**User oriented Enterprise Modelling for Interoperability with UEML**

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**Authors**

Kai Mertins  
Fraunhofer Institute IPK, Corporate Management,  
Pascalstr. 8-9  
D-10587 Berlin, Germany  
Phone: +49-030-390-06234  
Fax: +49-030-3932503  
kai.mertins@ipk.fraunhofer.de

Thomas Knothe  
Fraunhofer Institute IPK, Corporate Management,  
Pascalstr. 8-9  
D-10587 Berlin, Germany  
Phone: +49-030-390-06158  
Fax: +49-030-3932503  
thomas.knothe@ipk.fhg.de

Martin Zelm (Corresponding author)  
CIMOSA Association,  
Gehenbuehlstr. 18 a  
D-70499 Stuttgart, Germany  
Phone: +49-711-8386651  
Fax: +49-711-8386651  
martin.zelm@cimosa.de

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Abstract:

Modelling techniques and visual languages have become more important to support new approaches for the development of network organisations and for business transformation. User oriented holistic Enterprise Modelling must be capable to capture a multitude of enterprise aspects, business processes, inter and intra organisational integration as well as active knowledge management. Today, these requirements are addressed separately with single non-interoperating modelling tools. The paper describes the structuring of user requirements as well as the initial design of the Unified Enterprise Modelling Language (UEML). The feasibility and the benefits of shared modelling have been proven with a web based demonstrator integrating three commercial modelling tools MO²GO, eMagim and Metis. Work in process is focussing on broadening the generic approach and on solutions for interoperability in the extended enterprise environment.

**Keywords:** Holistic Enterprise Modelling, User orientation, Enterprise Model Exchange Format, Interoperability, UEML
Enterprise Modelling techniques associated with visual languages become more important to support new approaches for the development of network organisations, for business transformation and for interoperability. User oriented holistic Enterprise Modelling must capture a multitude of enterprise aspects, business processes, inter and intra organisational integration as well as active knowledge management. These requirements are today mostly addressed with single non-interoperating modelling tools. The paper describes the requirements elicitation and structuring as well as the initial design of the Unified Enterprise Modelling Language (UEML), a generic extendible solution for the interchange of enterprise models in a neutral format. The initial version, the UEML 1.0 has been demonstrated with three commercial modelling tools MO²GO, eMagim and Metis. Work in process is focussing on interoperability between models, modelling languages and tools.

As shown in Table 1, the European Thematic Network project UEML (IST-2001-34229) had two goals, namely to reach a European consensus for the UEML with regard to the user requirements on the language, applying a holistic approach with focus on (user) applications and to define a common format for the exchange of models for interoperability.

Table 1: Goal and mechanisms to define the Unified Enterprise Modelling Language (UEML)

<table>
<thead>
<tr>
<th>Goals</th>
<th>Mechanism</th>
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<tbody>
<tr>
<td>Support a European consensus</td>
<td>Provide a demonstrator for the model exchange between three modelling tools (eMAGIM, METIS, MO²GO)</td>
</tr>
<tr>
<td>Demonstrate feasibility</td>
<td>Define requirements across all enterprise modelling stakeholders</td>
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<td></td>
<td>Develop a specification for the UEML</td>
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</table>

To gain the full benefit, UEML must be accepted by a wide community of users and tool developers. Acceptance and awareness will be significantly leveraged if it is largely supported by the academic world and standardisation bodies. The requirements have been gathered via workshops with invited experts and interaction via a special web portal, in order to get a wide range of user requirements. An expert team has been created, who interacts with the core team, to comment and follow the development process.

Problems to be solved

Today, enterprises are using various methods to model their business processes, resources, organisation or assets. [1], [2], [3]. In spite of the well known advantages of enterprise modelling, various problems exist. Models are often not maintained and therefore have a limited value for the planning or the operation in the enterprise. Models are used only once, they lose their actuality and cannot be deployed in the day to day operation. Employees are not aware of the existence of new models. Due to administrative rules the update of models is performed only once a year, for example during the re-certification via ISO 9000.

Often, enterprise models are designed by external consultants. Only the external consultant knows the base and the concepts constituting the design of the model. Going back to simple methods and representing the enterprise processes by flow charts, usually results in an oversimplified and often inconsistent enterprise model. Further problems arise due to the lack of model interchange between modelling tools. Recent market studies have revealed that a large number of not compatible modelling
tools are offered on the market [4]. The tools should support collaboration between organisations. However, even the exchange of data between tools is not always feasible.

**Defining user requirements**

It is very challenging to obtain a consensus on the common requirements for a modelling language from the different stake holders, for instance to capture the different view points of end users, system designers and standardisation experts. Further, the size of an enterprise as well as the enterprise culture has an impact on the modelling language and methodology. Overlapping or excluding requirements must be identified and agreed. Gathering the comprehensive set of requirements we have

- Evaluated the state of the art from the literature
- Employed the experience of the involved tool vendors
- Collected and evaluated requirements from over 90 European experts via four membership meetings and two dissemination meetings held within the project.
- Elaborated further requirements from interactive work discussions via the UEML Internet portal

The total of over 250 requirements has been collected and structured in a framework. The requirements framework consists of four hierarchical layers, connected with each other by object relationships [8]. The top layer of the framework contains the five main goals, which UEML must be capable to support:

- Capture, represent and structure the enterprise
- Create, modify and exchange enterprise models
- Create, modify and exchange enterprise meta-models
- Utilise and employ models to solve different categories of problems
- Insure end user involvement in the modelling process and provide easy comprehensibility of models

![Figure 1: Requirements framework for the UEML, example 'Representation of a bill of material'](image-url)

The goals of the top layer have been decomposed at the next lower e.g. the second layer, where partial aspects of the goals have been identified providing more details. At the bottom layer, the third layer, types of the requirements elaborated at the second layer have been defined. The bottom layer provides textual detail descriptions of requirements, graphical representation and the attributes which are significant for the fulfilment of a requirement. At each layer of the framework, generic attributes may
be added, in order to ensure that requirements of different degree of detailing can be introduced. This was important for the consensus building, namely to integrate and share the view points of all stakeholders in the common requirements framework. Figure 1 shows as an illustrative example the requirements for ‘Modelling of Bill of materials’.

The following criteria have been selected to validate the UEML requirements for research and industrial applications and to perform a relevance analysis. 1) Relevance vis-à-vis existing state-of-the-art modelling methods and tools, to identify new requirements. 2) Distinguishing process types applied such as planning, operation, control or others. 3) Application area or sector, for instance industry, services, administration. 4) Organisational scope of the application with focus on individual employee, team, project or virtual enterprise. 5) Time horizon – days, weeks, years and 6) Importance of a requirement – high, medium, low.

Each requirement has received a quantitative value following the above described methods to structure the UEML requirements by goals and by criteria of relevance. Figure 2 shows the example of the most important five requirements for the goal ‘Capture represent and structure the enterprise’. The columns represent the importance as seen from the end user. The need to model both hard and soft aspects of a team development ranks at the top, followed by the requirement for a framework of simple and secure methods for enterprise collaboration. In total 250 user requirements for the UEML have been structured and evaluated according to the described framework with goals and criteria. A detailed description of the requirements definition is provided in the project report [9].

**UEML Specification**

The UEML specification has been developed applying the above described requirements as well as the modelling languages IUM, EEML and GRAI of the project partners Computas, GRAISOFT and FhG-IPK. We distinguish two basic development steps:

- The ‘Strategy for the UEML’ with the goal to integrate existing modelling languages into a ‘Unified Language’, which means to realise correspondences for the import/export from any modelling language to and from the ‘Unified Language’. This strategy represents a general re-useable concept.
- The UEML 1.0, being the first successful application of the above strategy, in which the meta model of the ‘Unified Language’ in UML representation, as well as the core constructs and the correspondences vis-à-vis the three modelling languages IUM, EEML and GRAI are defined. Syntax and semantics have been strictly separated.

The ‘Strategy for the UEML’ can be reused for integrating additional languages and tools, enabling a flexible extension of the UEML. On the other hand, the strategy depends also on the application scenario which impacts both the ‘Unified Language’ as well as the correspondences. Further investigations about the generic nature of the development approach are necessary. The details of the specification are documented in the UEML project report [10].
**Application Example**

UEML is not designed as an additional language replacing existing modelling languages. Moreover, UEML serves as a format for model exchange between modelling tools and interoperability. Figure 3 shows on the left hand side the concept of model exchange between different tools: Tool 1 can operate on the customer model B via the Gateway and the API, together with an application specific interpreter. On the left hand side of Figure 3, the exchange concept of the UEML 1.0 is depicted as implemented with the tools employed in the project, e-MAGIM (GRAISOFT), METIS (Computas) und MO²GO (IPK - FhG).

![Figure 3: Concept of model exchange and implementation of UEML 1.0](image)

The described method of interoperability for model exchange has been validated on a Web based demonstrator developed in the project by the partner Computas. The business process ‘PC Installation’ served as the demo scenario, which was modelled on the three tools [11], [12]. Applying the ‘Strategy for the UEML’ with a common XML based meta model, enterprise modellers of a team can work on the same model using different tools. The knowledge stored in the distributed model is available to all modellers. The exchange of models between tools is supported by the UEML, which has the potential of further extension.

**The Mission: UEML for Interoperability**

Collaboration among enterprises will further increase due to the needs for flexibility in adapting to changes in the global market. Enterprises must react fast and cope with changes in the business environment (new products or processes), the organisation (merging or re-organisation) or the Information and Communication Technology (new software versions, modelling languages or tools).

At the beginning of the UEML project, the exchange of models enabling connectivity between different methodologies was considered the most important goal. Later, the needs to obtain an easy, fast and efficient use of enterprise modelling for daily and strategic work in the extended enterprise became more important. An extended enterprise must be designed for interoperability, which means support of integration and cooperation of systems to perform common tasks.

Modelling with UEML must enable ‘Plug & Do Business’ which leads to specific requirements for interoperability [13], namely to

- Capture, preserve, exploit and validate an enterprise model on demand
- Deploy models and solutions decoupled from the modelling process
- Support concurrent model building and easy prototyping
- Provide model based communication between all enterprise actors

In standardisation, ISO, IEC and CEN as well as the OMG have produced a starting set of relevant standards for business process models. More work is required on the standardisation of modelling human-related aspects, the representation of human roles and skills as well as on business co-operations and interoperability.
Conclusion and outlook
The UEML project has demonstrated the feasibility to exchange enterprise models between three commercial modelling tools METIS, e-MAGIM und MO²GO. The described UEML approach offers several benefits to the end user: Enterprises will not be limited to employ one modelling tool. Teams can share one model working on several different tools. Partners in a virtual enterprise can employ the methods and tools they know well and are used to. Further investigations about the generic nature of the development approach and solutions for interoperability are necessary.

Work in process on UEML is continuing in two projects supported by the European Commission in the FP6. Each project will follow a different roadmap. The NoE type project INTEROP (IST-2003-508011) will extend UEML 1.0 beyond the exchange of process data and single models towards interoperability in the environment of distributed configurable models. The IP type project ATHENA(IST-2003-507312), starting from the base of UEML 1.0 will develop additional constructs needed in networked processes and – structures ‘on demand’ as well as optimised methods for application scenarios.

References