Towards an Integrated Model for Enterprise Interoperability

Wided Guédria
SSI, CRP Henri Tudor, 29 JFK, Luxembourg-Kircheberg, Luxembourg
wided.guedria@tudor.lu

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Abstract: One of the challenges faced by a network of enterprises is the development of interoperability between its members. Transformations in this context are usually driven by Enterprise Interoperability (EI) problems that may be faced. In order to quickly overcome these problems, enterprises need characterizing and assessing interoperability to be prepared to establish means for collaboration. Maturity models have been developed in response to this challenge. In this paper, we propose to define an integrated model based on a maturity model and an ontological formalization of the enterprise interoperability domain. This will allow diagnosing interoperability problems when assessing interoperability. The integrated model could be used improve the capability of an enterprise to interoperate based on a shared understanding of interoperability.

1 INTRODUCTION

As information systems and technologies grow in complexity and scope, the need for a coherent and comprehensive modeling approach becomes of paramount importance. The enterprise architecture deals with these issues in a coherent and integral fashion while at the same time a medium to achieve a shared understanding and conceptualization among all stakeholders involved and govern enterprise development based on this conceptualization (Proper, 2008). The intent of an enterprise architecture is to determine how an organization can most effectively achieve its current and future objectives. Among these objectives, we focus on improving the capability of the enterprise to interoperate with future partners.

The complexity of an organization can be huge due to many processes, departments and information systems involved. To provide architects with some structure, architecture frameworks have been introduced. These frameworks intend to aid architects by providing a meta-model (e.g. an ontology) which uses different abstraction levels to map all kinds of information needed. As part of EA, some of the models should be dedicated to interoperability, as an important issue that have to be taken into account to reach the business objectives. To our knowledge, none of the existing Enterprise Interoperability (EI) frameworks proposes a shared understanding and conceptualization of interoperability while improving the capability of an enterprise to interoperate.

In this paper, we propose to define an integrated framework that defines and improves the enterprise interoperability. The paper is structured as follows: section 2 defines the research ontext and reviews some of the related work. Based on that, section 3 defines and describes the integrated framework. Section 4 gives an example to use the proposed model. Conclusion and future work are outlined in section 5.

2 RELATED WORK

In the current globalised and networked society, enterprises need to collaborate with other enterprises to meet their own added values and to exploit the market opportunities. A major issue in global collaboration and cooperation is the development of interoperability. Many definitions of interoperability have been proposed in the literature. A review of them can be found in (Guédria, 2012). The most known definition is the one proposed by the IEEE, considering interoperability as the ability of two or more systems or components to exchange information and to use the information that has been exchanged (IEEE, 1990).

2.1 Enterprise Interoperability Frameworks

The main purpose of an interoperability framework is to provide an organising mechanism so that concepts, problems and knowledge on EI can be repre-

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sented in a more structured way (Chen et al., 2008). So far, the most known EI frameworks are: ATHENA (Advanced Technologies for interoperability Heterogeneous Enterprise Networks and Applications) Interoperability Framework (AIF) (Ruggaber, 2006), the European Interoperability Framework (CompTIA, 2004), the E-health interoperability framework (NEHTA, 2005) and the Framework for Enterprise Interoperability (FEI). The review of the different aspects and the frameworks coverage of these frameworks lead to identify the main elements in EI context (i.e. (a) the three interoperability aspects: conceptual, technical and organisational, (b) four concerns of EI: business, process, service and data); however, none of the EI frameworks defines interoperability, or proposes to improve it.

2.2 Ontology of Enterprise Interoperability (OoEI)

The OoEI aims at formally defining Enterprise Interoperability (EI) while providing a framework to describe problems and related solutions pertaining to the interoperability domain. Figure 1 gives an extract of the OoEI meta-model. Interoperability concerns, define the content of interoperation that may take place at various levels of the enterprise (data, service, process, business). Interoperability barriers identify various obstacles to interoperability in three categories (conceptual, technological, and organizational).More details can be found in (Guédria, 2012).

2.3 Maturity Model for Enterprise Interoperability (MMEI)

A maturity model is a framework that describes for a specific area of interest a number of levels of sophistication at which activities in this area can be carried out (Alonso et al., 2010). In our case, the specific area of interest is EI. EI maturity can be measured in two ways: *a priori* where the measure relates to the potentiality of a system to be interoperable with a possible future partner whose identity is not known at the moment of evaluation, *a posteriori* where the measure relates to the compatibility measure between two (or more) known systems willing to interoperate. Developing interoperability can induce many problems that have to be solved in order to achieve targeted objectives. Solving these problems may be a long iterative procedure which can fail due to the lack of a consensus between partners or the high cost of the solution applicability. Preventing and solving interoperability problems before they occur is simpler and usually less costly than developing corrective actions. Within this context, *a priori* assessment deserves particular attention in order to help enterprises knowing their strengths and weaknesses in terms of interoperability and undertaking improvement actions. Many maturity models have been developed in the literature. Among them, we find the Maturity Model for Enterprise Interoperability (MMEI) which is the only one defined within an *a priori* context of interoperability. A review and a comparison of them could be found in (Ford, 2008), (Guédria et al., 2008), (Guédria, 2012).

MMEI (Guédria et al., 2013) allows companies to evaluate their potentiality to interoperate, in order to know the probability that they have to support efficient interoperation and to detect precisely the weaknesses that are sources of interoperability problems. Moreover, MMEI differs from all other maturity models dedicated to interoperability so far. It is intended to cover the three interoperability levels (conceptual, technological, and organizational) at each of the EI concerns (business, process, service, data), as defined in the Framework for Enterprise Interoperability (FEI) (Chen, 2006). MMEI defines five levels of interoperability maturity (Guédria et al., 2013). A general view of the MMEI model with its contents is given by Table 1. Each one of the maturity levels is an instantiation of this general view with an evolution of the content regarding the evolution of the level.

3 INTEGRATED MODEL

In this section, we propose to define an integrated model allowing improving EI while sharing a common understanding of it. This integrated model comes in response to a research gap that we have been identified when reviewing the interoperability related work in the previous section. Indeed, each one of the presented interoperability frameworks and models has a unique purpose as presented in Figure 2.

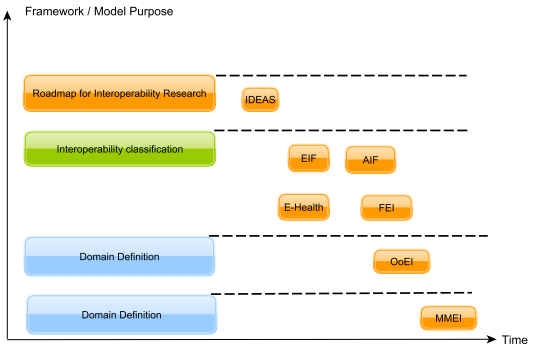

Figure 2: Enterprise Interoperability Frameworks and Purposes.

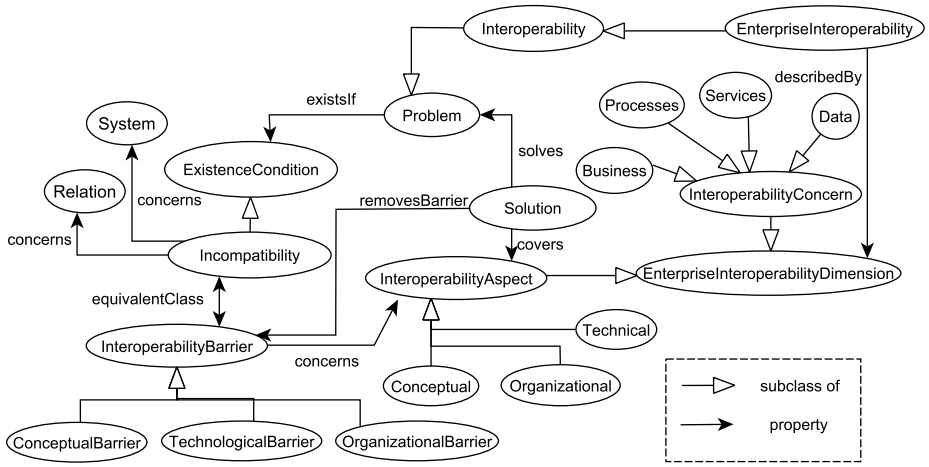

Figure 1: Extract of the OoEI.

Table 1: General view of MMEI levels structure.

	Conceptual	Technological	Organizational
Business	Business models, enterprise visions, strategies, objectives, policies	Infrastructure, technology	Work methods, business rules, and organizational structure
Process	Processes models	Tools supporting processes modeling and execution	Responsibilities, Process management and rules
Service	Services models	Tools supporting services and applications	Responsibilities, service and application management and rules
Data	Data models, (semantic, syntax)	Data storage and exchange devices	Responsibilities, data management and rules

To deal with this gap, this section proposes to define the integrated model based on the OoEI and the MMEI models.

The integration of the MMEI and OoEI will allow the enrichment of the OoEI with concepts and details from the MMEI, allowing the enterprise to better diagnose its interoperability problems and find suitable solutions. On the other hand the OoEI contains a considerable knowledge that may help the MMEI assessing the Interoperability readiness of a given enterprise.

The structure of MMEI is based on a simplified version of FEI where we can find the EI concerns (i.e. Business, process, service and data) and interoperability barriers (i.e. conceptual, technological and organizational), as depicted by table 1. These concepts can also be found in the OoEI (Naudet et al., 2008).

Moreover MMEI and OoEI follow a systemic view (Von Bertalanffy, 1968), where an enterprise is seen as a complex system. The content of each cell of the table 1 can be related to the OoEI. Figure 3 shows how these cells can be related to the OoEI. The OoEI concepts are presented with white ellipses while concepts related to the MMEI model are presented with gray color.

Based on the OoEI and MMEI review, three main dimensions of EI are considered: Interoperability aspects (conceptual, organizational and technical), EI concerns (business, process, service and data) and Interoperability barriers (Conceptual, Organizational, and Technological). These are represented by the concepts: InteroperabilityAspect, InteroperabilityConcern and InteroperabilityBarrier respectively. These are all modeled with their different constituents represented here as dimensions describing Enterprise Interoperability, as shown in figure 3.

Within the context of EI, interoperability problems are represented by the InteroperabilityBarrier concept. The term barrier is defined as an incompatibility, obstructing the sharing of information and preventing exchanging services (Chen et al., 2006).

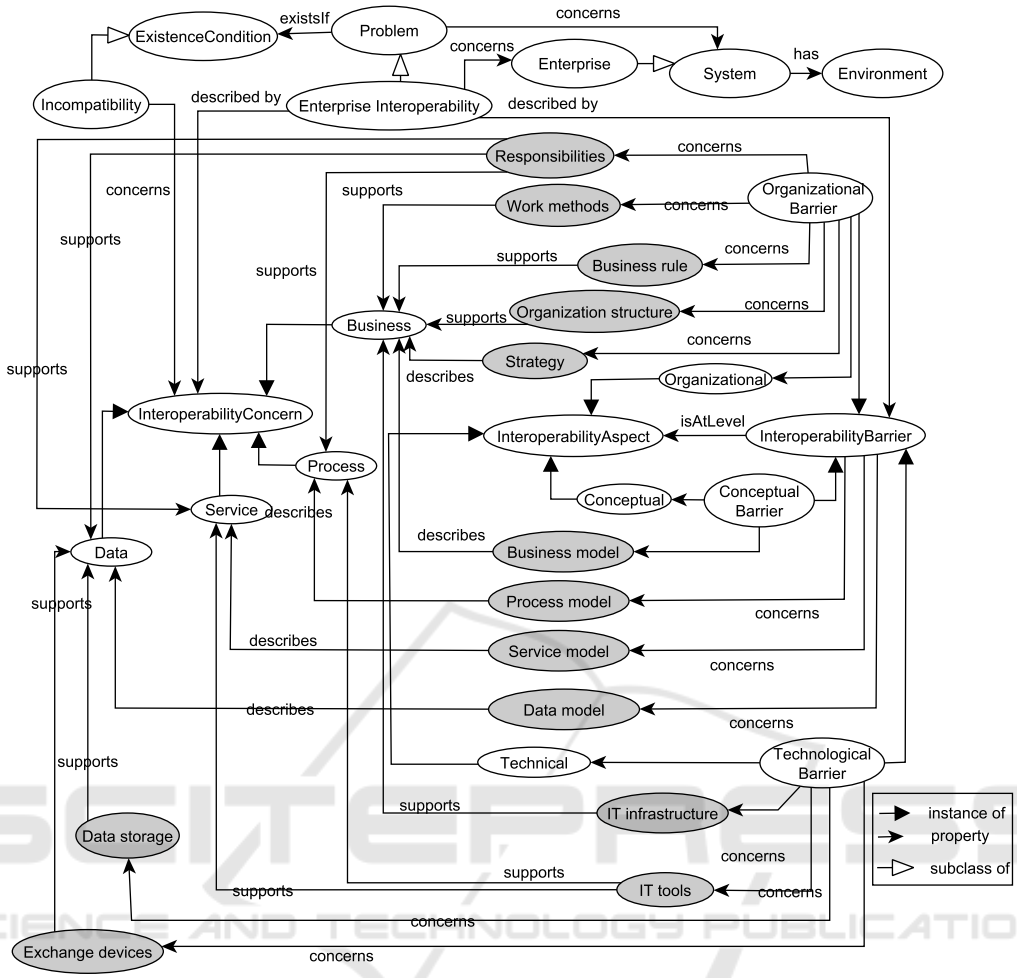

Figure 3: Extract of the integrated model.

The establishment of interoperability (with its three aspects) consists of removing identified barriers (conceptual barrier, organizational barrier or/and technological barrier). Hence each InteroperabilityBarrier is related to the corresponding InteroperabilityAspect (see figure 3).

For each OrgaizationalBarrier, the criteria that need to be verified are the definition and compatibility of the Responsibilities, Work methods, Business rules, Organization structure and strategy, as defined by the MMEI model (see table 1). This is represented by the concepts Responsibilities, Work methods, Business rules, Organization structure and strategy which are considered by the Organizational Barrier. Similarly, the concepts of Business model, Process model, Service model and Data model are concerned with the ConceptualBarrier and the concepts of IT infrastructure, IT tools supporting data storage and Exchange devices are concerned with the TechnologicalBarrier.

This model can be used thereafter to have the required knowledge to assess the EI of the considered enterprise. The gray MMEI concepts (gray ellipses) in the figure 3 presents the requirements and related information that need to be verified. For example, in order to assess the EI at organizational level, some of the requirements that assessors have to verify are whether responsibilities supporting business, process, service and data interoperability concerns are properly defined and that are compatible with those used within the enterprise environment.

4 ILLUSTRATIVE EXAMPLE

To better understand the application and the use of the above defined conceptual framework, it is interesting to check its utility by an illustrative example. A potential interoperability problem exists if the con-

sidered enterprise, say E has no defined models, tools, rules, etc. or that it uses incompatible ones with those used in its environment (including its partners, clients, providers, etc.). For example, if E adopts 50 hours of employment per week while being situated in France or Luxembourg, this will create incompatibility with the environment of the enterprise where a maximum of 40 hours is fixed for the employment. Figure 4 illustrates this interoperability problem that can be detected when assessing the interoperability of E towards unknown partner.

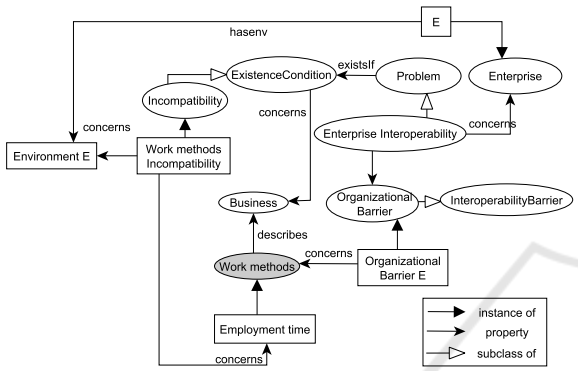

Figure 4: Illustrative Example with the enterprise E.

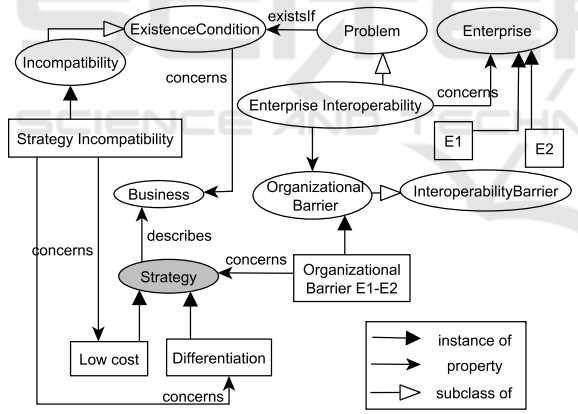

Figure 5: Illustrative Example with enterprises E1 and E2.

Suppose now that a particular interoperability project starts (i.e. the partner is known but the interoperations haven't started yet), barriers to interoperability can exist at each level of the company and of its partner. An interoperability problem exists if the two companies have different strategies. For example, one of the company, say E1 adopts a Low cost strategy which focuses on producing the product by lowering costs and maximizing income (by increasing volume), while E2 is adopting a differentiation strategy which focuses on producing different products (better) than those of competitors. Differentiation usually includes the processes for taking your product directly to consumers. So processing and marketing are involved. Differentiation in small markets often involves creating a personal relationship with consumers. An application of the defined conceptual model is presented in figure 5.

5 CONCLUSIONS

In this paper, we have proposed an integrated model based on the Maturity Model of Enterprise Interoperability (MMEI) and the ontology of Enterprise Interoperability (OoEI) concepts. The integration was facilitated by the common basis of the two models (systemics) and the use of the Framework of Enterprise Interoperability (FEI) by both of them. The integrated model allows having the required knowledge for the interoperability assessment and save human efforts in gathering information and validating it for each assessment. The interoperability assessment based on the integrated model allows diagnosing interoperability problems. This is facilitated by the nature of the OoEI which were conceived in a problem solving perspective. Future work are planned to improve this first version of the integrated model in order to implement an automatic assessment tool. The idea is to develop an ontology-based software infrastructure for web-based self-evaluation for enterprise interoperability. This tool will help to diagnose interoperability problems. This can be complemented by proposing solutions to interoperability problems, using best practices that have been developed for the MMEI (Guédria, 2012).

REFERENCES

Alonso, J., de Soria, I. M., Orue-Echevarria, L., and Vergara, M. (2010). Enterprise collaboration maturity model (ecmm): preliminary definition and future challenges. In *Enterprise Interoperability IV*, pages 429–438. Springer.

Chen, D. (2006). Enterprise interoperability framework. In *EMOI-INTEROP*.

Chen, D., Daclin, N., et al. (2006). Framework for enterprise interoperability. In *Proc. of IFAC Workshop EI2N*, pages 77–88.

Chen, D., Doumeingts, G., and Vernadat, F. (2008). Architectures for enterprise integration and interoperability: Past, present and future. *Computers in industry*, 59(7):647–659.

CompTIA (2004). European interoperability framework - ict industry recommendations. White paper, CompTIA, Brussels.

Ford, T. (2008). Measuring System Interoperability: An i-Score Improvement. *Proceedings of the 6th Annual Conference on Systems Engineering Research*.

Guédria, W. (Bordeaux, France, 2012). A Contribution to Enterprise Interoperability Maturity Assessment. Ph.D. thesis, University of Bordeaux1.

Guédria, W., Naudet, Y., and Chen, D. (2008). Interoperability maturity models–survey and comparison–. In *On the move to meaningful Internet systems: OTM 2008 Workshops*, pages 273–282. Springer.

Guédria, W., Naudet, Y., and Chen, D. (2013). Maturity model for enterprise interoperability. *Enterprise Information Systems*, (ahead-of-print):1–28.

IEEE (1990). *IEEE standard computer dictionary: A compilation of ieee standard computer glossaries*. Institute of Electrical and Electronics Engineers.

Naudet, Y., Latour, T., and D.Chen (2008). A systemic approach to interoperability formalization. In *IFAC08 workshops*.

NEHTA (2005). Towards an interoperability framework, version 1.8. White paper, National E-Health Transition Authority, Australia.

Proper, E. (2008). *Enterprise Architecture: Creating Value by Informed Governance*. Springer.

Ruggaber, R. (2006). Athena-advanced technologies for interoperability of heterogeneous enterprise networks and their applications. *Interoperability of enterprise software and applications*, pages 459–460.

Von Bertalanffy, L. (1968). *General System Theory: Foundations, Development, Applications*. Georges Braziller, Inc., New York, USA.