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THE CHALLENGES OF INTER-ORGANIZATIONAL BUSINESS PROCESS DESIGN – A RESEARCH AGENDA

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Abstract

Given the increasing importance of value chain collaboration, business processes need to be more closely aligned across organizational boundaries. Hence, business process modeling and design have to be enhanced and extended to cope with inter-organizational business relationships. Among the challenges that arise are interdependencies between internal and external processes, different process logic and terminology, missing clarification of responsibilities and confidentiality issues. This paper analyzes existing approaches to business process modeling, workflow management and B2B standardization with regard to the specific requirements concerning inter-organizational business process design. It extracts the relevant concepts addressing these requirements and draws up an agenda for further research.

Keywords: Inter-organizational business processes, business process design, business process modeling, B2B integration, enterprise architecture

1 INTRODUCTION AND MOTIVATION

Since the early 1990s, when the first seminal publications on Business Process Reengineering (Hammer & Champy 1993; Davenport & Short 1990; Hammer 1990) appeared, companies have recognized that their business processes represent a major source of competitive advantage. Although the original concept of IT-led, radical reengineering has often been criticised, business processes today are considered a key element of the organizational design of an enterprise (Melao & Pidd 2000). Based on a recent survey among larger corporations in Germany, Hess and Schuller (2005) report that business process orientation is considered an important management concept, as reflected by stable or increasing project budgets since 1995. Process modeling approaches and tools serve as a basis for documenting business process design, for analyzing or optimizing business processes, and for identifying the functional requirements for IS support.

For more than 10 years, the need for inter-organizational business process design has been highlighted and underpinned by a large number of case studies on companies that have successfully reshaped their business relationships (Österle & Fleisch & Alt 2000; Clark & Stoddard 1996; Wigand & Picot & Reichwald 1997; Venkatraman 1994). The importance of external collaboration is increasing since companies are redefining their vertical architectures (Jacobides & Billinger 2006), i.e. their scope and boundaries. Prominent examples are car manufacturers which shift the development and production of an entire car model to so-called tier 0.5 suppliers (Maidl & Axtner & Arlt 2005), or banks which externalize the processing of payments or securities that was considered core in the past (Lammers & Löhndorf & Weitzel 2004). With a growing number of external business relationships, business processes need to be more closely aligned across organizational boundaries. Hence, business process modeling and design have to be enhanced and extended to cover these requirements.

This paper discusses the consequences of inter-organizational relationships for the process architecture of the participating enterprises. It particularly addresses the following questions: (1) What are the particularities of inter-organizational business process design compared with internal business process design? (2) How should the internal business process models of an organization reflect the inter-organizational relationships? For this purpose, we conducted explorative research which is considered appropriate for gaining better insight and understanding of a given area. It is also suited to forming the basis of subsequent, conclusive research design methodologies – namely descriptive or causal design. In an initial workshop with business process experts from six automotive companies, we analyzed the particularities of and the requirements for inter-organizational business process design. We evaluated recent experiences with more intensive forms of B2B collaboration in supply chain management and product development. The findings were discussed with two additional groups of practitioners, the first one also from the automotive industry (five additional companies) and the second one representing different industries (six companies). In order to underpin the practitioners' view with the scientific view, we validated the findings with arguments from research on inter-organizational business processes. The explorative research forms the basis for the analysis of existing approaches to inter-organizational business process design, namely workflow management, business process modeling and B2B integration and standardization. The remainder of this paper is structured as follows: Section 2 clarifies the theoretical background and deduces a set of requirements concerning inter-organizational business process design. These requirements form the basis for the review of state-of-the-art approaches in inter-organizational business process design in Section 3. Comparing the requirements for inter-organizational business process design with existing approaches, we shall conclude by drawing up an agenda for future research.

2 INTER-ORGANIZATIONAL BUSINESS PROCESS DESIGN

2.1 Business Processes as a Constituent of the Enterprise Architecture

Business processes can be defined as a sequence of activities transforming certain inputs into an output of value to the customer. Among the key characteristics of business processes are results orientation, customer focus and cross-functional coordination as well as the use of information technology (cf. (Hammer & Champy 1993; Davenport & Short 1990; Österle 1995). Business processes emphasize the cross-functional (or horizontal) coordination between organizational units, thereby adding dynamic aspects to the organizational design of an enterprise. The importance of business process design is reflected by the fact that business processes are a main constituent of many enterprise architecture frameworks, such as the Architecture of Integrated Information Systems (Scheer 1995), the Semantic Object Model (Ferstl & Sinz 1995) or Business Engineering (Österle 1995). In this context, business process modeling is considered an integral part of enterprise modeling. The existing variety of business process modeling languages has increased lately by the second version of the Unified Modeling Language, UML (OMG 2004) and a number of standardization initiatives for business process modeling, including the Business Process Modeling Notation, BPMN (OMG 2006).

It is important to note that the term “business process” is widely used, and with different connotations. Business managers and analysts are usually concerned with the conceptual design of business processes. They use business process models as a basis for documentation and communication as well as process optimization. When it comes to the implementation of business processes, information systems analysts define the processes’ technical representation. In order to distinguish the conceptual model of the business process from its technical representation in information systems, we refer to the technical implementation of the business process as workflow (cp. Zur Muehlen 2004).

2.2 Requirements for Inter-organizational Business Process Design

The defining characteristic of an inter-organizational business process is that two or more autonomous organizations jointly execute a process with the purpose of creating a certain output. The term autonomous organization refers to both legally independent organizations and autonomously acting organizations being part of a group (e.g. business units, subsidiaries). Usually, organizational boundaries are associated with a lack of transparency, redundancies (e.g. the manual re-entry of data) and time lags, thereby delaying the process flow. Although most of these inefficiencies are also present in the case of cross-functional coordination, some specific challenges exist at the boundaries of organizations.

In the following, we outline these challenges in detail and deduce requirements for their representation in future process architectures. This set of requirements builds on outcomes of expert workshops with practitioners and has been complemented by findings from literature (cf. Section 1, Table 1).

1. BPR literature highlights the importance of a process owner that streamlines the entire business process. In the case of inter-organizational relationships, no such unique process owner exists. Business processes of external organizations are often perceived as a “black box” since process activities and their interdependencies with internal processes are unknown to the internal staff. *In order to allow for basic coordination among business partners and clarify interdependencies, the future process architecture needs to reflect external process integration.*
2. In an inter-organizational business process, responsibilities for the different process activities are shared among two or more organizations. Process coordination at the boundaries of organizations is often performed ad hoc due to inadequate clarification of responsibilities. *Process models have to provide means to split responsibilities among different organizations and allocate tasks to specific actors. They have to take into account the fact that the allocation of responsibilities to a specific organization might change over time.*

3. Business processes encapsulate the business logic and organizational knowledge of a company. For external business partners it is often very time-consuming to understand the internal process logic and terminology of an organization. This is specifically true for different industries.
Inter-organizational business process design has to provide concepts to support organizations in aligning the semantics that underlie business processes.
4. In inter-organizational business processes, actors are essentially autonomous and have the freedom to design and modify business processes within their organizational boundaries. This may result in individual business process life cycles, which may be very time-consuming or even impossible to align, especially in the case of a larger number of inter-organizational relationships.
Mechanisms for decoupling inter-organizational process design from the individual process design of business partners are required to reflect the autonomy of the participating organizations and to reduce the complexity of process design projects.
5. Business process design may contain specific organizational know-how that represents competitive advantage. Furthermore, processes contain confidential information, giving rise to a need for organizations to hide internal details of their processes. At the same time, successful inter-organizational relationships depend upon a certain level of information sharing.
The future process architecture needs to provide concepts for providing selective transparency of internal processes.
6. Boundaries between legal entities have to be treated differently than boundaries between internal organizational units. Collaboration between different legal entities is usually governed by contracts and legal frameworks specifying service levels and prices.
Process design has to formally describe the interfaces at the organizational boundaries and to embrace the information flow as well as qualitative, non-functional requirements.
7. As companies typically enjoy relationships with a lot of partners, they are only able to reconcile processes with a limited number of important partners. Bilateral reconciliations with all business partners would lead to an explosion of cooperation costs. In addition, compliance with industry (process) standards, like RosettaNet PIPs or CPFR (Collaborative Planning and Replenishment), becomes more important.
In order to accelerate the setup of inter-organizational business processes, concepts have to be provided that reduce bilateral negotiation and adaptation efforts, and foster alignment of business processes with multiple partners. This includes supporting reference processes which might be the result of B2B standardization.

Challenges & Requirements as identified in Expert Workshops	Referenced by
1. External processes as “black box” → Representation of inter-organizational business process	(Alt 2004, p. 119)
2. Lacking clarification of responsibilities at company boundaries → Allocation of tasks to actors	(Aalst 2000; Alt 2004 p. 119)
3. Different process logic and terminology → alignment of semantics	(Gopal & McMillian 2005; Alt 2004 p. 119; White & Prior & Radcliffe & Wood & Holincheck 2004; Zhang 2004)
4. Process autonomy → decoupling of internal and external processes	(Aalst & Weske 2001; Alt 2004 p. 119; Norta 2007)
5. Confidentiality → (Selective) visibility of internal processes to external partners	(Shen & Liu 2001; Norta 2007)
6. Contractual relationships → formal specification of process interfaces	(Alt 2004 p. 119; Matthews 2006)
7. Complexity of bilateral agreements → Support for alignment with multiple partners	(Österle 2004; Alt 2004 p. 119; Zhang 2004; Vanderhaeghen & Zang & Scheer 2005)

Table 1. Challenges and Requirements of Inter-Organizational Business Process Design

3 INTER-ORGANIZATIONAL BUSINESS PROCESS DESIGN – STATE OF THE ART

From the review of existing literature we have identified three fields of research which address the challenges and requirements outlined in the previous section. These fields of research explicitly delineate concepts for conceptualization and formal representation of inter-organizational business processes. We have chosen the most prominent contributions in these areas for our review. *Business process modeling* has formulated the key concepts of documenting process architectures. Business Process Modeling Notation (BPMN), UN/CEFACT Modeling Methodology (UMM) and extensions to Event-driven Process Chains (EPC) explicitly encompass inter-organizational process modeling. For some time, *workflow management* has been dealing with the challenges of distributed processes. Approaches like Public-to-Private (P2P), and the Process View Model distinguish internal and external views on workflows. Existing work on *B2B integration and standardization* provides a basis for dealing with inter-organizational process design, too. RosettaNet and ebXML define concepts for process standardization and incorporate them into holistic architectures which are complemented by methodologies and procedures.

3.1 Business Process Modeling

3.1.1 Event-driven process chains (EPC)

Event-driven process chains have been introduced by Keller, Nüttgens and Scheer (1992) in order to describe the temporal and logical sequence of functions contained within a business process. The popularity of EPC among practitioners is due to the fact that they are used in the context of ERP reference models (Vanderhaeghen & Zang & Scheer 2005). EPCs are similar to Petri Nets and comprise elements of functions, events and connectors linked via control flow arcs (Hoffmann & Kirsch & Scheer 1993). Additional element types enable the linking of different EPC models: Process interfaces point from the end of one process to that of the next, whereas hierarchical functions allow the refining of sub-processes. Recently, Klein, Kupsch and Scheer (2004) have suggested three enhancements of the EPC concept in order to cope with inter-organizational process design. First, they suggest explicitly indicating the different entities that are performing an inter-organizational business process, either by adding the attribute “organization” to existing object types (e.g. organizational unit, role), or by introducing the concept of swimlanes. The second amendment, i.e. the additional object type process module, abstracts process information by substituting subprocesses that represent a coherent part of a business process. The third enhancement comprises the conceptual modeling of process interfaces, which represent the transition between participating organizations. Process interfaces can be modeled either as events or using so-called interface diagrams. Inspired by the heterogeneity of business process modeling tools, Mendling and Nüttgens (2004) suggest the EPC markup language (EPML) as a platform-independent, XML-based interchange format for EPCs. They distinguish private from public views on business processes and argue that only public views should be exchanged between business partners.

3.1.2 Business Process Modeling Notation (BPMN)

The Business Process Modeling Notation (BPMN) was originally developed by the Business Process Management Initiative (BPMI) and became an OMG standard in 2005 (OMG 2006). Their target was to bridge the gap between visualizing business processes in a flow-chart format and representing these in a formal language for process execution like the Business Process Execution Language (BPEL). BPMN distinguishes three types of submodels (OMG 2006): *Private business processes* are those internal to a specific organization. *Abstract (public) processes* represent the interactions between a private business process and another process or participant. They comprise only those activities that are used to communicate outside the private business process, plus the appropriate flow control me-

chanisms. A *collaboration (global) process* consists of abstract processes of two or more participants communicating with each other depicted as a sequence of activities and message exchange patterns. Business process diagrams in BPMN suggest two elements specific to inter-organizational process descriptions: Message flows depict information exchanges between organizations, and swimlanes (lanes and pools) are used to represent entities (e.g. organizations) that perform business processes.

3.1.3 UN/CEFACT's Modeling Methodology (UMM)

UMM has been developed by UN/CEFACT to analyze and design B2B business processes and to concentrate on business semantics (UN/CEFACT 2006). All UMM artifacts are documented in UML. UMM's modeling of business processes pursues a three-level top-down approach. In the *Business Domain View (BDV)*, inter-organizational and internal business processes are described as high-level use case diagrams. Business partner types are defined as participants in a business process. Processes are complemented by activities, business entities and messages; they are described in detail in the *Business Requirements View (BRV)*. Finally, the *Business Transaction View (BTV)* defines the choreography of information exchanges and delineates most of the artifacts specific to inter-organizational business process modeling. Artifacts dealing with dynamic aspects of a collaboration are defined in *Business Choreography Views* and *Business Interaction Views*. They describe the sequence of a complex business collaboration and interactions leading to synchronized states of business entities at both partners. The *Business Information View* deals with structural aspects of a collaboration, i.e. artifacts describing the information exchanged. The Business Interaction View itself is a container for artifacts that define interactions between business partners in detail. Each partner is represented by a swimlane comprising the business actions performed, i.e. the specific area of responsibility. Information exchange between business actions is described by information envelopes. Information envelopes contain business entity data changed by the partner.

3.2 Distributed Workflows

3.2.1 Process-View Model

Shen and Liu (2001) suggest a process-view-based coordination, and postulate that inter-organizational workflows are coordinated through virtual states of process-views. An organization provides *process-views* that represent an appropriate view of the internal *base process* for different roles by abstracting information. Through this concept, the organization conceals critical information and only provides participants with necessary information. An inter-organizational process flow is performed via interactions between process-views. Ideally, these are implemented on the basis of existing standards, such as CORBA and XML. An integrated process is a company's view on the inter-organizational workflow, which consolidates the internal base processes and the partners' process-views. Both the integrated process and the process-view are virtual processes. Liu and Shen (2003) provide a modeling tool for inter-organizational workflows as well as an interoperation mechanism to coordinate autonomous, heterogeneous and distributed workflow management systems.

3.2.2 Public-to-Private Approach

According to the Public-to-Private (P2P) approach developed by Aalst and Weske (2001), the participating organizations should agree on a common *public workflow* in a first step. They subsequently partition the public workflow according to domains, which basically represent the participating organizations. Combining the public parts assembles the inter-organizational workflow. Public parts are allowed for private refinement by the organizations. Projection inheritance and transformation rules guarantee that *private workflows* are correct subclasses of the public workflow. The P2P approach uses workflow nets (WF-nets), a specific form of Petri Nets, to model workflows. The specific notation of the inter-organizational workflow is called inter-organizational workflow net

(IOWF-net). The IOWF-net basically consists of all participants' WF-nets and additional elements to connect them. Inputs and outputs of private workflows are called methods. Methods are connected by channel flow relations; messages exchanged between methods are represented by so-called channels (e.g. orders, confirmation messages).

3.3 B2B Frameworks and Standardization

3.3.1 *RosettaNet*

RosettaNet (www.rosettanet.org) is a consortium of 500 companies from the high-tech and electronics industries driving B2B standardization. Fundamental to the RosettaNet standard (RosettaNet 2001) are the Partner Interface Processes (PIPs) which specify business processes between trading partners. Each PIP specification describes business roles for a given business process, business activities between these roles, and type, content and sequence of business documents exchanged by business partners. A PIP specification is described by means of three views, i.e. *Business Operational View* (BOV), *Functional Service View* (FSV), and *Implementation Framework View* (IFV). RosettaNet PIPs focus on external process interactions between companies and require internal processes to conform to the PIPs. Besides PIPs, RosettaNet standards comprise the RosettaNet Business Dictionary as a basic vocabulary, the RosettaNet Technical Dictionary, which specifies how business messages are wrapped and transported, and the RosettaNet Implementation Framework, which specifies message content, transport protocols for communication (HTTP, CGI, email, SSL), as well as security mechanisms (digital certificates, digital signatures).

3.3.2 *ebXML*

ebXML (www.ebxml.org) provides a framework for the establishment of business relations and subsequent execution of business transactions. The framework's specification, which corresponds to business processes, is called ebXML Business Process Specification Schema (ebBP), and is based on UN/CEFACT Modeling Methodology (UMM). Other business-process-related components include Core Component Technical Specification (CCTS, defines business documents), Message Service Specification (ebMS, provides message packaging, routing and transport facilities), and Collaboration Protocol Profile and Agreement (CPP/CPA, describes business collaborations supported by a party and agreements between parties) (OASIS 2006). In an ebBP business collaboration, business partners interact through business transactions. Business transactions are the highest granularity of the partners' processes. The business transaction choreography defines the sequence of transactions and is described by activity diagram concepts like UML or BPMN. Each business transaction is implemented by business document flows between trading parties.

3.4 Contributions to Inter-organizational Business Process Design

In this section, we compare the contribution of the existing approaches towards the challenges of inter-organizational business process design, which we outlined in Section 2.2. To this purpose, Table 2 depicts each requirement, whether it is addressed by the approach and, if so, by which concepts. Our evaluation scale ranges from comprehensively fulfilled (depicted by a filled circle), partially fulfilled (semi-circle) to not fulfilled (empty circle).

The approaches investigated introduce a representation of the inter-organizational business process, which uses either an existing modeling notation or its extensions. Specific artifacts are necessary for describing inter-organizational business processes, among them external organizations, roles or partner types as well as messages, business documents and channels. With regard to the allocation of tasks to the actors in the inter-organizational business process, swimlane concepts have become popular.

	Event-driven process chain (EPC) ¹ trad. EPC / ² enhancements	Business Process Modeling Notation (BPMN)	UN/CEFACT Modeling Methodology (UMM)	Process-View Model	Public-to-Private Approach (P2P)	RosettaNet	ebXML
General information							
Authors / Source	Codeveloped with SAP, in the context of ERP reference models (Keller & Nüttgens & Scheer 1992); recent enhancements by (Klein & Kupsch & Scheer 2004) and (Vanderhaeghen & Zang & Scheer 2005)	International computer industry standardization consortium OMG (OMG 2006)	United Nations body UN/CEFACT (UN/CEFACT 2006)	(Shen & Liu 2001; Liu & Shen 2003)	(Aalst & Weske 2001)	RosettaNet, consortium of 500 companies from high-tech and electronics industries (RosettaNet 2001)	International standardization consortium OASIS (OASIS 2006)
Process notation	EPC, enhancement of Petri Nets	BPMN	UML profile based on UML meta-model 1.4.2	Activity-based workflow model, graphically represented as directed graph	Workflow-Nets (WF-nets) based on Petri Nets	UML activity diagrams	Activity diagram concepts, e.g. UML activity diagrams or BPMN's BPD
Artifacts	Function type (active elements), event type (passive elements), connector types (AND, OR, XOR) linked via control flow arcs	Flow objects (events, activities, gateways), connecting objects (sequence flows, associations), artifacts (data objects, group, annotation)	Use case diagrams (use case, association, dependency, specialization, actor), class diagram (class, package), activity graphs (states, partition)	Subprocesses, activities, dependencies, loop structures	Tasks modeled by transitions, causal dependencies by places and arcs, splits and joins	Activity diagrams (e.g. states, activities, forks, joins, transitions)	Activity diagrams (e.g. states, activities, forks, joins, transitions)
Artifacts for inter-organizational business process design	Attribute "organization", swimlanes, process modules, process interfaces	Swimlanes (lanes, pools), message flows	Partner types, swimlanes, information envelopes, business actions	Role-specific process-views as external interfaces to internal base processes	IOWF-Nets: Domains, methods, channel flow relations, channels	Business roles, business documents	Roles, business documents, cf. BPMN and UMM

Requirements regarding Inter-organizational Business Process Design							
1. Representation of inter-organizational business process	○ ¹ / ● ² (modeled as EPC)	● (collaborative process)	● (business process views)	○ (only individually per partner)	● (public workflow)	● (PIP)	● (ebBP)
2. Allocation of responsibilities / tasks to actors	○ ¹ / ● ² (swimlanes)	● (swimlanes)	● (swimlanes)	● (base process)	● (domains)	● (PIP include roles and allocation to tasks)	● (pools)
3. Semantics underlying the business process	○ ¹ / ◐ ² (EPML as interchange format)	○	● (business information view, business entity view)	○	○	● (dictionaries, document content model)	● (glossary, CCTS, UMM business transaction patterns)
4. Process autonomy / decoupling of internal and external processes	○ ¹ / ● ² (private process modules/views)	● (collaborative process couples abstract processes, not private processes)	○ (both internal and shared actions are defined in business process views)	● (coupling of process-views, which abstract from base processes)	◐ (due to inheritance limited autonomy)	● (only inter-organizational process considered)	● (only inter-organizational process considered)
5. (Selective) Visibility of the internal processes to external partners	○ ¹ / ● ² (abstraction through process modules)	● (abstract process)	○ (aspects of internal processes are part of the shared process)	● (process-view)	● (private workflow)	○ (internal processes not considered)	○ (internal processes not considered)
6. Formal specification of process interfaces	○ ¹ / ● ² (process interface diagram)	◐ (documents connected to message flows define message content)	◐ (information envelopes, only functional requirements)	○	◐ (channels and channel flow relations represent messages)	◐ (content and structure of messages as well as message flow)	● (CPP/CPA, ebMS, CCTS)
7. Support for alignment with multiple partners	○ ¹ / ◐ ² (may be modeled as EPC)	◐ (may be modeled as collaborative process)	● (reference process modules for business transactions)	○ (inter-organizational process consolidated from process-views)	○ (bilateral definition of workflows)	● (PIP)	● (ebBP)

● - Requirement fulfilled ◐ - Requirement partly fulfilled ○ - Requirement not fulfilled

Table 2. Review of Existing Approaches with Regard to the Specific Requirements for Inter-organizational Business Process Design

Their strength – as opposed to just considering the organization as an attribute of the activity or function – is that they explicitly illustrate the distribution of the business process among the participating organizations. The need for alignment of the business semantics underlying the business process is recognized by some approaches, most of them from B2B standardization. They define data dictionaries and glossaries as well as formal information models. The most important contribution of existing approaches relates to the decoupling of internal and external business processes. They introduce different views on business processes and distinguish between public (or external) processes and private (or internal) processes. Whereas public processes appear to provide stable interfaces with external partners, private business processes might be subject to change more frequently. So far, selective visibility of internal processes has been mainly addressed by extensions to workflow concepts, but is also gaining attention from the business process modeling community. Appropriate means for selective visibility include abstracting those parts of the business process considered internal as well as the creation of (partner-specific) views on internal business processes. The formal specification of interfaces between organizations is a central contribution of B2B frameworks. They typically comprise detailed specification of message types and formats. Contrary to information-flow-related specifications, less attention is devoted to the control flow and other regulations governing the inter-organizational process flow.

Requirements (cf. Section 2.2)	Contribution from Business Process Modeling (Section 3.1), Workflow Management (Section 3.2) and B2B Standards (Section 3.3)
1. Representation of inter-organizational business process	<ul style="list-style-type: none"> • Graphical representation of inter-organizational business process • Introduction of artifacts related to organization / roles, messages / business documents and channels
2. Allocation of tasks to actors	<ul style="list-style-type: none"> • Graphical representation using swimlanes, pools or domains • Organizational / role model to include external parties
3. Alignment of semantics underlying the business process	<ul style="list-style-type: none"> • Data dictionary, glossary • Information modeling
4. Process autonomy / decoupling of internal and external processes	<ul style="list-style-type: none"> • View concepts • Differentiation between public (or external) business processes and private (or internal) business processes
5. (Selective) visibility of internal processes to external partners	<ul style="list-style-type: none"> • Abstraction concepts • Partner-specific views
6. Formal specification of process interfaces	<ul style="list-style-type: none"> • Specification of messages (information flow) • Interface descriptions
7. Support for alignment with multiple partners	<ul style="list-style-type: none"> • Modeling / graphical representation of inter-organizational process • Reference processes

Table 3. Contribution towards Inter-organizational Business Process Design

It is apparent from this analysis that existing standardization initiatives have not fully linked up with business process modeling as it is used in practice today. As (Reimers 2001) highlights, there are many intricate issues related to moving B2B standards from the syntactic to the semantic to the pragmatic level. Even mature e-business standards (like RosettaNet) or e-business frameworks (like ebXML) mostly address message exchange in simple, e.g. single-step business processes. So far, they do not model sophisticated sequences of activities.

4 CONCLUSION: RESEARCH AGENDA

In conclusion, we outline how research needs to address the challenges and tasks related to inter-organizational business process design discussed in the previous sections. The proposed research agenda aims at systemizing emerging fields of research; it is also intended as a starting point for further debate and augmentation by scholars and practitioners of this discipline.

Traditionally, internal processes of an organization acted as the primary focus of business process modeling and design. To cope with the increasing demand for inter-organizational business process alignment, approaches to business process modeling and design have to

- enhance internal business process models and documentation to cover interdependencies with external organizations,
- extend existing organization and role models to include external organizations,
- support semantics and terminologies of reference to be used with external partners,
- formally specify process interfaces as a basis for contracts or service level agreements as well as for implementation of B2B integration mechanisms,
- incorporate view and abstraction concepts for the private and the public domain, and
- integrate external business process models which may be provided by industry consortiums, standardization initiatives or other partners.

Once these aspects have been incorporated in enhanced process modeling concepts and tools (which has already started, as we can see from Section 3), additional challenges arise related to increasing interoperability of business processes between organizations (Legner & Wende 2006):

1. *Exchangeability of business process models between organizations, more specifically the public views on these models:* Due to the number and heterogeneity of modeling languages, easy (horizontal) exchange of business process models is required. Emerging research suggests *common meta-model* which facilitates model transformations (cp. POP* in ATHENA 2006) as well *XML-based exchange formats* for business process models (cp. the EPC Markup Language EPML suggested by Mendling & Nüttgens 2004).
2. *Semantic alignment of business processes:* In the past, reference process models were helpful as templates for internal process design. We expect this to hold for the “public” view of inter-organizational relationships, too. Reference processes could significantly reduce setup costs for external process integration and accelerate agreements with multiple partners. With more complex B2B scenarios, these *reference processes* should be an integral part of B2B standardization initiatives, but also need to better address integration into the internal process architecture (Theling & Zwicker & Loos & Vanderhaeghen 2005). In addition, semantic concepts might support the alignment of process logic and semantics underlying business processes between multiple organizations (cp. semantic reconciliation and ontologies as suggested by Missikoff & Taglino 2004).
3. *Model-driven approaches linking inter-organizational business process design to implementation:* Besides the horizontal interoperability of process models, the gap between conceptual process models and their implementation has to be addressed, e.g. by concepts from model-driven architecture (MDA). Applied to inter-organizational integration, the inter-organizational business process could be transformed in several steps into an executable model (Greiner & Lippe & Kahl & Ziemann & Jäkel 2006).

In our view, these areas of research are necessary in order to assist enterprises in coping with the increasing requirements of cross-organizational business process design. As a result, companies should be able to reflect external relationships in their internal process architectures and to easily adopt emerging B2B reference processes (e.g. standardization results).

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