Mapping IEM to Enterprise Modelling Ontology

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Abstract
Enterprise Modelling ontology is seen as a basic step towards the development of interoperability of enterprise models. This paper tentatively presents the ontology of IEM language developed by IPK Berlin and the integration of IEM ontology to the Enterprise Modelling Ontology (EMO) we published previously. The objective of this research is to develop a unified enterprise modelling ontology in a progressive and incremental way. In this paper, the IEM ontology is elaborated and presented following an ontology building methodology. Then the IEM ontology is mapped to EMO (version 1.0). Both IEM and EMO are modelled and represented using OWL and Protégé.

Keywords 1
Enterprise modelling, Ontology, IEM, Enterprise model

1. Introduction

Enterprise modelling and the interoperability of enterprise models will play an increasing role in the development of industry 4.0. This paper aims at developing the IEM ontology and its mapping to the Enterprise Modelling Ontology 1.0 we have published previously [7]. This version 1.0 of ontology was built with the modelling constructs of IDEF0, IDEF1, IDEF3, GRAI grid, GRAI nets. As IEM process modelling and GRAI decisional modelling are complementary, it is important to formally define their ontology and develop their semantic interoperability.

At first the modelling constructs and concepts of IEM have been identified. Then they are compared and mapped to a reference process language (IDEF3) which is part of the Enterprise Modelling Ontology. Based on this mapping, we followed the ontology building methodology [2] already used in [1] to identify the relationships between IEM's modelling constructs and concepts to constitute its ontology, namely Taxonomy (IsA), Attribution (HasA) and Meronymy (PartOf). The resulting IEM ontology is first modelled and represented using the Web Ontology Language (OWL) and then with Protégé tool.

2. IEM modelling language

Integrated Enterprise Modeling (IEM) is an enterprise modeling method developed by the Fraunhofer Institute for Production Systems and Design Technology (Fraunhofer IPK) in 1980s for process reengineering [3][4][5]. The kernel of the model structure incorporates two views: the "Information Model" and the "Business Process Model". The former emphasizes the structures and features that describe all relevant objects of an enterprise while the latter emphasizes the tasks and business processes that are executed on the objects [5].

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The basis for the development of the model as a description of an individual company is formed by the object classes "Product", "Resource", and "Order". The required corporate functions and data are assigned to these objects when creating the model [5].

In a Generic Activity Model, these objects are changed or transformed through the implementation of instance of the class "Action", whereby five basic types of connection elements that contain further information about their logic (e.g. or, and, synchronized, etc.) are available [3][4][5]. The IEM secures the reusability of modeling constructs and models for different purposes and enterprise types. Libraries of object classes and business processes can be created.

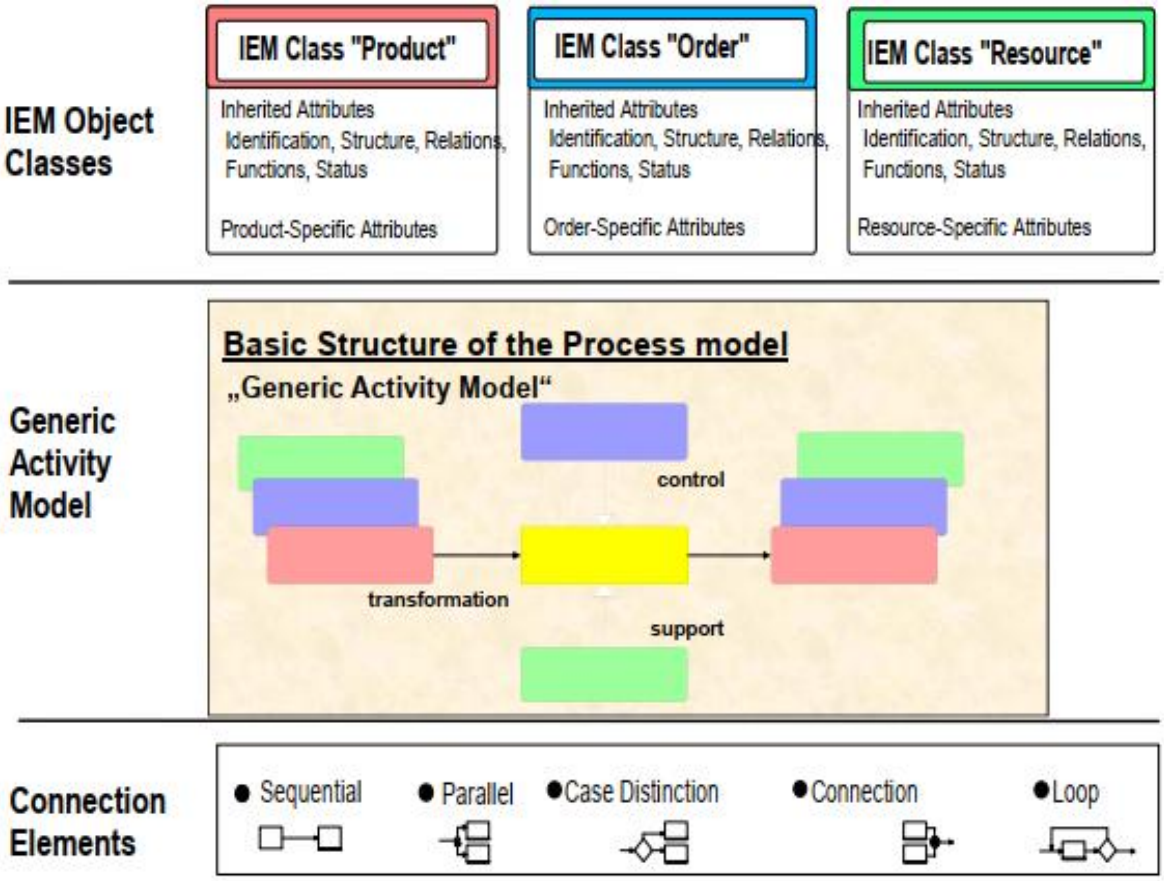

Figure 1. IEM Modelling elements [3]

3. Comparison and mapping

Figure 2 below shows the mapping of IEM elements to IDEF3 [8].

As shown in figure 2, the ‘Action’ of IEM representing any concept of activity, function and process. It can be mapped to the ‘Unit of behavior’ of IDEF3. Junctions in IDEF3 are of three types: And, Or, Xor. They are further divided according to converging/diverging and synchronous/asynchronous. In IEM, different concepts are used to name and define junctions in different ways (see also figure 2).

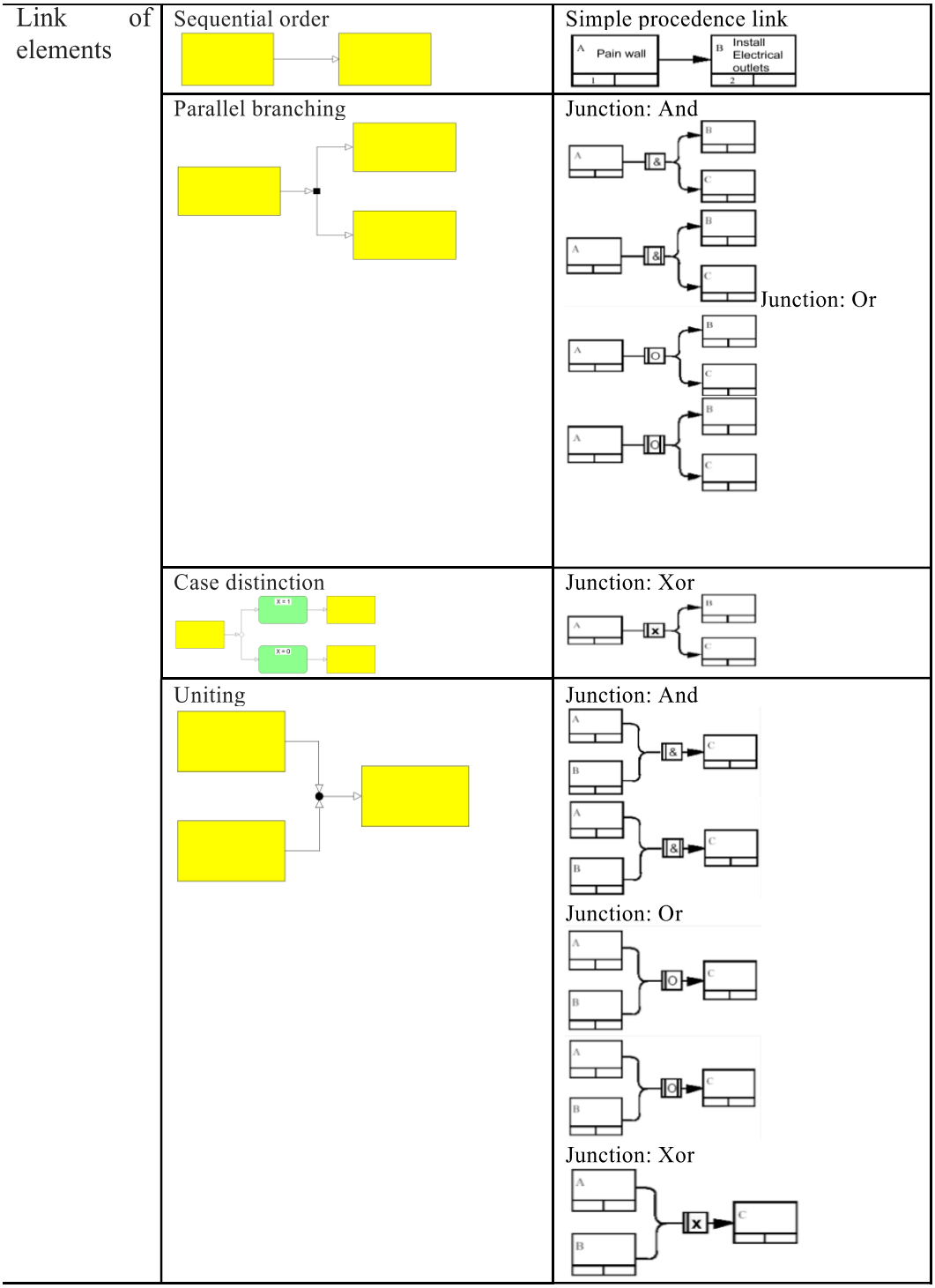

Figure 2. Mapping IEM to IDEF3

4. Ontology of IEM

Based on the mapping and with the help of the UPON Lite methodology[2], the ontology of IEM modelling language is first elaborated. Figure 3 shows the OWL representation of IEM modelling language ontology.

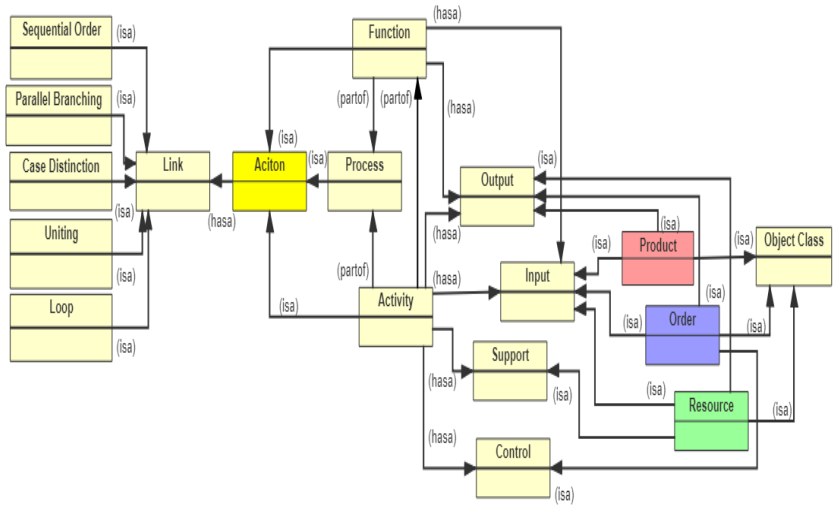

Figure 3. IEM ontology representation using OWL [8]

5. Ontology of IEM

At this stage, only concepts and basic OWL relationships are defined without identifying attributes. Through comparing individual modelling language ontologies (IDEF0, IDEF1, IDEF3, GRAI grid and GRAI nets) proposed in [7] to the ontology of IEM, their associations and differences are identified. The IDEF (0,1,3) ontology and GRAI grid and net ontology are obtained as a basic version. Then IEM ontology are mapped to the IDEF and GRAI ones. Finally, the unified Enterprise Modelling Ontology is built using both OWL and PROTÉGÉ tools. Figure 4 shows the OWL representation of the ontology. Figure 5 shows its PROTÉGÉ representation.

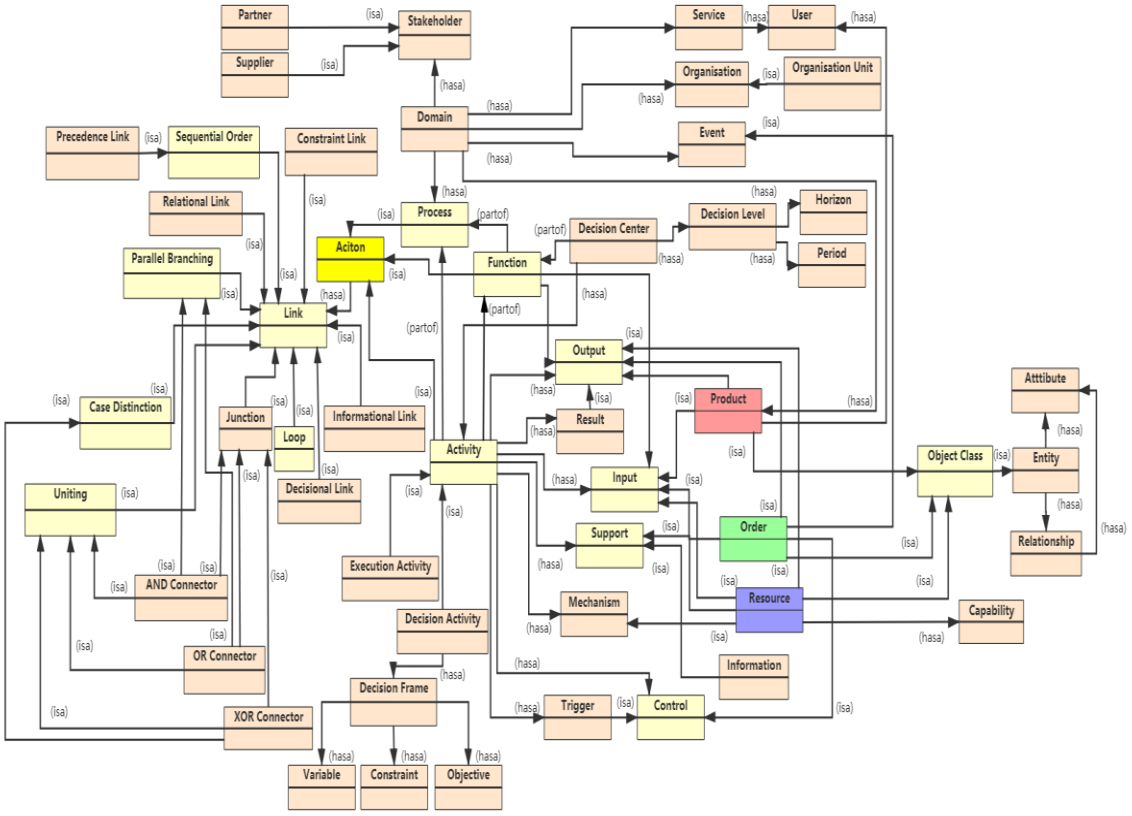

Figure 4. Enterprise Modelling Ontology (version 2.0) using OWL

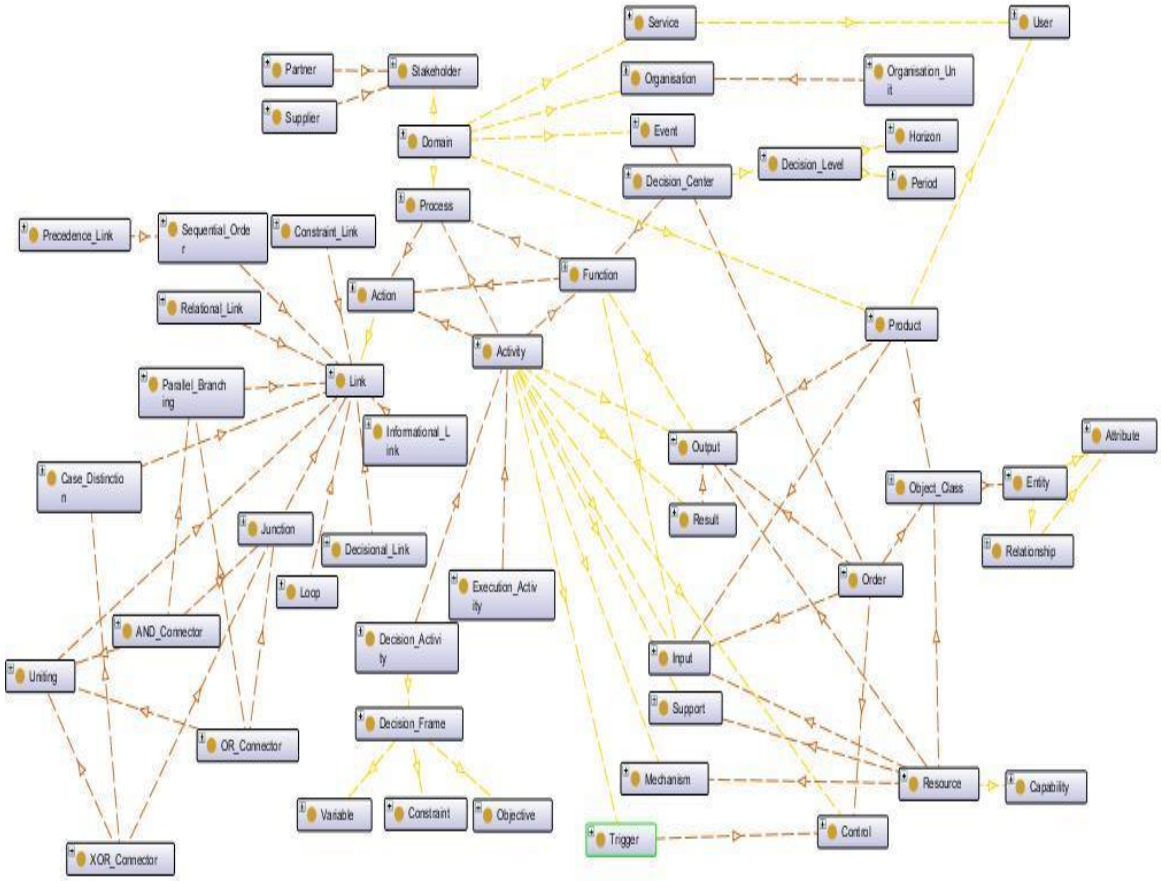

Figure 5. Enterprise Modelling Ontology (version 2.0) using PROTÉGÉ

6. Conclusion

This paper tentatively presented the IEM ontology and its mapping to Enterprise Modelling ontology. This work has been performed in a Master training project at University of Bordeaux. The IEM modelling concepts (Action, Product, Resource and Order as well as various Junctions) were first mapped to IDEF3 and then to EMO (version 1.0). The result obtained should be considered as preliminary. The resulting new version of EMO (version 2.0) still needs to be further refined and validated. As a continuous effort to developing enterprise modelling ontology, it will be further extended to cover other enterprise modelling languages such as BPMN for example.

Indeed, developing Enterprise Modelling Ontology is a difficult and long process that can only be achieved in a progressive and incremental manner. Mapping modelling concepts and comparing their semantics are a challenging task because the semantics of most of existing enterprise modelling concepts are not explicitly defined at the moment when those modelling languages were developed. Moreover, even the semantics of various different concepts (terms) are identified, it is not always obvious to map them one to another at a one-to-one basis.

7. References

[1] Chen, D. (2018). Developing an Enterprise Modeling Ontology: Smart Services and Business Impact of Enterprise Interoperability. Enterprise Interoperability, 335–342. doi:10.1002/9781119564034.ch41.

[2] De Nicolas, A. and Missikoff, M. (2016). A lightweight methodology for rapid ontology engineering, ACM, 59(3), pp. 79-86. 5.

[3] Frank-Walter Jaekel (2019). IEM AND MO²GO: METHOD AND APPLICATIONS IN INDUSTRY, Lecture in University of Bordeaux.
[4] Kai Mertins, Frank-Walter Jaekel (2006). MO2GO: User Oriented Enterprise Models for Organisational and IT in Handbook on architectures of information systems. Berlin: Springer, 2006, (International handbook on information systems), Second Edition 2006.
[5] Kai Mertins, Roland Jochem (2000). Integrated Enterprise Modeling: Methodology, Tool, and Industrial Cases in Enterprise Modeling: Improving Global Industrial Competitiveness.
[6] Knothe, T., Busselt, C. and Boll, D. Deliverable D23 – Report on UEML (Needs and Requirements), UEML, Thematic Network, 2003.
[7] Minh Hieu Nguyen, Salauddin Al Mamun, John Wilson and Yuli Liu, Zhang Yue and Wang Yao, Onltology for enterprise modelling. Master project report, University of Bordeaux, January 2018.
[8] Liu Ting, (2020). Establishing IEM ontology, Project Report of Master of Enterprise Engineering, University of Bordeaux. January 2020.