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Enterprise Modelling for Achieving Interoperability

Keywords: enterprise modelling, interoperability, SME, enterprise networks, clusters, supply chain

Abstract

The application of enterprise modelling supports the common understanding of the enterprise business processes in the company and across companies. The company is supported to succeed in reducing the throughput times, in improving the process quality, in reducing costs and therefore in improving the customer satisfaction and competitiveness. To assure a correct cooperation between two or more entities it is mandatory to build an appropriate model of them. This can lead to a stronger amplification of all the cross-interface activities between the entities. Enterprise models illustrate the organisational business aspects as a prerequisite for the successful technical integration of IT systems or their configurations. If an IT system is not accepted because its usefulness is not transparent to the staff members, then it quickly loses its value due to erroneous or incomplete input and insufficient maintenance. This at the end results in investment losses.

The enterprise models cover the knowledge of the internal processes and between organisations as well as the demand on IT support. The paper exemplifies the strengths, values, limitations and gaps of the application of enterprise modelling to achieve and to support interoperability between companies.

1. INTRODUCTION

The implementation of information systems and new organisational structures into and between companies requires discussions between different stakeholders of the enterprise (e.g. process design experts, managers, process owners, IT experts). Therefore the modelling of enterprise processes including the related information systems and organisational units is an essential step in the process of changing and improving enterprise structures. The target is to achieve a common understanding regarding the requirements of the new system. This is true for big companies as well as for small and medium size enterprises (SME). Furthermore the enterprise model represents the bridge between the working processes and the IT processes. Therefore enterprise business process modelling covers the relation between the process organisation of an enterprise and the processes implemented within the IT systems. The complexity of the modelling approach increases if used across enterprise networks. This requires well understandable tools which allow a fast and effective modelling.

The modelling of enterprise business processes becomes more and more a well known technique especially within big companies. Now also SMEs are forced by their customers to increase the transparency of their processes. Moreover, the need of IT support such as ERP systems increases for SMEs. The establishment of information systems within a company is a difficult task. Various applications of IT systems are not efficient because of a lacking acceptance on the user side and of deficits between the real process organisation of the enterprise and the support of the IT systems.

Experiences from industrial projects illustrate that companies which buy an IT system without a clear strategy for enterprise business process improvement and little knowledge regarding the organisational effects often fail in applying the software. Therefore, big companies as well as SMEs require a modelling approach to create an enterprise (business) process blue print for a successful implementation of IT systems. The model is oriented to and across process owners or stakeholders of operational and management departments. Consequently the description of the process structure and its relations to different resources such as organisational units, IT infrastructure, information exchange, etc. has to be easily understandable.

The modelling of enterprise business processes illustrates especially the relation between the organisational aspects and the IT aspects of the processes. This is more a holistic view including all processes and not only the processes executable by an IT system. The organisational view in relation to IT systems is required because a system which is not correctly used along the working processes is meaningless. However, especially SMEs are quite often not convinced to use enterprise business process modelling techniques because they believe they are too complex and too expensive.

The relations between customers and suppliers in enterprise networks, however, become closer. The customer requires more trust in the performances and effectiveness of the suppliers. The customer wants to know available resources, stock levels, replenishment lead times etc.. Also information exchange is required in order to support cooperate design between companies. Therefore, interoperability between ICT systems is becoming a real bottleneck in the collaboration and co-operation of enterprises. Organisations have to exchange business information and must have the same understanding of the meaning of the exchanged information to trust both the communication itself and the validity of its contents. Therefore, interoperability is not only an issue of IT systems. Moreover, it is related to all aspects of an enterprise. It needs prerequisites in the company organisation, the terminology and the culture of the company, trust aspects, management of resources, etc.. This kind of information is expressed in enterprise models. However, these models have to be interoperable for model based analysis or compassable between companies.

The topic is covered by the European INTEROP [1] Network of Excellence concerned with interoperability research for networked enterprises applications and software, its goals, rationale and early results and by the European integrated project ATHENA [2] (Advanced Technologies for Interoperability of Heterogeneous Enterprise Networks and their Applications). In INTEROP IPK works on the synchronisation of the modelled content between companies and IPK leads the enterprise modelling aspects in ATHENA. In the European SPIDER-WIN [3] (Supply Information Dynamic Exchange and Control by Web-based Interactive Network) project IPK coordinates and applies enterprise modelling for the development of supporting services for the order transfer within supply chain. The modelling approach is applied in 3 different European regions: Spain, Poland and Italy. The composition and analysis of the models is done in Germany. Consequently, methods are developed to coordinate the distributed, cross region and cross company modelling approach as well as to support the analysis of these models.

The originality of the project INTEROP is to take a multidisciplinary approach by merging three research areas supporting the development of interoperability of enterprise applications and software (Fig. 1):

- Architecture & Platforms: to provide implementation frameworks,
- Enterprise Modelling: to define interoperability requirements and to support solution implementation,
- Ontology: to identify interoperability semantics within and between enterprises.

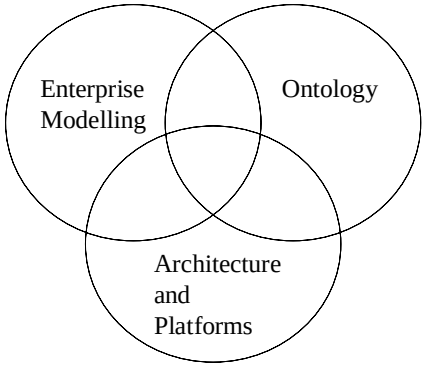

Fig. 1. Aspects of Interoperability in INTEROP

The project ATHENA is based on those three main aspects of interoperability between organisations.

2. MODELS ACROSS ORGANISATIONS

2.1. Research Topic of Enterprise Modelling between Companies

In the actual situation regarding enterprise modelling several modelling methods and tools are used in enterprises (Fig. 2). Tools are applied because of different advantages of those tools. For example, MO²GO supporting the integrated enterprise modelling is preferred because of a fast and easy understandable modelling method across different stakeholders. GRAI Tools are prioritised especially for modelling the decisional processes of an enterprise. ARIS is popular for enterprise modelling especially in the IT domain and IT departments. METIS supports a very flexible meta modelling and therefore a good adaptation of the user wishes according the modelling constructs. The information covered by these tools is similar. Therefore, to save the investment for method training and model elaboration an exchange of the information modelled within the different tools should be provided. In the first step within INTEROP this is a topic of the Unified Enterprise Modelling Language (UEML) [4, 5].

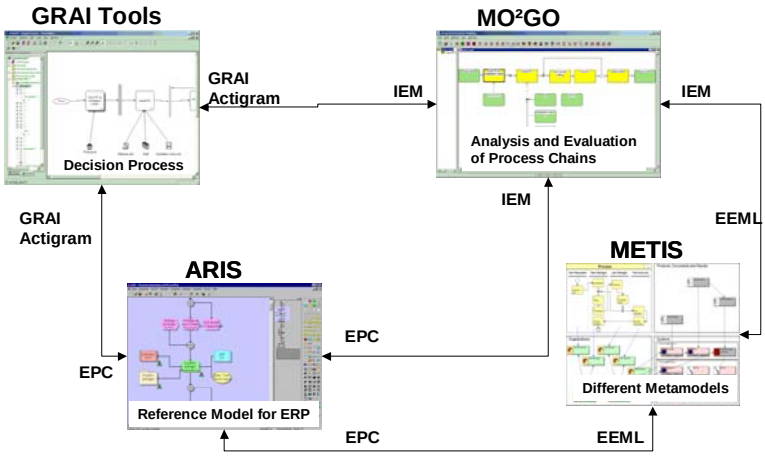

Fig. 2. Methods, Tools and Advantages

However, IPK uses, successfully, MO²GO together with the integrated enterprise modelling (IEM) methodology [6, 7, 8, 9] in most of the enterprise modelling projects. Consequently the problems of different tools and languages do not appear in these projects. However, the composition and analysis of the models needs further concepts because the models are also created under different targets, company cultures, from different persons with different backgrounds and so on.

So the work with different models does not only depend on the modelling language. The same issue might be defined in two different models with different terms (e.g. Lead engineer / Project engineer) but at the same time in a third model these terms may have another meaning. Instead of the modelling language the natural language might be hindered by an information exchange and cooperated work on the models because a translation into an interlingua e.g. English might result in misinterpretations without having a common ontology support. The perspective between two models dealing with the same information might be different e.g. order processing or product processing concerning the external interfaces of an enterprise. The structuring of the processes as well as the design of the process chains might be dissimilar e.g. the two processes “Preparation” and “Send quotation” could be in another model just the process “Enquiry processing” (Fig. 3). These are some examples of the problems under consideration in the INTEROP work around synchronisation of distributed enterprise model. Further problems arise concerning the management of such distributed enterprise models. An

enterprise model associated with different other models requires clear procedures of how to perform changes.

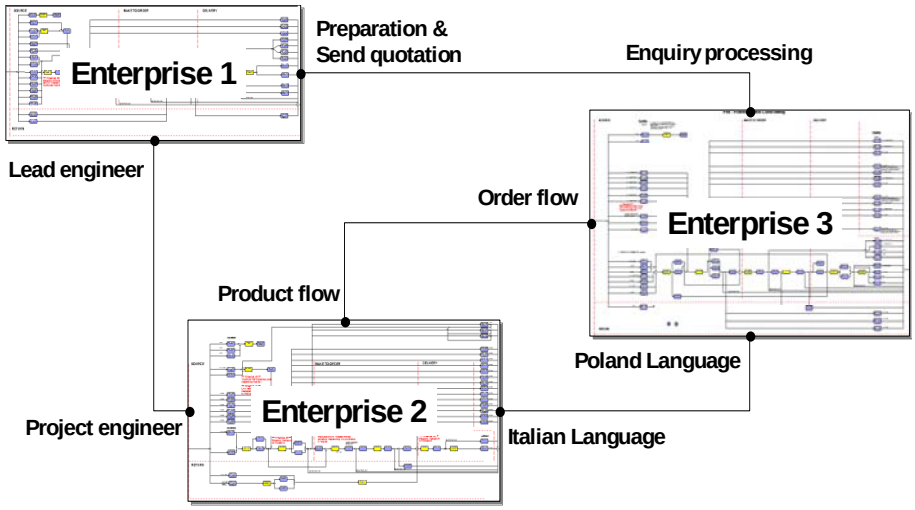

Fig. 3. Same modelling language but different understandings

2.2. Applications and Values

The application of enterprise modelling supports the common understanding of the enterprise business processes in the company and across companies. The company is supported to succeed in reducing the throughput times, in improving the process quality, in reducing costs and therefore in improving the customer satisfaction and competitiveness. Enterprise modelling should be the basis of the information system planning process. The use of enterprise modelling for supporting and achieving company interoperability has different motivations, for example:

- Identification of companies´ potentials for acting within different cooperation through identification of the present systems and their interoperability, the provided information, and the readiness for data to be circulated.
- Enabling companies to participate within collaborations through gathering the required data from the companies, aggregation of the required data ("transparency levels") and establishing required process structures in relation with the companies' internal processes.
- Clarification of the connection between the operating processes of the companies and the required IT support through the illustration of additional operations such as data input and their uses, organisation-overlapping, working procedures to apply systems, requirements of the operating process described as the requirements of the system implementation. The systems must not only assure the interoperability between the companies but also effectively support the operating processes.
- Model based coordination, composition and synchronisation of organisation structures and business processes between the companies, especially identification of the aspects which support or, what is even more important, inhibit interoperability. This is achieved through clarification of security and thrust aspects between the organisations, clarification and visualisation of thrust aspects connected with the IT systems (the system supplies wrong information, crashes, interferes with the operating process, etc.), visualisation of data quality issues (e.g. data input is too slow or missing because it is not clear or there was no training). Thus, this includes the analysis of non-functional aspects of the IT systems.

2.3. Applications

The SPIDER-WIN [3] approach includes three field studies in different European regions, providing the potentially available data as well as the related quantified effort and economical benefits. Enterprise modelling is used to efficiently grasp the information from small companies, which are, informally organised and maintain extremely fuzzy data, only. The partners are Fraunhofer IPK, Fibertecnic, PM, Joinet, IMIK, CIAP, Ducati, PZL, SISTEPLANT and Bentivogli.

The requirement of synchronisation of enterprise models arises because of the need to have models from different companies in different nations modelled by different persons. Moreover, these different models have to fit in a general overall model for analysing the communication and control flow (order, prediction, etc.) between the companies to support their interoperability.

The main target of the modelling approach within the project is to have transparency of the external communications to customers and suppliers and their influence to the internal processes especially to the control processes of planning, the production (management) and services (e.g. engineering, construction) for each involved company and for the whole supply chain. The principle situation within the supply chain as well as some issues which are under consideration are illustrated in Fig. 4.

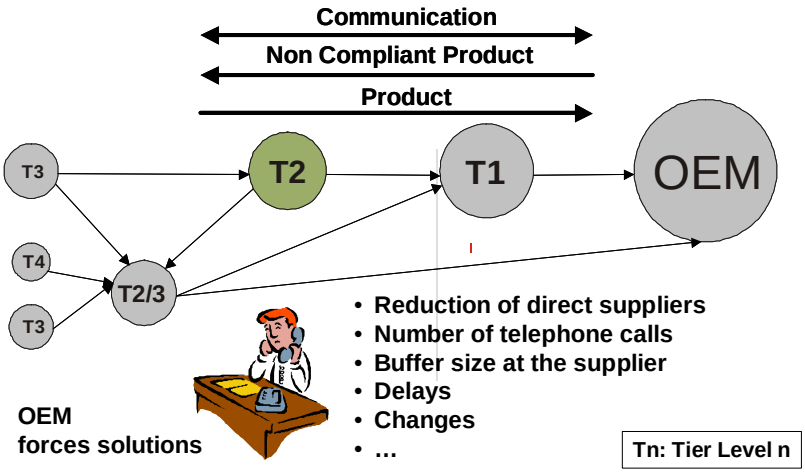

Fig. 4. Supply Chain Scenario

The modelling starts on the basis of SCOR [10] and reference structures available at IPK. Therefore, it was possible to select one unique modelling language for the whole approach. On the other side belonging to the situation of already existing models in heterogeneous modelling languages in the different enterprises, the problem would be much more complicated. This situation could arise, for example, if an enterprise participates in different supply chain networks. Here UEML would be helpful to harmonise the different languages. However, also the work on the different models needs concepts to achieve compliant model structures, which can be managed, combined and analysed. In SPIDER-WIN mechanisms like templates, semantics of terms, definition of interface objects as well as modelling procedures are introduced. The general concept was then applied in the Full Field Study. The major work has been done within tasks for each region, where the local coach previous skilled by IPK is fully responsible. IPK supported the other partners, and regularly monitored the development of models, in order to ensure a common model world and to avoid that any section of the field studies runs into a dead end road for whatever reason.

The different process models, for each single enterprise from the full field study, are combined based on their interface descriptions to an overall supply chain model (Fig. 4). The different supply chain models from the three different regions are used to derive a general model for the implantation of a order transfer and tracking service within supply chains.

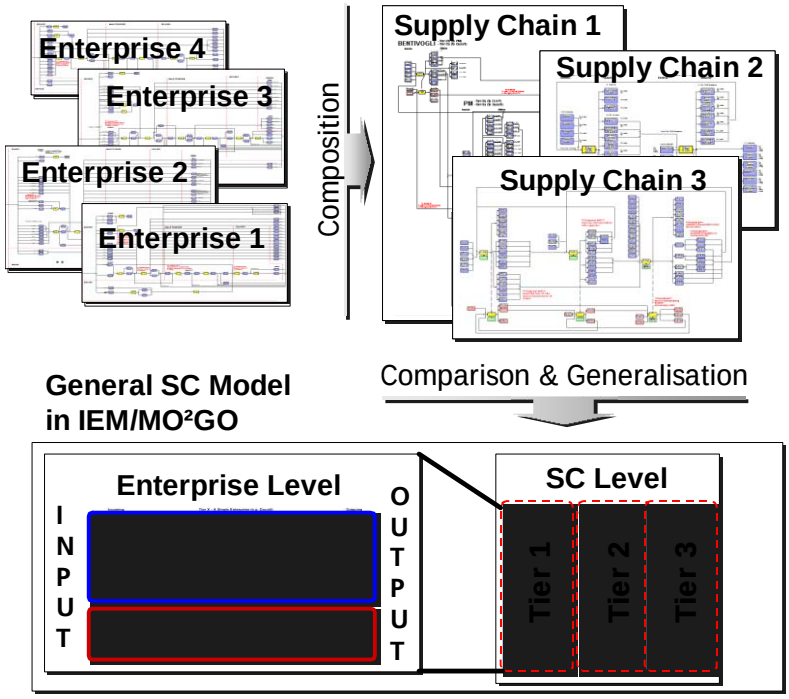

Fig. 5. Modelling between companies and supply chains

The approach above illustrates one usage of enterprise modelling within and between companies to support a better interoperability. Other applications at IPK are such as model based benchmarking between organisations, virtual enterprise building and prearrangement of certifications. An example is the TS16949 certification preparation with the following strengths:

- Fast implementation – less than 5 month from start
- Sustainable – after 2 years implementation the system is running and up to date with less efforts
- The system is used for implementing ISO TS 16949 as well ISO 14000 in subsidiaries in only one month
- The model is used for supporting several enterprise developments – e.g. improve the entire outbound logistic
- All employees are involved and supported by having their role oriented view of the company.

1. CONCLUSION

The reflections above illustrate the need of enterprise modelling to achieve and support interoperability between organisations. The INTEROP approach of the synchronisation and management of distributed enterprise models focuses on the organisational aspects of such models e.g. the common understanding regarding modelling structures or terms given to modelling elements to express the model content [11]. The INTEROP pilots [12] illustrate the advantage, needs and requirements for enterprise modelling regarding interoperability as well. Most of the pilots started with a modelling phase introducing different tools and methodologies. It also illustrates that there is not any general procedure applied and the models depend on how the organisation provides the modelling activities. Moreover, the involvement of the enterprise stakeholders is different.

Under these circumstances one can imagine the problem of a company (e.g. a SME supplier) which has to participate into different co-operations and has to be compliant with the other enterprise models. First of all, the modelling language might be considered. The solution could be using the INTEROP unified enterprise modelling language (UEML) approach [11]. But afterwards the content of the model needs to be related to other models (structures, terms, etc.). Moreover, for achieving both compatibilities in the language and in the content (modelled information), the management of the decentralised models is required. What about changes within the model of the SME? Should they be reflected, directly, in all network models in which the SME participates? What are the results and implications of such changes? This leads to a set of research questions:

- How to manage enterprise models between companies in a simple way including maintenance of the models?
- How to support companies related to different networks which have to support different models?
- How to perform enterprise analysis, design and simulation based on enterprise models between companies?
- How to manage enterprise models on distributed locations within an enterprise network?
- How to manage different enterprise models (overlapping of information) within and between organisations?
- How to synchronise the IT business processes to the real working business (model) between enterprises?
- How to perform decentralised complex modelling approaches in the future?

Organizations develop models using different languages and different background knowledge. In order to achieve enterprise interoperability, it is necessary that these models will be interchangeable and comprehensible for people involved in the organization processes. The possibility of different companies to cooperate generates the necessity for models to be connected in a dynamic way. Changes in one of the models of an enterprise can affect processes, decisions and important aspects on the side of other partners. Therefore, synchronization is necessary among models from different enterprises in order to deal with changes, evolution and different views. This is a critical aspect (when models represent enterprise processes, information, organizational structures, products or decisions) for those who are closely connected to the same supply chain or to extended or virtual enterprises. Requirements have to be defined and methods have to be developed in order to support synchronisation.

4. ACKNOWLEDGEMENTS

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