A holistic Methodology for model-driven B2B Integration: From Business Values over Business Collaborations to Deployment Artifacts

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ABSTRACT

Business-to-business (B2B) electronic commerce based on the principles of Electronic Data Interchange (EDI) systems has been conducted for a long time. In recent years, we observe a switch to a rather business process-based thinking for implementing interorganizational systems. UN/CEFACT's Modeling Methodology (UMM) - which I co-authored - is considered as one of the mature graphical modeling approaches for modeling interorganizational business processes. However, UMM has still several shortcoming that prevent a throughout model-driven software engineering approach. In this PhD proposal, further contributions to the UMM are identified that are required to lift it to an holistic B2B methodology for the development of interorganizational systems. These contributions will extend the UMM to become an integrated approach starting with business models, leading over to business collaboration models, and finally resulting in deployable artifacts for business service interfaces. The proposed top-down approach is in line with the ideas of model-driven engineering resulting in shorter development cycles and reduced complexity.

1. MOTIVATION

Conducting electronic business between enterprises was not an invention of the internet age, but has existed for decades. However, requirements of business-to-business (B2B) electronic commerce have changed since that time. In former days, when B2B electronic commerce was referred to as Electronic Data Interchange (EDI), its focus was document-centric. This means, in order to avoid bilateral agreements on business documents, business partners agreed on business document standards. But, as history has shown, the results of these standardization efforts were overloaded and ambiguous document standards. This led to costly EDI systems and participation in electronic business was reserved to large companies that were able to afford such implementations. As a consequence, only circles of acquainted enterprises exchanged business messages electronically in order to reach their business goals and gain financial benefits.

With the advent of the internet, the area of electronic business started to boom. In the field of B2B electronic commerce, small and medium sized companies now saw their chance to enter electronic markets. Now, it seemed possible to find new business partners electronically and to dynamically conduct e-business. In addition, with the advent of XML, the problems of EDI appeared to be solved all of a sudden. However, this was a broad misconception - the pure mapping of EDI concepts to brackets did not yield a solution to the shortcomings of traditional EDI.

At this time, business process management was already in use to specify intraorganizational workflows. Enterprises started to adopt business process modeling in order to monitor their procedures and to design process-based solutions. In the context of EDI, the concept of a business process has already existed - but buried in the minds of those people that were responsible for the interorganizational systems. These people were aware, for example, what to do next when an invoice was received and how to trigger manual compensation if - in case of a failure - a dunning letter was received before an invoice. They were able to resolve the problem by phoning the business partner, because their counterpart was known to them. In this respect, the notion of a business process - as a protocol for specifying the course of business - was already there.

However, according to the idea of modern electronic markets where companies of almost any size conduct business in a dynamic way, business partners are not acquainted as described above. Dynamic B2B e-business involves spontaneous agreements, which might exist just for one economic transaction. There are no offline negotiations and no face-to-face relationships. Instead, agreements are made online, which requires business partners to unambiguously define how to conduct business with them. In other words, business partners must describe what business processes they offer in order to show potential business partners how to interact with them. It follows, that interorganizational business process models are the basic building block for flexible and spontaneous B2B e-commerce.

Figure 1 shows a slightly extended version of the Open-edi reference model [14]. It separates the development of interorganizational systems into business and technology concerns. Specifications for capturing collaborative business logic are covered by the business operational view (BOV). The functional service view (FSV) com-

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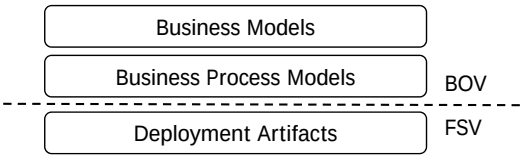

Figure 1: Refined Open-edi reference model

prises technology specifications for implementing business logic. In this thesis a holistic approach for B2B integration is developed starting with business models, leading to business process models, and finally resulting in deployable artifacts.

Modeling interorganizational business processes is considered as the foundation of this approach. Hence, the currently most promising approach for modeling interorganizational systems - UN/CEFACT's Modeling Methodology (UMM) - will be the starting point of this thesis. I co-authored UMM 1.0 during my undergraduate studies [15] and was one of the authors of the first book on UMM [23]. Considering figure 1, UMM sits on the business process layer. The first part of this PhD thesis will concentrate on amply improvements of the current UMM version [22]. The second part of this thesis lays focus on integrating value-based requirements engineering in UMM. By integrating business modeling, UMM enables to show the economic rationale behind business collaborations. Business models are considered as a layer on top of business process models. Finally, this thesis will propose approaches for deriving deployment artifacts for interorganizational systems from UMM business collaborations. The resulting approach that spans the three layers depicted in figure 1 corresponds to the overall goal of this thesis - a holistic methodology for B2B integration. We already published this three-layered approach in [11].

The remainder of this proposal is structured as follows: Section 2 describes the state of the art in regard to current B2B modeling approaches. Section 3 elaborates the contribution of this work by outlining solutions to current shortcoming of the UMM. Each shortcoming as well as the corresponding solution is discussed in its own sub section. Finally, section 4 concludes this proposal.

2. STATE OF THE ART

People have learned that traditional EDI concepts do not realize the idea of dynamic e-commerce as envisioned at the beginning of this proposal. In this respect, the need for modeling interorganizational business processes has become evident.

Traditionally, business process modeling focused on intraorganizational business processes in order to capture workflows that are internal to an enterprise. Internal processes are always modeled from the perspective of the respective company. In a collaborative context, however, a partner-specific view on a process is not sufficient. If each participant in a collaborative process describes its own perspective on the same process in isolation, the resulting process descriptions will most likely not match. Thus, modeling interorganizational processes requires a global perspective.

Today, several modeling approaches exist for capturing collaborative business processes. Some appropriate approaches have been identified in [2]. Amongst these approaches, UN/CEFACT's Modeling Methodology (UMM) [22] is the most promising one. UMM builds upon the Unified Modeling Language (UML), which is considered as the "lingua franca" in software development and also widely accepted for business process modeling. UMM is standardized by UN/CEFACT (United Nations Center for Trade Facilitation and Electronic Business) known for its standardization efforts in EDIFACT and ebXML.

UMM defines a meta model and a development process ranging from requirements elicitation to business collaboration design. In previous versions of the UMM - before version 1.0 - there was a lack of formal correctness of the meta model, which made it impossible to derive software artifacts from the model according to a model-driven software development approach. In addition, the meta model's complexity was the reason that applying the UMM was a tremendous task - oftentimes it resulted in faulty business collaboration models. The current version 1.0 of the UMM [22] is a considerable improvement. Nevertheless, UMM is still rather accepted in academia than in the industry.

The current UMM 1.0 will be the starting point for this thesis. On top of UMM, an integrated B2B methodology following three layer approach will be defined as outlined in the section before. A detailed description of current problem fields and the contributions of this thesis are given in the next section.

3. PROBLEM FIELDS - CONTRIBUTION OF THIS THESIS

When I started to work on the UMM, it was a so-called "UML profile" but it was not formally specified as one. A UML profile customizes UML for a domain-specific purpose by defining a set of stereotypes, tagged values and constraints. The versions before UMM 1.0 [22] lacked the definitions of constraints. Hence, there were no unambiguous and formal definitions of UMM modeling artifacts as well as which relations between UMM stereotypes are allowed and which are not.

3.1 Migrating UN/CEFACT's Modeling Methodology to UML 2

The UMM Foundation Module 1.0 is the first UMM version that satisfies the formal requirements of a UML profile. When the UMM 1.0 project was started within UN/CEFACT, UML 2.0 was not considered as stable enough. Hence, UMM is currently built on UML 1.4, but today UML 2 is considered as the state of the art. Consequently, UMM stakeholders ask for a "UMM 2.0" that is defined on top of UML 2. In addition, UML 2 provides major improvements to key modeling elements of the UMM (e.g., activity diagrams). It follows that moving UMM to UML 2 is required. Beside the criticism that the current UMM is based on an outdated UML, the meta model of the UMM is still often bashed as too complex (e.g., UMM 1.0 models often result in excessive package structures). Furthermore, some workarounds that were necessary in the meta model due to the use of UML 1.4 contribute to often bloated UMM models.

For this reason, the initial contribution of this thesis will be a definition of UMM on top of UML 2, reflecting experiences and comments from stakeholders. The result is an easier to use UMM that builds on current standards. This ensures further adoption by potential users and fosters the support of tool vendors. The new UMM version serves as the core for the further extensions and improvements suggested throughout this thesis. The use of UML 2 also eliminates the above mentioned workarounds in the UMM meta

model. In [7] we give an outlook on the migration of UMM to UML 2 and [24] covers a detailed presentation of UMM 2.0.

Beside UML activity diagrams several other notations and modeling languages emerged in the past to capture process flows. In the past, the Business Process Modeling Notation (BPMN) [19] has gained very much attention from end users and tool vendors. People often consider UMM and BPMN as comparable approaches for modeling interorganizational processes. So when presenting UMM 2.0 in this thesis, the differences between UMM and the BPMN will be discussed and it will be shown why BPMN is not sufficient for designing interorganizational processes.

3.2 Introducing value-based requirements engineering into UMM

Modeling business processes shows how an enterprise acts in order to reach an economic goal. In the context of B2B, the business process model captures how different enterprises interact to exchange objects of economic value. However, a business process model does not concentrate on economic reciprocity - what objects of value are exchanged to gain other objects of value. It is the purpose of business models to capture this aspect of economic transactions. According to Timmer [21] a business model is an architecture for the product, service and information flows, including a description of the various actors and their roles, together with a description of the sources of revenues and potential benefits. In other words, a business model captures what economic values are exchanged between enterprises and collaborative business process models describe the interactions required in order to implement the value exchange.

The current UMM concentrates on specifying business process models as well as their requirements, but lacks value-based requirements engineering by means of business models. However, it is an interesting fact for an enterprise to combine these different views on economic transaction. It helps identifying business processes that have to be supported in order to realize a given value exchange. In addition, it allows monitoring if a deployed business process still fulfills a given business model.

In order to provide value-based requirements engineering in UMM, this thesis will propose the integration of an e-business modeling approach. As identified in [2], currently popular business modeling approaches are e3-Value [4] [3] [5], the Resource-Event-Agent Methodology (REA) [17] and the Business Model Ontology (BMO) [20]. The work in this thesis will concentrate on e3-Value. In e3-value, a business model is regarded as a value constellation, i.e., a network of enterprises that jointly create and distribute objects of economic value to satisfy a consumer need. Focus is on an economic value proposition, i.e., expressing the objects of values an actor is willing to exchange for other objects. The model ensures the concept of economic reciprocity, i.e., if an actor delivers an object of value, he or she gets another object of value in return. Hence, the model illustrates which actors can have economic transactions with each other on an abstract level, without the internal processes necessary to create these values.

The e3-Value approach currently defines its own notation. A first step towards the integration of e3-Value into the UMM is definition of a UML profile for e3-Value. This contribution has been published in [13]. Still an issue to address is aligning the e3-Value concepts with the UMM development process. In addition, specifying that a business model fits to a certain business process models (or vice versa) necessitates consistency checks between those artifacts. In [1] the authors propose consistency checks between e3-Value models and petri nets. [25] outlines an analog approach for e3-Value and activity diagrams. A similar approach has to be researched for UMM and e3-Value.

3.3 Deriving deployment artifacts from UMM models

According to the idea of model driven software development the derivation of deployable artifacts from collaborative business process models is desirable. In the field of Web Services, the Business Process Execution Language (BPEL) [18] gained a lot of attention for implementing business processes. BPEL describes a business process from a partner-specific view. In contrary, UMM focuses on global choreographies. Thus, in order to generate BPEL artifacts from UMM, global UMM business collaboration models have to be mapped to partner-specific BPEL processes. Starting with a graphical model showing a global perspective provides major benefits for three reasons: Firstly, the business collaboration model serves as a kind of contract partners agree on. Secondly, the business collaboration model allows the generation of complementary process specifications for each partner's interface. This ensures that the partner interfaces interact according to the global choreography of the business collaboration. Finally, the generation of such artifacts allows quick and cheap customizations of a B2B system to changing business requirements.

There already exists some work in the field of deriving deployment artifacts from business process models. In [6] the authors outline a proof-of-concept approach generating BPEL code from UMM. This approach was implemented in [16] and its shortcomings are described in [15]. It does neither map all UMM concepts nor is the generation of executable artifacts possible. Recently, we published an unambiguous mapping from UMM to executable BPEL artifacts [8]. The UMM to BPEL mapping will be another contribution of this thesis.

Besides the pure Web Services approach, this thesis will also focus on the implementation of UMM processes using workflow frameworks. The Windows Workflow Foundation (WF) is an upcoming technology allowing developers to create workflow-centric applications. The WF approach is not limited to workflows internal to a company, but allows the implementation of interorganizational business processes. Similary to the BPEL approach, this thesis will propose a derivation algorithm for generating Windows Workflow artifacts from UMM business collaboration models.

3.4 Managing UMM artifacts within business registries

The vision of dynamic B2B presupposes that business partners find each other electronically based on the descriptions of business processes and of the services they need and offer. This idea requires that business partners are provided with means to publish as well as to consume information related to their business conditions. It follows, that the concept of a business registry is required in order to provide enterprises with a central site for to find each other. Such a business registry must be capable of managing UMM artifacts. Artifacts might be whole models or just parts thereof. Parts of a UMM model might be re-used in another interorganizational business process.

In order to solve the issue explained above, this thesis will describe

the representation and management of UMM artifacts within business registries. More specifically, ebXML registries will be the target platform for managing UMM artifacts. The work in terms of registering artifacts is made up of two parts:

Firstly, approaches are proposed to store UMM models as a whole or just several parts thereof. Since dependencies might exist between different parts of a UMM model, the proposed approach will outline how to maintain these relationships in a business registry. We already published this contribution in [10] and [9].

Secondly, since business models and UMM business collaboration models are combined a representation of business models within a business registry is required. The thesis will include an approach describing semantic links between business models and business process models. This enables potential business partners to find each other based on business models or business process models. This contribution was published in [12].

4. CONCLUSION

The goal of this thesis is a holistic B2B modeling methodology potentiating enterprises to participate in dynamic e-business environments. The current UMM will be revised and amply extended in order to be a tool for enabling successful and real-world B2B integration. The resulting methodology follows a three step top-down approach starting with business models, leading to business collaboration models, and finally resulting in deployable artifacts for business service interfaces. Applying the methodology will foster the vision of dynamic B2B e-commerce.

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