary and an outlook on further research issues.

2 Requirements for CBP Modelling

2.1 Analysis of Business Scenarios

Supporting CBP modelling imposes special requirements on methodologies, languages, tools, and standards. Those requirements can only be derived as a result of an extensive analysis of possible cross-organisational business interactions. We have gathered collaborative business cases and requirements from the field, referring to users and practitioners from different countries and industrial sectors. Best practice approaches already in use (e.g., [Ro04]) as well as desired features and long-term scenarios from market leaders and analysts have been taken into account. Precisely we have based our requirements analysis on the following sources:

- The ATHENA project [At05]
- IV&I Min/Max Replenishment Scenario [Op05]: This project consists of an international team supported by AIAG, OESA, and Odette. The initial business process to be defined will be min-max, in which suppliers are allowed to view customers' inventory data and make decisions to cover customer build and support internal operations.
- IDEAS Project [Id05]: Deliverable 1.2 contains various real life scenarios on cross-enterprise interactions. For each scenario a textual description is provided together with a graphical representation.

- SAP Scenario Maps [Sa04]: SAP Business Scenario Maps provide a detailed graphical representation of key end-to-end processes for a particular industry or cross-industry. This content is available for about 50 industry segments and 10 cross-industry areas.

Based on a detailed analysis of these CBP scenarios, we have identified a set of requirements which should be supported to facilitate CBP modelling. These requirements form a framework against which relevant work will be evaluated. In the following we give a short overview and describe the requirements and build up the framework for the evaluation of the state-of-the-art.

2.2 CBP specific requirements

The framework for requirements covers different aspects of CBP modelling. To receive a feasible metric that can be used to evaluate the state of the art, we consider seven top-level requirements:

- support of process abstraction concept,
- a CBP modelling framework should be offered,
- modelling of the CBP business context,
- support for modelling at the CBP design level,
- support for modelling at the CBP execution level,
- support of efficient CBP assembly,
- support of global business information schema.

These requirements contain more fine grained points, which are described below.

Process abstraction concept: CBPs are based on multiple data-sets, owned and maintained by the different involved parties with the goal to interweave the existing partner processes whilst creating minimal impact on the existing processes. By means of distribution and outsourcing, a CBP indirectly connects private business processes in a cross-enterprise business scenario [Sch02]. Thus, a suitable concept to selectively hide details of private processes, whilst providing a process-oriented interface to facilitate the state-oriented communication between trading partners is required. We can therefore state as a first requirement the need for a concept which allows for abstraction of internal processes and the creation of a selected interface to the outside world. In detail this maps to the following requirements:

- The modelling approach should allow on one hand for protecting the internal/private information of the partners that should not be published. Whereas on the other hand information must be revealed to successfully create a CBP and define the desired interaction.
- Therefore the approach must be able to represent internal/private processes and an external/public visible abstraction of the process.
- In addition mapping between internal processes and external process views must be enabled as well as the combination of different process abstraction to a CBP.

CBP modelling framework: Given the distinct natures of business and technical aspects of modelling, a collaborative and integrated CBP modelling framework incorporating the ‘best-of-breed’ techniques for the different levels of modelling – from

a business-level view to a technical perspective – is required. This also comprises an appropriate tool support. A similar requirement is described in [KK02] which introduces a metamodelling platform. The framework should fulfil the following requirements:

- The CBP framework must facilitate collaborative development of CBP specifications by business users in the different stakeholder partners. The emphasis of collaboration here is on the development aspect of CBP specifications. Thus, functions such as the seamless, multi-developer partitioning of a model, support of incomplete models, model versioning, or tracking of open issues requiring resolution for model completion typify collaborative model development.
- Furthermore, a common environment is required to facilitate interaction of partners and to allow for sharing context and state information related to symmetric cooperative and collaborative processes.
- The related aspects of models must be integrated across the different techniques supported in the framework. In other words, an integrated CBP modelling framework is required.
- The specifications of CBPs and the modelling techniques must be captured, as far as possible, through a highly effective graphical/visualization user interface. Where inappropriate or not possible for a part of CBP specifications to be captured through graphical means, the non-graphical (i.e. textual) part must be well-integrated with the graphical part.

Business context: The modelling of the underlying business context should be supported. The business context describes an operational business situation, including its goals, objectives, expectations, and problems. Not all aspects of models at the business context level will be executable (e.g. meetings, problem escalation up the organizational hierarchy, physical transport of materials). Thereby, the following aspects should be considered:

- The relationship between the CBP business context and CBP design model is one of loose refinement. This is because business users determine what aspects of the context should be automated (scoping) and how the problem-focused business context relates to the solution-focused CBP design model (informal mapping). Thus, it is important to support this informal, loose refinement step.

CBP design level: The CBP design level is a level which is distinct from the business context level out of which it was designed and the platform execution level. The CBP design level must be conceptual, independent of operational business contexts and platform-specific implementation levels. The CBP design level is characterized by the following requirements:

- The CBP design level must support conceptual specifications for the business level. Therefore, they must be highly suitable for business users, have a sufficient expressive power, and a clear (formal) semantics to avoid modelling ambiguities and errors.
- Business users must be able to validate CBP design models through model execution (i.e. model simulation).

CBP execution level: In addition to the CBP design level it is also important that the approaches support modelling at the CBP execution level which is transformed out of the CBP design level. Its purpose is to demonstrate the correctness of the design model

with respect to the implementation platform. The CBP execution level can be characterized as follows:

- It must allow application and platform specific aspects of the specification to be factored in (e.g. invocation of the application components, the implementation choice for message channels).
- The target platform chosen must be general enough so that the demonstration of implementation can be used to indicate how other platforms might be used. A support of all possible target platforms must not be the goal (similar to model driven architecture [Om05]).

Efficient CBP process assembly: This deals with a mechanism for the assembly of CBPs through process components from private and public processes. This level comprises the following detailed requirements:

- Partial input of the partners and input and output flow within the CBP has to be represented. This regards the input of the partners for the process and the relationships in between. That tackles the issue which input does one partner need from other partners in order to fulfil its part. This point plays an important role if the CBP output is a physical product.
- Also the information flow within the CBP has to be represented. The language must be capable to represent the information flow between the partners, e.g. different versions of a document. This point is much more important if the CBP output is a service.
- A modelling language must be able to describe the CBP interfaces, esp. the relevant information within the process interfaces, so that the CBP can run properly.

Global business information schema: A global business information schema should be supported which provides a common reference of business messages interchanged in cross-organisational business processes. A global business information schema may be characterized as follows:

- Common message interchange data and formats must be available through the schema for all CBP applications. All business documents are required to abide by this structure in order to be supported for message interchange in CBP applications.
- The schema should also store global business object types, relationships, and constraints for CBP applications. This will allow parties in a CBP application to structure business messages at the conceptual (i.e. implementation independent) level. It will also provide an independent basis for mapping to party-specific data definitions.
- It is important that the schema also provides definitions of the specific business objects of each party if it is necessary or whished to expose these internal data structures to partners. The global to local mapping of business object types and business message structures would be visible for all CBP applications or within the application that the party is involved with. The party should nominate the level of visibility for its exposed data definitions.
- It is important to make the system scopes of a CBP explicit to reflect the different sensitivities of information and event flow in those scopes. One scope might be the different parties in a CBP which essentially are part of the same organization and a known coalition with an established degree of trust (like government agencies). Business messages should contain the relevant data for parties within a system

scope. Thus, two different scopes entail different degrees of business message detail for the parties in the scopes.

- The modelling methodologies or languages should have the ability to reflect internal organizational constraints externally. CBP specifications must contain organizational role requirements for undertaking CBP activities. This allows CBP parties to understand at an external level the role context involved in undertaking a CBP activity. The role requirement specified against a CBP activity might be used to discover either at design or runtime a concrete binding of the activity.

3 Description and Evaluation of Related Work

In our survey we have considered several approaches dealing with CBP modelling and enactment. For the presentation in this paper we concentrated on those approaches for modelling of CBPs which are based on standards resp. standard proposals or are widely used. Some approaches do not directly use XML but at least provide an XML export of the proprietary format. In summary, the following relevant work has been considered:

- Event-Driven Process Chains (EPC) [Ho92],
- the Integrated Enterprise Modelling (IEM) method [MJ99][Sp96],
- Business Scenario Maps [Sa04],
- the Business Process Definition Metamodel[1] (BPDM) [Om03a] together with the Business Process Modeling Notation (BPMN) as a possible notation,
- the Unified Modelling Language (UML, which may also be used as a notation for BPDM) [Om04],
- ebXML [eb04],
- RosettaNet [Ro04],
- the Business Process Modelling Language (BPML) [Bp04],
- the XML Process Definition Language (XPDL) [Wf02],
- and the Web Services Business Process Execution Language (WS-BPEL) [An03] in combination with the Web Services Choreography Definition Language (WS-CDL) [W04].

For the evaluation of the state of the art for facilitating CBP modelling we have created a schema in which we rank how well a particular approach meets the requirements specified in section 2. We classify a requirement as fully supported if the approach supports this requirement without any restrictions. A requirement is partly supported if some but not all of the aspects identified in section 2 are supported. Not supported applies if an approach does not address a requirement at all.

The results of the state of the art analysis are summarized in Table 1. For a clearer presentation we only added the top-level requirements in the table. In the following we shortly describe the different approaches and explain the findings outlined in Table 1.

[1] Note, that we have considered the current submissions as the standardization will not be finished until the end of 2005.

Requirement	*fully supported*	*partly supported*	*not supported*
Process abstraction concept		WS-BPEL/WS-CDL	EPC IEM Business Scenario Maps UML BPML XPDL BPDM ebXML RosettaNet
CBP modelling framework		EPC IEM Business Scenario Maps BPDM UML RosettaNet BPML WS-BPEL/WS-CDL XPDL	ebXML
CBP business context	EPC IEM Business Scenario Maps		RosettaNet BPDM UML ebXML BPML XPDL WS-BPEL/WS-CDL
CBP design level	EPC IEM Business Scenario Maps BPDM UML	BPML	ebXML RosettaNet XPDL WS-BPEL/WS-CDL
CBP execution level	ebXML BPML XPDL WS-BPEL/WS-CDL	BPDM RosettaNet	EPC IEM Business Scenario Maps UML
CBP assembly	EPC IEM Business Scenario Maps BPDM UML ebXML BPML XPDL	RosettaNet	

Requirement	*fully supported*	*partly supported*	*not supported*
	WS-BPEL/WS-CDL		
Global Business Information Schema		EPC Business Scenario Maps ebXML IEM BPDM UML RosettaNet BPML XPDL WS-BPEL/WS-CDL	

Table 1: Evaluation of relevant work.

Regarding the first requirement, the support of a process abstraction, only WS-BPEL (a merger of IBM WSFL and Microsoft XLANG) partially meets this requirement as it has the notion of "abstract processes" that can be used to model abstract views of business processes. To define CBPs WS-CDL may be used in combination with WS-BPEL as it provides a global, message-oriented view of a process involving multiple Web services. Some of the other approaches offer constructs which might be used to model process views (for instance, UML 2.0 which introduces some new features for modelling business processes, e.g. interaction and composition structure diagrams) but they do not support the concept explicitly. In particular, there is no support for generation of views, mapping of views and private processes or interweaving of process abstractions to create CBPs.

With respect to the requirement of a CBP modelling framework nearly all approaches offer tool support, mainly with graphical user interfaces. However, they often only support either the business/CBP design level (e.g. EPC, IEM, or Business Scenario Maps) or the execution level (e.g. BPML, XPDL, WS-BPEL) or modelling of platform independent control flow[2]. The latter is supported by BPDM which defines an abstract metamodel for business process definition. As such this metamodel provides a common abstraction for multiple business process or workflow definition languages. We fail to identify an approach that gives a comprehensive modelling support on all levels.

Regarding the modelling of business context EPCs, IEM, and Business Scenario Maps are well suited as they focus on modelling of CBPs from the business level perspective and provide methods to capture business context. For instance, EPCs depict complex processes by describing the logical activity flow through a sequence of function, event, and logic operators. These are typically very high-level and may also capture business goals, expectations, or organisational hierarchies. In contrast to that BPDM, UML, ebXML, BPML, XPDL, and WS-BPEL/WS-CDL do not support the modelling of business context. They focus on modelling only business processes, data exchange or

[2] as in model driven architectures (MDA) [Om05]

process definition exchange. RosettaNet defines common business procedures which are independent of the concrete context

Approaches that deal with process modelling on the business level (EPCs, IEM, Business Scenario Maps) do fully support the CBP design level. This also holds for BPDM and UML as they aim at offering a platform independent process model which is well suited for the design level. BPML already takes into account the execution level by regarding events and messages but still can be viewed as offering design level support. In contrast to that the strength of ebXML, RosettaNet, XPDL, and WS-BPEL/WS-CDL is on modelling CBPs on the execution level. Thus, they offer only limited or no support for modelling on the CBP design level but good support for the CBP execution level.

An efficient CBP assembly considering CBP internal data flow and CBP interface descriptions is well supported by nearly all approaches. RosettaNet, a consortium of major information technology, electronic components, semiconductor manufacturing, telecommunications and logistics companies, aims at creating and implementing industry-wide, open e-business process standards. Thus, it offers only limited support for CBP assembly as it focuses on the definition of common business procedures and reflects data flow only partially.

A global business information schema contains common messages, business objects, scopes for defining the visibility of business objects, and support of a role concept. Furthermore, an efficient mapping between business objects should be supported. None of the investigated approaches meets all of these requirements. However, each approach meets some of them to a certain extent. For instance, approaches that are well suited for the CBP design level (e.g. EPCs and IEM) offer role concepts and definition of scopes. For instance, ebXML, a project to standardize the secure exchange of business data using XML, offers common data types used in CBPs. WS-BPEL supports amongst other things the modelling of data exchanged in CBPs. However, a comprehensive support for mapping private objects to common business objects and mapping of business objects on each other (e.g. with additional semantic information) is not addressed in any of the approaches.

4 Discussion of the State-of-the-Art

From table 1 we observe that none of the investigated approaches supports all requirements that should be addressed by methodologies, languages, tools, and standards facilitating the modelling of CBPs. Looking at the strengths and weaknesses of the different approaches in terms of which requirements they fully or partially support, the following can be concluded:

- **Sufficient support for CBP assembly in most of the languages:** We observe sufficient support for representing information flow between different partners in most approaches, except RosettaNet which has its main focus on process descriptions.

- **Insufficient support for modelling of process abstraction and linking up internal processes to CBPs:** Even though CBPs can be modelled and interfaces between the partners can be specified, we observe a shortcoming in explicitly linking up internal processes to CBPs. None of the discussed approaches offers a suitable mechanism to link up private processes into CBPs, enabling information hiding at the same time. We propose a suitable concept to overcome this shortcoming further down in this chapter.
- **Need for a collaborative and integrated modelling framework comprising all levels of abstraction:** Taking into account the evaluation of languages concerning the requirements of supporting business context, the CBP design level and the CBP execution level, we observe that each language, standard and tool has a strength in either of those modelling levels. We therefore propose a 3-level modelling approach, incorporating the best techniques for each level.

Insufficient support for linking up internal processes to CBPs: A systematic way is required, that allows partners to selectively expose internal information and interweave process steps to CBPs. As promising concept in this context we propose the conceptual model of process views, where process views are introduced as an additional layer above the private processes of an organisation [SL01]. Private processes contain data that must not be revealed by default whereas process views provide an abstraction of the private process that is sufficient to coordinate internal actions with activities of external trading partner(s) [SO04]. This modelling concept is depicted in Organisation 1 in Fig. 1. A particular interaction may require involved partners to adapt for the purpose of the communication. This adaptation can not necessarily be reflected in the partners' private (internal) business processes without inflicting their ability to interact with other partners in a different context. Imagine an automotive supplier that is providing parts to two different car manufacturers that prescribe a particular sequence of interaction. The supplier's goal will be to run the same internal process and still to collaborate with both manufacturers. To enable this, process-oriented abstraction needs to be modelled and tightly bound to the corresponding private business process. Therefore based on one private process, different views can be generated (cp. Organisation 3) and thus reflect the specific requirements of multiple interactions. CBPs are then constructed by interweaving process views of different organisations (cp. CBP 3 in Fig. 1). Using different views of the same internal processes, organisations are able to interact in a different context without changing the internal process (cp. Organisation 3 in Fig. 1).

The concept of creating views to provide abstract information about internal processes was first introduced by Liu and Shen in 2001[LS01]. It is derived from views as they are used in database systems and the authors present a formal model of processes and extend it to virtual process views providing transformation rules. While the views in the initial work are only used to provide necessary information about processes to other company internal departments, they extend their work in [SL01] for the purpose of CBPs. Parallel to this work Chiu et al. introduce workflow views to control visibility of internal processes and to enable inter-operability of e-services [Ch02a]. The main focus in this work is on combining views of different partners to composite e-services (CBPs) and the implementation of the views with contemporary Web services. A mapping mechanism to ensure the coupling between private processes and views in all circumstances is not

provided. Schulz et al. take up the concept of views, discuss it in the context of mediated and un-mediated communication and formalize the dependencies between private processes, process views and CBPs [Sch02][SO01][SO04].

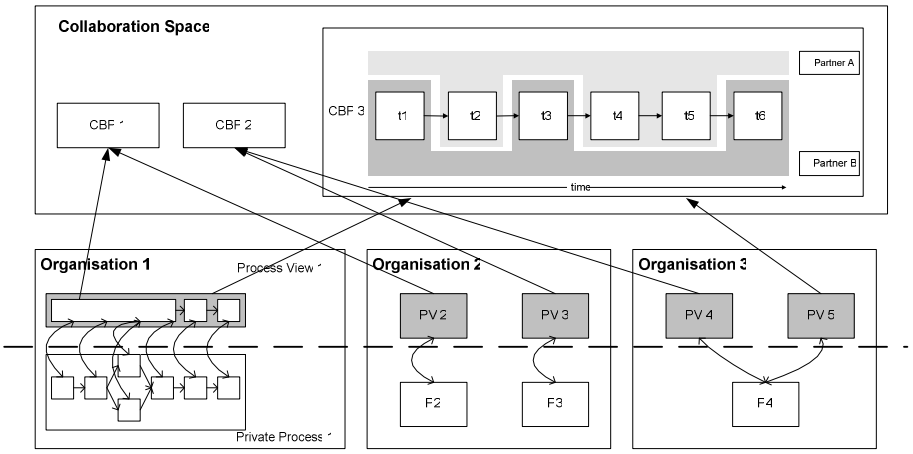

Figure 1: Dependencies between private processes, process views and CBPs.

Need for a collaborative and integrated modelling framework comprising all levels of abstraction: Motivated by the requirements we identify three levels on which CBP models are created (cp. Fig. 2):

- **Business level: Business processes**: This level represents the business view on the cooperation and the cross-organisational process that describes the interaction of the partners. The CBPs modelled on this level are not executed. This level mainly supports the perspective of a business analyst.
- **Business level: Technical processes**: This level provides a more detailed view on the CBP representing the complete control flow of the process. For instance, single tasks and messages exchanged are modelled on this level. However, the control flow is specified in a platform independent manner, so that the CBP models at this level are still not executable by a business process engine.
- **Execution level: Executable processes**: The CBP model on this level contains platform specific interaction information and may be executed in an appropriate execution engine. Platform specific information is e.g. the concrete message formats sent or received during CBP execution or the transport protocols used.

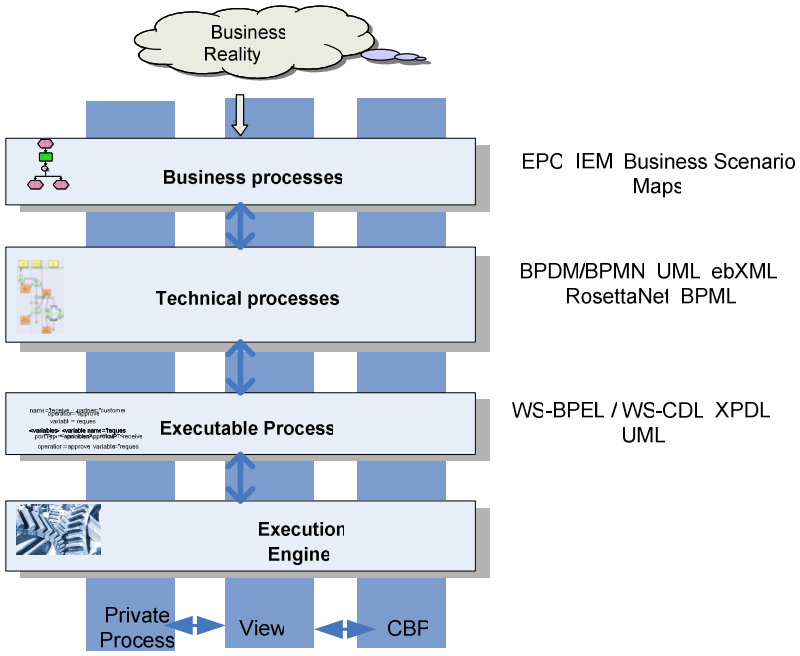

Figure 2: Proposed CBP Modelling Framework.

The different approaches presented in section 3 can then be incorporated into the different levels. Concluding from table 1, we derive the following mapping (cp. Figure 2):

- **Business level: Business processes**: EPC, IEM, Business Scenario Maps
- **Business level: Technical processes**: BPDM / BPMN, UML, ebXML, RosettaNet, BPML
- **Execution level: Executable processes**: XPDL, WS-BPEL / WS-CDL, UML

There are two possible ways to deal with the fact that there is no approach being able to support the modelling of CBPs on all levels. The first one is to take one approach that already fulfils a large number of requirements and extend it so that it also addresses the missing requirements. However, as the approaches typically focus on a particular perspective, e.g. CBP design vs. execution, an extension might never reach the expressive power that existing techniques on the respective level can offer. A second approach is therefore more feasible where the best candidates of each level are identified. However, there may be more than one suitable candidate for a level. For instance, if partners wanting to cooperate in a CBP already use different tools to model business processes on the business level they should be able to continue using their tools on this level. Thus, the selection of candidates cannot be generalized but depends on the concrete case. Furthermore, to reach the goal of providing an integrated CBP modelling framework the process models generated on the different levels have to be linked and a top-down as well as a bottom-up mapping has to be enabled (cp. Figure 2).

Furthermore, to provide a concept that allows the partners to control the visibility of their private processes, the concept of process views should accomplish the 3-level approach. It is applicable on each of the three levels. To integrate the view approach with the 3-level modelling framework, two kinds of mappings between process representations are needed: a horizontal mapping between private process, process view, and CBP on each level as well as a vertical mapping between CBP models on different levels. Future work should investigate on these mapping requirements.

5 Conclusion and Outlook

Often business processes not only involve internal resources of an organisation, but take place between multiple independent partners crossing organisational boundaries. These cross-organisational business processes are emergently of interest for research and industry. In the context of modelling CBPs, we derived comprehensive requirements from CBP scenarios and best practice approaches. The requirements can be summarized in the following high-level requirements:

- support of process abstraction concept,
- a CBP modelling framework should be offered,
- modelling of the CBP business context,
- support for modelling at the CBP design level,
- support for modelling at the CBP execution level,
- support of efficient CBP assembly,
- support of global business information schema.

Based on these requirements, we have conducted a state of the art survey which allows us to draw the following conclusions. Most of the languages offer sufficient support for CBP assembly. However, they provide insufficient support for modelling of process abstraction and linking up internal processes to CBPs and do not offer a collaborative and integrated modelling framework comprising all levels of abstraction. Thus, a 3-level approach should be used to allow for a comprehensive modelling of CBPs taking into account different perspectives. We have identified the following levels: Business Level – Business Processes, Business Level – Technical Processes, and Execution Level – Executable Processes. As no modelling technique is able to support all levels, we argue that it is necessary to identify the ‘best of breed’ for each level. Therefore a mapping between the CBP models created on the different levels is necessary and should be supported by tools. This allows bridging the gaps between different existing approaches. Additionally, to provide a concept that allows the partners to control the visibility of their private processes, the concept of process views should accomplish the 3-level approach by introducing an abstraction level between the private processes and the views.

Future research issues should address how the mappings between the CBP models on the three levels can be performed efficiently and how the concept of process views can be represented in the investigated approaches on the different levels. This will also help to identify which approaches should be selected as ‘best of breed’ on the different levels.

Acknowledgements

The work published in this paper is (partly) funded by the E.C. through the Athena IP (http://www.athena-ip.org). It does not represent the view of E.C. or the ATHENA consortium, and authors are solely responsible for the paper's content.

References

[An03] Andrews, T. et al.: Business Process Execution Language for Web Services, Version 1.1. May 2003.

[At05] ATHENA project. Information available at http://www.athena-ip.org

[Bp04] BPML. Available at http://www.bpmi.org/bpml.esp

[Ch02a] Chiu, D.K.W., Karlapalem, K., Li, Q., Kafeza, E.: Workflow view based e-contracts in a cross-organisational e-services environment. Distributed and Parallel Databases 12(2-3), Dordrecht, 2002; pp. 193-216.

[De03] Delphi Group: BPM 2003. Market Milestone Report. A Delphi Group White Paper. 2003.

[eb04] ebXML. Available at http://www.ebxml.org

[Ho92] Horrmann, W., Kirsch, J., Scheer, A.-W.: Modellierung mit Ereignisgesteuerten Prozeßketten: Methodenhandbuch; Stand: Dezember 1992. In: Scheer, A.-W. (ed.): Veröffentlichungen des Instituts für Wirtschaftsinformatik, no. 101, Saarbrücken, 1992.

[Id05] IDEAS project. Available at: http://www.ideas-roadmap.net/webpage/Phps/scheme.php

[KK02] Karagiannis, D., Kühn, H.: Metamodelling Plattforms. Proc. of EC-Web 2002 – Dexa 2002, France, 2002; p. 182.

[LS01] Liu, D.-R., Shen, M.: Modeling workflows with a process-view approach. Proceedings of Seventh International Conference on Database Systems for Advanced Applications, Hong Kong, 2001, pp. 260-267.

[Me04] Mendling, J., Neumann, G., Nüttgens, M.: A Comparison of XML Interchange Formats for Business Process Modelling. Proc. of EMISA'04, 2004; p.129-140.

[MJ99] Mertins, K., Jochem, R.: Quality-Oriented Design of Business Processes. Kluwer Academic Publishers, Boston, 1999.

[Om03a] OMG: Business Process Definition Metamodel – Request for Proposal. OMG Document: bei/2003/01-06.

[Om03b] OMG: XML Metadata Interchange. Available at http://www.omg.org/technology/documents/formal/xmi.htm

[Om04] OMG: Unified Modeling Language. Available at http://www.uml.org

[Om05] OMG: Model Driven Architecture. Available at http://www.omg.org/mda/

[Op05] Available at: http://www.openapplications.org/downloads/meetings/20040817-19-Detroit/2-Wednesday/1975,1,Project Definition

[Ph03] Phifer, G., Hayward, S., Flint, D.: Technologies That Enable Business Process Fusion. Report by Gartner. October 2003.

[Ro04] RosettaNet. Available at http://www.rosettanet.org

[Sa04] SAP. SAP business maps. Technical report, SAP AG, http://www.sap.com/solutions/businessmaps/c-businessmaps, 2004.

[Sch99] Scheer, A.-W.: ARIS – Business Process Modeling, 2nd. ed. Berlin, 1999.

[Sch02] Schulz, K.. Modelling and Architecting of Cross-Organisational Workflows. PhD thesis, The School of Information Technology and Electrical Engineering, The University Of Queensland, Australia, 2002.

[SO01] Schulz, K., Orlowska, M.E.: Architectural Issues for Cross-Organisational B2B Interactions. Proc. International Conference on Distributed Computing Systems, Workshop, 2001; p. 79-87.

[SO04] Schulz, K.A., Orlowska, M.E.: Facilitating cross-organisational workflows with a workflow view approach. Data & Knowledge Engineering 51(1),2004; p. 109-147.

[SL01] Shen M.X., Liu D.R.: Coordinating interorganizational workflows based on process-views. Database and Expert Systems Application Lecture Notes in Computer Science, Berlin, 2001; pp. 274-283.

[Sm01] Smith, H., Neal, D., Ferrara, L., Hayden, F.: The Emergence of Business Process Management. A Report by CSC'S Research Service. Version 0.1, January 2001.

[Sp96] Spur, G., Mertins, K., Jochem, R.: Integrated Enterprise Modelling, Berlin Wien Zürich, Beuth, 1996.

[W04] W3C: Web Services Choreography Description Language Version 1.0. October 2004.

[Wf02] WfMC: Workflow Process Definition Interface – XML Process Definition Language, v.1.0. WfMC document number WFMC-TC-1025, 2002.