HAL
open science

Interoperability through model-based generation: The case of the collaborative information system (CIS)

Jihed Touzi, Jean-Pierre Lorre, Frederick Benaben, Hervé Pingaud

To cite this version:

Jihed Touzi, Jean-Pierre Lorre, Frederick Benaben, Hervé Pingaud. Interoperability through model-based generation: The case of the collaborative information system (CIS). Enterprise Interoperability: New Challenges and Approaches, 2007, Bordeaux, France. pp.407-416, 10.1007/978-1-84628-714-5_38 . hal-01596384

HAL Id: hal-01596384

https://hal.science/hal-01596384v1

Submitted on 20 Feb 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Interoperability through Model-based Generation: The Case of the Collaborative Information System (CIS)

Jihed Touzi[1], Jean-Pierre Lorré[2], Frédérick Bénaben[1] and Hervé Pingaud[1]
[1] Centre de Génie Industriel – Ecole des Mines d'Albi-Carmaux, Campus Jarlard, Route de Teillet, 81013 Albi Cedex 09, France.
{touzitou, benaben, pingaud}@enstimac.fr
[2] EBM WebSourcing, 10 Avenue de l'Europe, 31525, Ramonville, France.
jean-pierre.lorre@ebmwebsourcing.com

Keywords: interoperability, information system, MDA, enterprise models

1 Introduction

Interaction between ISs is complicated because of regional and business specificities. Interoperability is the cornerstone of a perfect interaction in order to address inherent partner's heterogeneity at cultural, linguistic, business and technological levels. A group of organizations can have an intermediate system that understand their cultural and business background, and which is able to deal with their special needs and to adapt software. The work described in this paper intends to provide a method to develop an inter-organizational solution in order to support a collaborative process in a context of enterprise interoperability.

In section two, we present requirements to make ISs of collaborating enterprises interoperable. In the third section, we present our proposal of the target framework to make ISs interoperable: the collaborative platform to manage collaboration. We propose a model-driven method that permits, starting from a collaborative process model to define the needed integration of partner's information systems. Our method takes into account interoperability requirements. The ISs integration will be explained with details in the fourth section. We present translation rules to obtain UML diagrams that define our collaborative solution. We also show that we need pertinent collaborative architectures (logical and technical) as a support to build the dedicated and exploitable collaborative IS model.

2 Enterprise collaboration and the need for interoperability

In this paper, we consider the collaboration of enterprises, based on their information systems. According to [1], collaboration is used to refer to the flow of messages taking place between two parties for a given purpose; it is a particular view on the whole set of messages exchanged in a multi-party system. Collaborative processes are meant to specify the collaboration partners behavior in terms of messages to be exchanged and synchronization of their different activities.

Organizations have to react to the raised innovation pressure by improving their collaboration with their partners. Problems of communication between people, between people and "information and communication technology" (ICT) and between different ICTs must be treated [2]. Information systems can do more than collaborating, they can be interoperable. In the next section we present concepts of enterprises interoperability and a projection of these concepts on the information systems field.

2.1 What is enterprises interoperability?

Interoperability is a crucial issue in open networked systems where enterprises need to cooperate. The interoperability in enterprise systems can be defined as "the ability of a system or a product to work with other systems or products without special effort from the customer or user" [3]. So, the question is about the nature of this special effort that ISs must do, to interoperate. The definition of the IEEE [4] gives an insight about the nature of this effort: "interoperability is defined as the ability of two or more systems or components to exchange information and to use the information that has been exchanged". The last definition indicates, clearly, that the special effort needed to achieve interoperability can be about the exchange and the use of information. The use and the exchange of information require that the relevant enterprise applications (which deal with information) communicate.

In our context of IS interoperability, we need to know more about IS, how they are composed? How they collaborate? Then, we have to identify how they can work together without a special effort to consider them interoperable.

2.2 How to make Information Systems interoperable?

Firstly, we have to define what an IS exactly is. Many definitions exist. P. Bernus [5] says that "an IS must guarantee that the right information is available whenever and wherever needed, in the quality and quantity needed". We consider that an IS is an interaction of data, applications and processes. This definition is compliant with the perception of C. Morley [6]. She considers that an information system is decomposed in two parts: an integrated data processing system (involving actors, data and processes) using a computing system (software, hardware and networks).

From the above definition of an IS that we retain, a few issues arise about interoperability of ISs. Considering that "IS are interoperable if they can interact

without special effort", we deduce that the problem of ISs interoperability is a problem of interaction (without a special effort) of applications, data and processes of collaborating ISs. We detail these three aspects of IS interoperability.

- **Processes interaction**: processes present a tool to modelize how partners work. They give information related to the organization and the operations of an enterprise. According to [7], cooperation requires a certain degree of compatibility of business procedures. So, in a collaborative context, partners must provide the required knowledge of their internal process for the configuration of the common collaborative processes. Internal process models must be protected against external insights but at the same time integrated into the whole collaborative process [8]. Partners have their own "private" set of established process modeling methods and tools in use. Approaches like XML (*Extensible Markup Language)* based model transformation can solve the problem of interaction of different process modeling methods. On the other hand, the problem of dynamic reconfiguration of internal and collaborative processes when a collaboration is established presents an interoperability issue.

- **Data interaction:** data must be understandable by all collaboration partners. Partners are often from different business domains like industry, finance, health. They must have a common terminology of the exchanged information. Research works in the ontology domain aim at giving solutions by dissociating the semantic meaning and the syntactic description of the information. On the other hand, partners need to verify their inherent compatibility at the information level, but at the same time, they have to preserve their competitive advantage and confidentiality. Access rights to partners information must be managed and secure.

- **Applications interaction:** often, applications are not compatible. Applications are not made to interoperate together. Technical solutions like EAI (Enterprise Application Integration) and ESB (Enterprise Service Bus) provide a strong support for application interoperability. Access rights to invoke different applications by external partners must be managed and secure.

Additionally, interoperability of ISs includes resulting interactions between process, data and applications: applications use, modify and create data, processes call applications. The three identified aspects of ISs interoperability match the definition of interoperability of [9]: "Interoperability is achieved if the interaction between two systems can at least take place at the three levels: data, applications, and business process with the semantics defined in a business context". In the next section we propose our solution of a Collaborative Information System (CIS) to support a collaborative process in an interoperability context. This solution takes into account interaction problems of the three aspects: processes, information, and applications.

3 Conception of collaborative solution: a proposal

The previous section proposes a projection of interoperability concept onto the information system field. The resulting requirements proposed for information systems interoperability are the following:

- data conversion from one partner to the other (data point of view),
- management of applications heterogeneity and accessibility,
- synchronization of the collaborative process with the internal processes of the partners.

The goal of this section is, first, to propose a logical solution to meet these basic requirements, and, second, to present our approach to build this conceptual proposal.

3.1 Presentation of the Collaborative Information System

According to the basic "IS-interoperability" requirements identified in section 2, we propose to place a transitional system (between partners of the collaboration) in order to deal *with data conversion*, *application sharing* and *process management*.

This CIS aims at supporting information system interoperability, that is to say, "collaboration without special effort" between information systems of partners. We can focus on the nature of this CIS using figure 1.

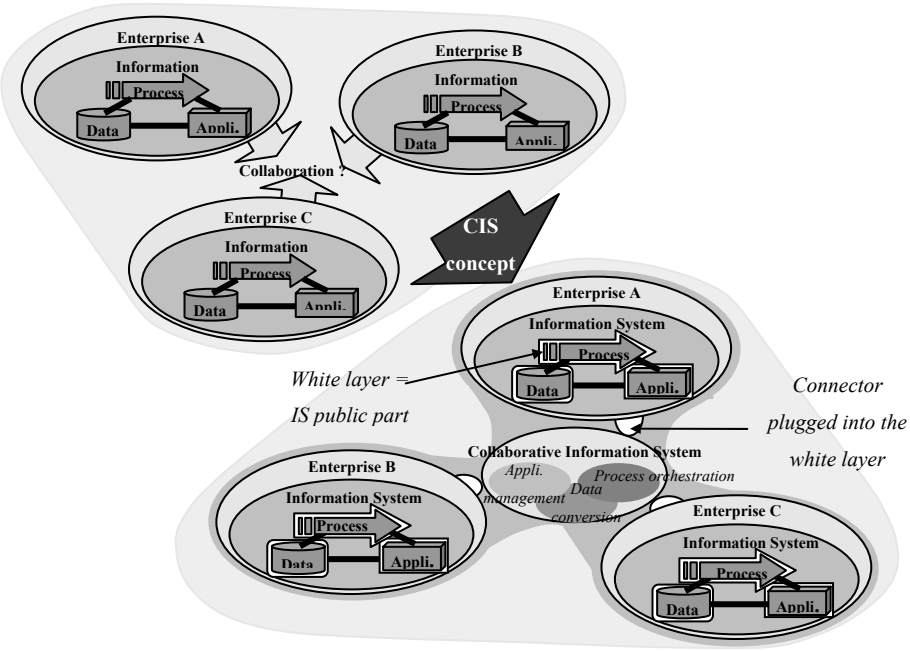

Fig. 1. From Collaboration to Interoperability using CIS

Enterprises are based on their ISs, which can be seen as a set of connected processes, data and applications. According to section 2, the CIS, to be relevant, should deal with business global orchestration, data conversion between partners and application management. This CIS should then include two different parts:

- connectors to be plugged into partners information systems (in order to reach data and services to manage the collaboration). Obviously, there are access-rights considerations, but it is part of CIS attribution to deal with access-rights and to be considered as trustable in the collaboration.
- The concrete entity managing the collaboration: an intermediate information system, dealing with semantic and syntactic aspects of partners' data (schematically ontology and style sheets), workflow (to drive collaborative process) and applications dictionary (to dispatch collaboration needs).

3.2 A model-driven approach to design collaborative information system

In this subsection, we aim at presenting an approach to design the right collaborative information system for a specific collaboration. The first and crucial point is that we consider that the most powerful means to tackle the collaboration is to handle the associated collaborative process. Our proposal is to extract, from collaborative process models, information to design UML model of adequate CIS (Fig 2.).

Nevertheless, we assume that this is a non-homogeneous equation: there is not enough knowledge into the left part of the chain (behavioral process representation) to fulfill the right part (multi-view UML model). CIMOSA method [10] provides four points of view for enterprise modeling: functional, informational, organizational, and resources.

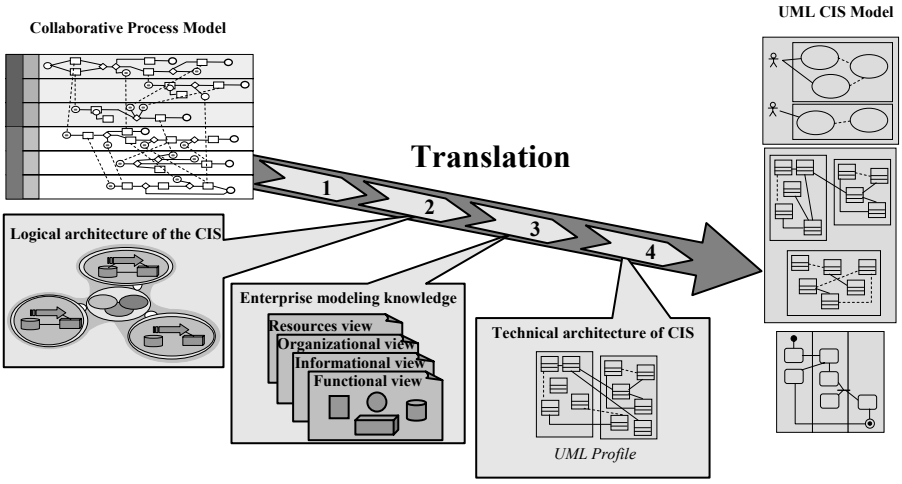

Fig. 2. Model-driven CIS design method

If CIS model should naturally cover the four points of view (because IS collaboration concerns those four points of view), collaborative process model only covers the functional point of view (even if, using rich formalism such as BPMN, it is possible to extend beyond the exact limits of functional view). Consequently, we propose the following principle of translation. The principle of the translator is the following:

- step 1: it starts from BPMN diagram (as a model of collaborative process) in order to extract specific information of the collaboration (we will see in section 4 examples of translation rules).
- Step 2: this knowledge is then integrated into a logical structure chosen for the CIS (in UML).
- Step 3: the obtained result is enriched with data extracted from the enterprise modeling field (this part concerns models of the collaboration more than models of partners): this step involves concrete human intervention to complete specific qualities of the collaboration.
- Step 4: then, the obtained model is finally fitted into a technological architecture (based on a specific UML profile, see section 4).

3.3 MDA concordance

Our method is compliant with a model-driven approach where:

- Platform Independent Model (PIM) concerns the result of steps 1, 2 and 3 (representation of the collaborative business process according to BPMN syntax and its transformation into an enriched UML model of the CIS).
- Platform Model (PM) is the technical architecture of CIS (UML Profile).
- Platform Specific Model (PSM) concerns the result of step 4.

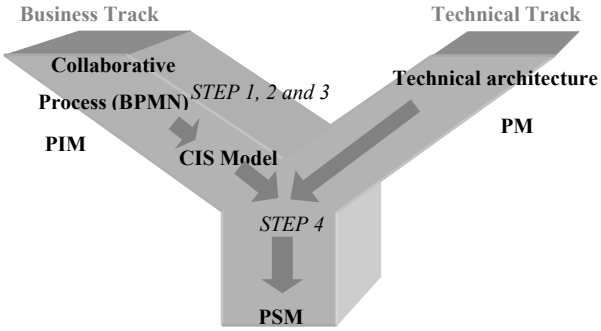

Fig. 3. Model-based architecture and CIS design

The business track supports the definition of business process according to BPMN syntax and its transformation into an UML2 information system model. Obtained

UML models will be enriched with knowledge about collaboration. The technical track deals with the representation of a target technical architecture.

4 The required knowledge for the process model translation

The basic step in our work is the translation of a BPMN process model to a UML IS model. The identification of translation rules is based on semantic correspondences between BPMN modeling components and IS UML diagram components. We present (table 1.) a brief description of some correspondences, needed to generate different UML diagrams. See [11] for more details.

Table 1. Semantic correspondences between BPMN modeling components and IS UML diagram components.

UML components		**BPMN components**
Use case diagram	Use case	Activity
	Principal actor	Pool
	Secondary actor	Lane
Class diagram	Internal data	Sequence flow
	Public data	Message flow
Activity diagram	Collaborative activity	Activities with a message flow
	Partition	Pools and lanes
State diagram	Transition	Activity

Indeed, the objective is to create an IS model (located on a different level) from specific data contained in process models. The following section explains the required knowledge, needed in the different translation steps:

4.1 A logical model of the CIS

We can define the logical model of the CIS, using some UML diagrams. We present here an example of a class diagram that reflects the chosen architecture. This architecture is composed of:

A collaboration package (the core of the collaborative IS), composed of four sub-packages:

- *functional package*: it contains a “process synchronization module” in charge of the synchronization between public and internal process definitions, an “access rights module” responsible for access rights management (for data, applications and process definitions), an “applications invoke module” responsible for managing partners

applications and an "exchanged data management module" to deal with the heterogeneity of partners exchanged data.

- *Collaborative data package*: this package contains a definition of different formats of partner data to ensure data integration and semantic definitions of information to be stored (independent of data presentation).
- *Registered applications package*: it contains a description of the registered partner applications for the collaboration.
- *Collaborative processes definition*: it contains definitions of collaborative processes of partners.

Several partner's packages, each one is composed of four sub-packages:

- *functional package:* a set of functions (services) the partner is responsible for. Each service is linked with relevant data.
- *Data package*: it contains "internal data", (dedicated to internal process) and "global (or public) data" (accessible and visible for all or part of the partners).
- *Registered applications package*: it contains a description of partner applications.
- *Internal processes package*: it contains definitions of internal processes of the partner.

4.2 An enterprise knowledge to enrich obtained UML diagrams:

We need some additional knowledge about collaboration partners to enrich obtained UML IS models. Enterprise modeling methods/methodologies can be used to modelize different views of the enterprise:

- informational point of view: Structure of data and information exchanged in the enterprise.
- Organizational point of view: More information about hierarchy and organization.
- Resources point of view: Description of enterprise resources capabilities and competences.
- Functional point of view : Description of services (functionalities) offered by the enterprise.

We In this paper we don't explain how to integrate enterprise models with collaborative process model. It is a part of our future work.

4.3 A collaborative technical architecture

Our method is independent from technical architectures. But Service Oriented Architecture (SOA) seems to be the perfect support for applications interoperability [12]. The chosen technical framework is based on a SOA implemented by a JBI (Java Business Integration) compliant open-source ESB (Enterprise Service Bus). *EBM WebSourcing* is developing such technology inside

the ObjectWeb open-source community; the project is called Petals (see http://petals.objectweb.org). An ESB (Fig.4) is a standard-based integration platform that combines messaging, web services, data transformation and intelligent routing to reliably connect and coordinate the interaction of a significant number of diverse applications across extended enterprises with transactional integrity [12].

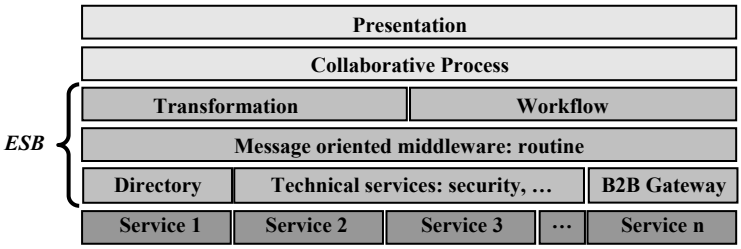

Fig.4. ESB layers

Some work has been done dealing with the definition of an UML profile for SOA (see [13]). This work focus on the representation of basic SOA entities (e.g. mainly Provider, Consumer, Service). In a future work, we aim at proposing foundations of an ESB profile.

5 Conclusion and perspectives

This paper does not claim completeness in terms of interoperability of information systems. On the one hand, it rather focuses on an intermediate system (Collaborative Information System) that validates deduced concepts of ISs interoperability. These concepts are a projection of interoperability requirements into IS field: the need of a global interaction of partner ISs (data, applications and processes). On the other hand, this paper presents a model-driven method to design the Collaborative Information System.

Related challenge to achieve our final goal of process model translation is about the identification of translation rules. We identify (manually) the logical correspondences between BPMN process model components (task, pool, etc.) and UML CIS components (collaboration use case, actor, etc.). This identification is based on our experience and background in the two domains of process modelling and collaborative systems modelling. Another challenge is about the enrichment of the collaborative process. It is based on the linking of the BPMN model with needed enterprise models. For example, how can we find information (structure and format) about an exchanged order between a customer and a supplier ? (using an informational view of the collaboration).

One perspective of this work is to develop a prototype based on a collaborative process example. Translation rules related to this example may be explained with

ATL[1] or MTF[2]. We also have to use the open-source Intalio BPMN designer[3] to model and exploit a XML definition of the collaborative process. Obtained UML models can be viewed using one of the open source UML tools (StarUML[4], ArgoUML[5], etc.). The evolution of our work will be presented in communications to come.

6 References

[1] Bruno, G, (2005) Modeling and using Business Collaborations, Proceedings of the first conference on Interoperability of Enterprise Software and Applications; Springer, ISBN 1-84628-151-2.

[2] Kosanke, K, (2005) ISO Standards for Interoperability: a Comparison, Proceedings of the first conference on Interoperability of Enterprise Software and Applications; Springer, ISBN 1-84628-151-2.

[3] Konstantas, D., Bourrières, J.P., Leonard, M., Boudjlida, N, (2005) Preface - Proceedings of the first conference on Interoperability of Enterprise Software and Applications; Springer, ISBN 1-84628-151-2.

[4] IEEE, (1990) IEEE (Institute of Electrical and Electronics Engineers): Standard Computer Dictionnary- A compilation of IEEE Standard Computer Glossaries.

[5] Bernus, P., Schmidt, G, (1998) Architectures of Information Systems, Handbook on architectures of information systems, Springer Verlag, ISBN 3-540-64453-9.

[6] Morley, C, (2002) La modélisation des processus : typologie et proposition utilisant UML. In Processus et Systèmes d'information – Journées ADELI, Paris, France.

[7] Athena Consortium, (2004) public document: ATHENA General description v10, http://www.athena-ip.org/.

[8] Vanderhaeghen, D., Zang, S., Hofer, O., Adam, O, (2005) XML-based Transformation of Business Process Models – Enabler for Collaborative Business Process Management. Proceedings of the 2nd Workshop of German informatics Society e.V. (GI) in conjunction with the 11th GI Conference BTW 2005. Karlsruhe, Germany.

[9] Chen, D., Doumeingts, G, (2003) European initiatives to develop interoperability of enterprise applications basic concepts, framework and roadmap, Annual Reviews in Control 27, pp. 153–162.

[10] Vernadat, F, (1996) Enterprise modeling and integration. Chapman & Hall.

[11] Touzi, J., Benaben, F., Pingaud, H, (2006) Collaborative IS design: from process model to IS model, accepted paper, INCOM'06- Saint-Etienne-France.

[12] Chappell, D. A., Enterprise Service Bus, O'Reilly.

[13] Johnson, S. UML 2.0 Profile for Software Services, IBM- http://www128.ibm.com/developerworks/rational/library/05/419_soa/.

---

[1] http://www.eclipse.org/gmt/atl/

[2] http://www-128.ibm.com/developerworks/rational/library/05/503_sebas/index.html

[3] http://www.intalio.com/products/designer/index.html

[4] http://www.staruml.com/

[5] http://argouml.tigris.org/