Information Sciences 334–335 (2016) 83–102

Contents lists available at ScienceDirect

Information Sciences

journal homepage: www.elsevier.com/locate/ins

Collaborative process cartography deduction based on collaborative ontology and model transformation

Wenxin Mu[a,*], Frédérick Bénaben[b], Hervé Pingaud[c]

[a] School of Economics and Management, Beijing Jiaotong University, 3 Changyuancun Xizhimenwai Beijing 100044, China
[b] Industry engineering center, Toulouse University – Ecole des mines d'Albi-Carmaux, Campus Jarlard, Allée des sciences, Albi, France
[c] Champollion University, Place Verdun, Albi, France

ARTICLE INFO

Article history:
Received 27 January 2015
Revised 30 October 2015
Accepted 9 November 2015
Available online 25 November 2015

Keywords:
Model transformation
Ontology
Mediation information system
Business process management

ABSTRACT

With an increasing background in inter-enterprise collaboration and interoperability, the automatic deduction of collaborative business processes is increasingly being viewed as a crucial research subject. The common solution is believed to involve either semantic ontologies or metamodeling, which can be combined with semantic algorithms or transformation rules. However, from the viewpoint of enterprises, the modeling of collaborative processes should be software integrated and can be changed to workflow. The design of the targeted collaborative process model does not fit the need. This has led to a lack of concepts and transformation rules for the ontology or metamodel. In this paper, a new collaborative process model called collaborative process cartography is designed. Related collaborative ontology and its knowledge-expanding rules have also been updated. Collaborative ontology contains essential concepts for the collaborative situation and includes the rules and algorithms for process deduction. A prototype for the supporting tools is also provided.

1. Introduction

The ability of organizations (enterprises or institutions) to operate in collaboration is a key indicator of their level of competitiveness. However, organizations, whether recent or well established, rarely take considerable interest in their collaborative capacities (which are mainly empirical abilities that are informally built and used as needed). We propose to study the specificities and requirements of organizational collaboration from an IS (Information Systems) point of view and to define an engineering approach dedicated to facilitating the deployment of these emerging collaborative networks.

Enterprise interoperability can be seen as the capacity of enterprises or organizations to structure, formalize, and present their knowledge and to exchange or share it. Guedria et al. [14] introduce numerous methods, tools and languages, which have been developed to enhance enterprise interoperability. In Nicolle et al. [31], various architectures for the interoperation of information systems are introduced and compared, including the Peer-to-Peer [30,47], Standardization[1], Federation[2], Multi-base[3], Ontology [13,16] and Mediation [44] methods. Considering the difficulty in building common standards and initializing a collaborative environment, the combination of ontology and mediation is the most suitable way to solve interoperability problems.

* Corresponding author. Tel.: +8651683673; fax: +8651684925.
E-mail address: wxmu@bjtu.edu.cn, olinamu@126.com (W. Mu).

[1] Standardization uses a pivot model, canonical model or meta-model to reduce the number of translators (similar to the Peer-to-Peer method).
[2] Federation is derived from the standardization and uses a global, static federated schema.
[3] Multi-base uses a single language for many ISs.

http://dx.doi.org/10.1016/j.ins.2015.11.033
0020-0255/

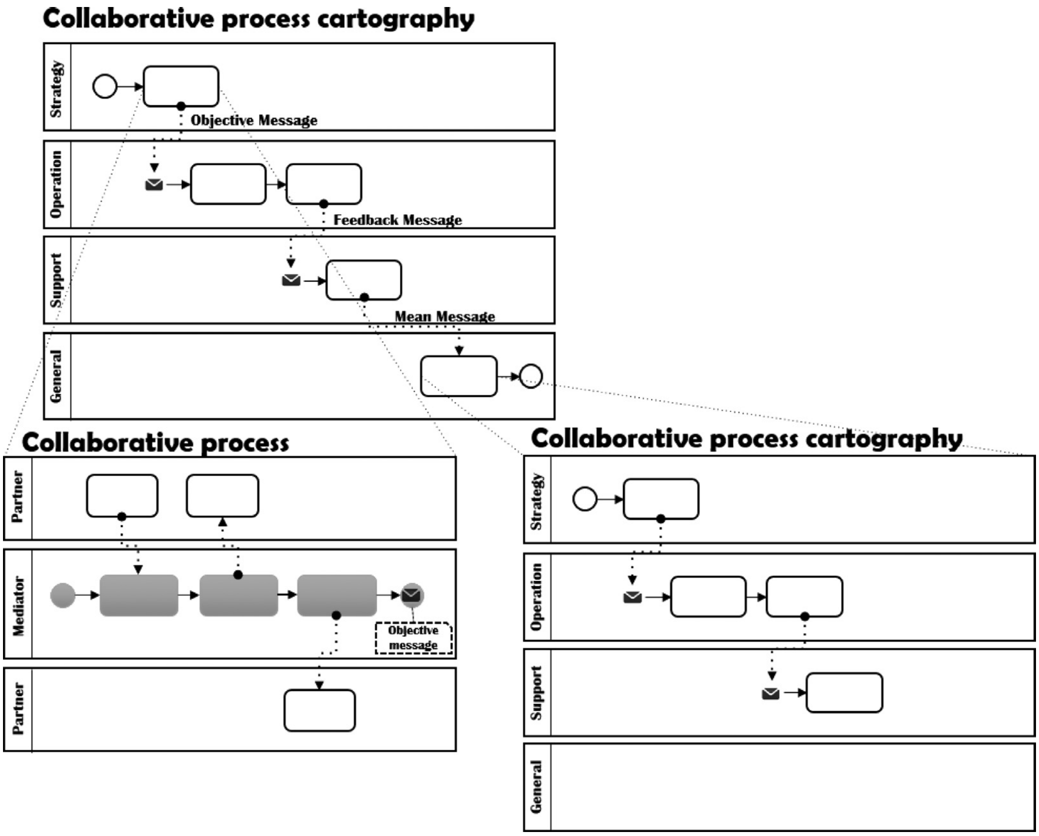

Fig. 1. An example of collaborative process cartography.

Achieving sustainable interoperability among organizations in a networked environment is a crucial factor for successfully managing collaborations at all levels: abstract (business) and concrete (technology) [20]. In the field of IS (Information Systems) interoperability, the research topics and results are focused on either the business process or the technical workflow. This has led to the development of a huge gap between the business level and the technical level. Therefore, our research is focused on filling this gap by transferring business knowledge to a collaborative process.

To address the difficult task of constructing an automatically collaborative business process, our lab launched the Mediation Information System Engineering (MISE) project (2003-2014). Rajsiri et al. [39] defined the business level of MISE 1.0 (Mediation Information System Engineering version 1.0) by using the Model-driven Architecture (MDA) [29] and the Service Oriented Architecture (SOA) [23,42]. They defined collaborative ontology for gathering collaborative information and transferred this information to a collaborative business process. However, according to ISO 9000 [19], the business process is classified as a strategy, operation and support process. One single but complex collaborative process in MISE 1.0 leads to a problem: the collaborative process is difficult for partners to understand in different roles, e.g., managers, workers, and operators.

To solve this problem, a cartography of collaborative processes is required to classify the entire collaborative process into strategy, operation or support collaborative processes (as shown in Fig. 1). In 2009, our lab launched MISE 2.0 to generate the cartography of collaborative processes automatically. Fig. 1 shows an example of collaborative process cartography, which is based on BPMN (Business Process Modeling Notation) [34,35,37]. The collaborative process cartography first defined the collaborative process by its main functions, which are positioned in different pools (strategy, operation, support and general). Each main function is specified by another collaborative process cartography or a collaborative process, which depends on the complexity of the main function.

To deduce the collaborative process cartography, the following research questions should be answered:

- How should a collaborative ontology be defined? In ontology, all concepts involved in the collaborative situation, collaborative process, and process cartography should be included.
- What is the best way to search or transfer the useful process entities to fill the collaborative ontology?
- How should the deduction rules to be used to obtain the collaborative process cartography that will be defined?

In this paper, Section 2 gives the introduction of related works. Section 3 presents the global view of this research work and our working definition of collaborative ontology. Section 4 provides the transformation rules from gathered knowledge to deduced knowledge in the collaborative ontology. Section 5 presents the deduction rules used to deduce the cartography of collaborative