Multi-layered Enterprise Modelling and Its Challenges in Business and IT Alignment

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Abstract: In this article we have presented different challenges that need to be handled during enterprise modelling if we want to achieve business and IT alignment. The over all research question in the paper is: *What are the challenges within and between the levels in a multi-layered model for business and IT alignment?* In relation to this research question we have addressed what consequences these challenges will have on our view on and use of enterprise models as a mean to achieve business and IT alignment. The aim with the paper is also to give guidance about how to deal with these challenges. Our recommendations for how to deal with these challenges are summarised in five conclusions about, 1) the use and support from ontologies, 2) change as driving force during modelling (AS-IS – TO-BE). 3) the dependencies within and between layers must be clarified, 4) create balance between degree of formalism, degree of details, and degree of accuracy, and 5) guidelines and best practices about how to deal with these types challenges during enterprise modelling to create business and IT alignment.

1 INTRODUCTION

A *model* is usually an abstraction and a representation of a phenomenon for a certain purpose (Matthews, 2007) and modelling is the activity of creating and manifesting the model as a tangible artefact. Models are used for different purposes and in the context of this paper we focus on models and modelling as a mean to deal with the gap between organizational context and technology. We are therefore concerned with how to deal with different challenges related to models and business and IT alignment. Based on this we have identified the following challenges:

- How to deal with different abstraction levels of an enterprise?
- How to deal with the transformation from AS-IS to TO-BE models?
- How to deal with different aspects (focal areas) of an enterprise, both within and between different abstraction levels?
- How to deal with the degree of formalism on different abstraction levels?
- How to deal with degree of details on different abstraction levels?
- How to deal with degree of accuracy on different abstraction levels?
- How to deal with the mutual traceability between different abstraction levels?

2 CONCEPTUAL FOUNDATION

Enterprise models are to be regarded as tangible descriptions of patterns addressing different aspects and constructs of an enterprise where people are acting often supported by artefacts, within and between enterprises (Lundqvist et al., 2011).

To arrive at business aligned IS/IT solutions we need to understand and to be able to handle the complexity that exists in terms of different aspects or conceptual domains of an enterprise (Langefors, 1973); (Vernadat, 2002). Lankhorst (2005) exemplify these multiple enterprise aspects with five heterogeneous architectural domains (Information architecture, Process architecture, Product

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architecture, Application architecture and Technical architecture), which are related to each other and need to be integrated in the alignment process.

One way to deal with business and IT alignment in this context is through a three level framework (Seigerroth, 2011), which also has served as a foundation for this paper, see figure below.

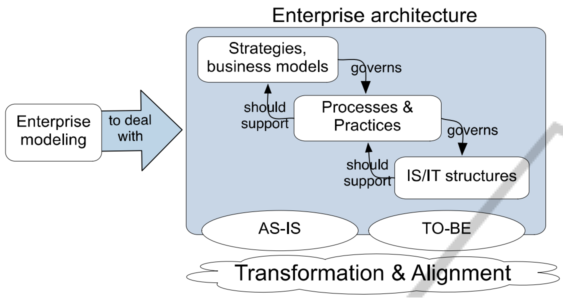

Figure 1: Levels in enterprise architecture (Seigerroth, 2011).

This conceptualization depicts conceptual areas that we need to deal with in the area of business and IT alignment. In this conceptualization enterprise architecture is divided into three levels: 1) strategies & business models, 2) processes & practices, and 3) IS/IT structures and how they are related to each other. Enterprise modelling is also depicted in the figure where enterprise models will serve as the prime tool for addressing business and IT alignment during transformation (AS-IS to TO-BE). This conceptualization conveys our belief in the power of enterprise modelling and enterprise models as artefacts for coherent descriptions, evaluation, and design of the three levels in Figure 1 above.

Ontological models is in this context used to solve heterogeneity problems of models and different enterprise elements. It provides the common semantics for interoperability, information reuse & sharing between disparate modelling methods, paradigms, languages and software tools (Uschold and Grüninger, 1996). Ontology engineering is based on an ontology hierarchy. Three levels of ontologies have been pointed out (e.g., Guarino, 1998).

The *top-level ontology* is the "shared ontology" for domain independent representation of the problem set. This type of ontology is needed to describe an abstract model using common knowledge model representation. Such ontologies describe very general concepts like time, matter, object, action, etc., which are independent of a particular problem or domain.

Domain ontologies and task ontologies describe vocabularies related to a generic domain (like production, or automobiles) by specializing the terms introduced in the top-level ontology.

Task Ontologies are oriented to solving specific problems and consist of ontologies of tasks and methods. A task ontology includes all the concepts necessary to describe the inferential process, from the very abstract concepts related to the inference scheme to more specialized concepts specific for single methods.

Application Ontologies describe concepts depending both on a particular domain and task, which are often specializations of *both* related ontologies. The purposes of an application ontology is (1) remove the gap between domain ontologies and task ontologies joining them into one application ontology; (2) enable domain experts to use the language which is applied in application they work with, and which may differ from the language used in the domain and task ontologies.

3 DISCUSSION: CONSEQUENCES ON ENTERPRISE MODELLING AND ENTERPRISE MODELS

Degree of Formalism has to do with how formal the notation rules for a certain type of model are. There exist modelling notations that span from very formal machine interpretable languages to very informal rich pictures.

Selecting formalism has profound consequences as it defines the expressivity and thus sets boundaries to what can, and what cannot be expressed in the model. The difficult question to answer before starting the modelling is: what will be left behind as a result of the decision regarding the formalism to model in, and whether it will be vital for the task or not. This question essentially can't be answered for a given case (as one has only vague idea of what is to be modelled before engaging into the exercise), it can only be answered based on previous modelling experiences.

Degree of Detail is about deciding how many things we put into a model at different layers of enterprise modelling in order to describe a certain situation.

There is a certain tension between the formality, and the number of details of the model required by IT perspective, and the usefulness of the model to the business perspective. On the other hand the great number of details (often technical ones) does not concern modellers at the business level.

Unfortunately, the details have to be added somehow anyway during the transformation of design models into the real IT system. There are two problems connected with that - the process of adding the details is often unspecified, and second, the modelling tools are not designed to support this. It is usually unclear who adds the necessary details. Formalisms in models are most of the time inflexible - it is often not possible to model in a given formalism with “less” detail and “more” detail, or if it is possible, then essentially separate models have to be created without explicit connection between them. For example it is possible to model a business process in a general way (just specify a single chain of tasks to be performed in the organization) or in a detailed way (specifying conversations or message exchange protocols between process participants as well as message exchange formats and semantics), but there is little connection between the general and detailed models of the same process. Consequently it is usually impossible to abstract from details in a systematic way and see a simplified model.

Accuracy of the View is a challenge of selecting the right point of view when modelling.

Multi aspect representations stems from the inherent characteristic of different focal areas. First it is hard to keep the multi aspects in sync. Models evolve over time and maintaining multi aspect models is even harder than maintaining a single view one. Second, it seems, that when implementing an IT solution it is hard to sustain all the aspects and specific views on the modelled objects or situations that has to be selected. This problem result in information systems that usually adopt one view (or approach, or method), which from the business point of view makes them less flexible, constrained and eventually may lead to the need to change the system. If we accept this, then the question is how to make educated decisions on which view would suit best the goals set for an enterprise, the processes that should be supported or the strategy to be implemented. There is a deficiency in many models and modelling approaches, because they don't give straightforward answers to what will be the impact on other parts of the model if we select certain approach or view on some distant part of the model.

Change and Model Dependencies refer to the fact that modelling usually is done in a constantly changing environment.

Regarding the dynamic aspect of modelling - the transition from AS-IS to TO-BE, the need for transition may arise in two ways. Either the business drives the need for change in the IT/IS layer, or that the technology drives the change - which gives new opportunities or creates certain restrictions for the processes that are supported by IT solutions. Assuming that we use modelling as approach to the problem, and all the layers have their respective models, the model of TO-BE differs from the model of AS-IS. It is usually not a problem to identify the differences in the models of a single layer. The question is how the differences should propagate to other layers. It is not entirely sure at this stage whether such clues can be delivered automatically. But the even modest support for noting these changes and the consequences of changes (how did change in the model X influenced the change in the model Y) would be certainly beneficial to make sense of the whole business / IT infrastructure evolution process. Currently no tools or other instrumental support exist to record this evolution even in a single layer, therefore the challenge is even greater for the multi-layered enterprise modelling.

4 CONCLUSIONS AND OUTLOOK FOR THE FUTURE

The discussion of challenges and their consequences to enterprise modelling leads to several conclusions on how to deal with the challenges or what is still necessary in enterprise modelling in order for it to be able to ensure a better business and IT alignment.

It seems that ontologies applied at and between different levels of enterprise modelling, despite their inherent problems, would allow to build connections between these levels and aid in creating coherent multilevel models spanning across different focal areas. The challenge in this will be to create a working relations between the four types of ontologies that has been presented in this article, top-level ontology, domain ontology, task ontology, and application ontology.

Secondly, current modelling approaches lack the notion of model evolution or change, in the sense that they do not adopt the change as the main driving force in modelling. As indicated previously, modelling transition from AS-IS to TO-BE might be the key to show the mutual influences between the business and IT layers of the enterprise. Currently, there is little correspondence between the different subsequent versions of the model of a given focal area, except from the obvious one (e.g. “this object is the same as in the previous version of the model”). Since there is no explicit notion of change and linkage between subsequent model versions, there is no way to specify why certain changes were introduced, and what might be their consequences on the other parts of the model.

The third conclusion is that changes in the model on one layer might influence other layers (e.g. a change in the business layer might influence necessary technological transitions in the IT layer). If multilayer, ontologized models are available, and there is a way to explicitly model changes and their influence on different model parts, it would be possible also to model the influences of changes on different layers of the model. The dependencies between the layers are the key to aligning the business with IT and giving them the dynamic aspect might contribute to better understanding of the whole enterprise and its evolution over time.

The fourth conclusion is that there is a need to strike a balance between degree of formalism, degree of details, and accuracy of the view in different enterprise models on different levels. In many cases these dimensions will be determined based on situated criteria's and therefore it will be important to be able to capture such criteria's and to translate them into the actual models.

A fifth conclusion is that based on the four conclusions above there is a need for more developed guidelines and best practices about how to deal with these types challenges during enterprise modelling to create business and IT alignment.

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