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A new paradigm for the continuous alignment of business and IT: Combining enterprise architecture modelling and enterprise ontology

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ABSTRACT

The paper deals with Next Generation Enterprise Information Systems in the context of Enterprise Engineering. The continuous alignment of business and IT in a rapidly changing environment is a grand challenge for today's enterprises. The ability to react timeously to continuous and unexpected change is called agility and is an essential quality of the modern enterprise. Being agile has consequences for the engineering of enterprises and enterprise information systems. In this paper a new paradigm for next generation enterprise information systems is proposed, which shifts the development approach of model-driven engineering to continuous alignment of business and IT for the agile enterprise. It is based on a metamodelling approach, which supports both human-interpretable graphical enterprise architecture and machine-interpretable enterprise ontologies. Furthermore, next generation enterprise information systems are described, which embed modelling tools and algorithms for model analysis.

1. Introduction

The paper deals with Next Generation Enterprise Information Systems in the context of Enterprise Engineering (EE). Giachetti [1] defines Enterprise Engineering as "the body of knowledge principles and practices to design an enterprise" where an enterprise is a "complex socio-technical system that comprises interdependent resources of people, information, and technology that must interact with each other and their environment in support of a common mission".

The ability of keeping up with continuous and unexpected change is an essential quality of modern enterprises and will become a necessity for existence. Dove [2] calls this characteristic *agility* and defines it as "the ability of an organization to thrive in a continuously changing, unpredictable business environment." The concept of the agile enterprise emerged in the early 1990s [3]. An agile enterprise rapidly adapts to changing business challenges and opportunities and it continuously improves to optimize costs, quality and speed of delivery. It enables top management to quickly implement new strategies and control key business parameters to gain a competitive advantage [4], which means that enterprise engineering is an ongoing activity. An enterprise is not designed just once, but an enterprise is, to varying degrees, redesigned many times [1]. Implemented business processes and information systems have to be continuously adapted. As changes may be triggered from the business as well as from developments in the technology, a *continuous alignment of business and IT* is needed.

The pace of change is continuously accelerating and managing the change is increasingly beyond the control of companies. The rate of technological progress increased throughout history. For example, in the car industry new models are developed within few months instead of years. In the banking industry, the time to market for new financial products is a few weeks instead of months [5]. Each new product or service requires new or adapted processes and information systems to produce the products and to deliver the services. Reduced time to market increases the demand for

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changes of business processes and information systems. Considering the multiyear nature of many enterprise engineering initiatives, the architecture at the start of a development might not be appropriate anymore when the new business processes and information systems are rolled out.

The grand challenge for today's enterprises, which is deal with in this research, is the *continuous alignment of business and IT in a rapidly changing environment.* According to Gartner [6] enterprises are facing a new era of enterprise IT, the 'digitalization' era, "a period characterized by deep innovation beyond process optimization, exploitation of a broader universe of digital technology and information, more-integrated business and IT innovation, and a need for much faster and more agile capability".

In order to deal with this grand challenge an approach is proposed, which uses model-based engineering as visualized in Fig. 1.1. The approach builds on the principles of model-driven enterprise engineering [7] and is supplemented with two innovative and challenging developments:

- Shift the paradigm of model-driven engineering from *development* to *continuous adaptation*. In contrast to software development it is unusual for enterprise engineering to follow a greenfield approach and start from scratch. Instead, typically a 'running' enterprise is adapted. The challenge is to react on change in the business (e.g. due to an altered business strategy) and IT (e.g. due to innovative technology) alike and to continuously keep business and IT aligned. Models are used for designing and adapting enterprises and enterprise information systems before they are changed in reality.
- Support machine interpretable and human interpretable models: McCauley [8] defines an agile organization as "one that can sense opportunity or threat, prioritize its potential responses and act efficiently and effectively". In order to support in sensing, prioritizing and acting, the models should not only be passive storage of knowledge intended for human use but model processing in this context also demands automated operations on models that retrieve and interpret information for decision making. The focusing on machine interpretable knowledge is called knowledge engineering (KE) [9] and is distinguished from knowledge management (KM), which is focusing on human interpretable knowledge. The challenge is to keep both representations consistent.

To meet these challenges a metamodel approach for next generation information systems is proposed, which builds on the knowledge engineering for business process management presented in [9]. These are the main characteristic of the approach:

- Graphical notations are provided, which can easily be understood by humans.
- Semantic lifting makes the semantics of metamodels explicit [10,11] such that the analysis, adaptation and evaluation of models can be done by a machine. The semantics of the metamodel is specified by an ontology.

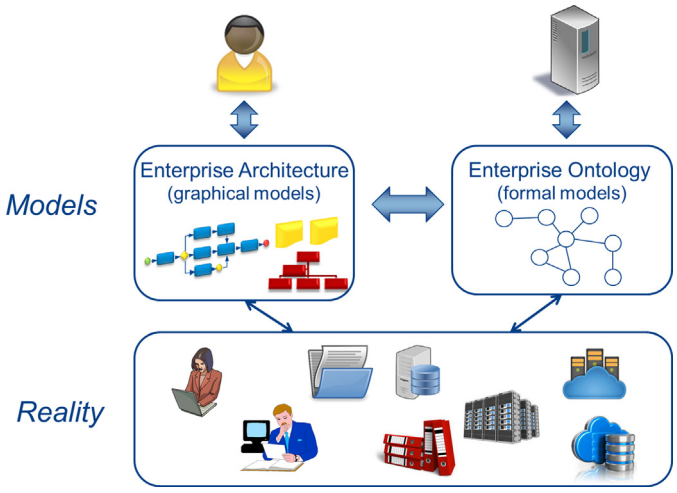

Fig. 1.1. The modelling approach for continuous business-IT alignment.

The next section provides some background information as well as more detail on metamodelling. Solutions, which are already available to realize the proposed approach for the next generation enterprise information systems, are discussed. Challenges that still need to be solved in order to fully realize this approach are highlighted. In Section 3 elements of modelling methods are explained. Then in Section 4 the modelling method for continuous business-IT alignment is presented. Finally in Section 5 the contribution is summarized and an outlook on future work is given.

2. Background

In this section background information in relevant topics for continuous alignment of business and IT is provided. First different types of agility are discussed followed by an explanation of business–IT alignment in the context of an agile enterprise. Lastly background on enterprise modelling is provided and showing how it supports the alignment of business and IT.

2.1. Enterprise agility

Cummins [4] divides agility into four dimensions: dynamism, adaptability, flexibility and awareness.

- *Dynamism* is defined as the ability to change the process definition of an enterprise. The need to change a process definition may result from process improvements to process innovation or process reengineering.
- *Adaptability* is the ability of an enterprise to react to exceptional circumstances or unexpected events during the performance of a process instance, which may or may not be foreseen.
- *Flexibility* is the ability to deal with a fair degree of uncertainty.
- *Awareness* is the ability to detect opportunities and risks.

Reichert and Weber [12] also distinguish between four types of agility[1] needs in Process Aware Information Systems (PAIS) namely variability, looseness, evolution and adaptation. *Evolution* represents the ability of the process implementations to change. Since business processes can evolve over time, it is not sufficient to implement them once and then to never touch the PAIS again. Evolution is equivalent to the dynamism in [4] and in this paper the focus is on evolution/dynamism as well as awareness.

2.2. Complexity and change

In order to identify the need for changes, an organization has to continuously monitor itself and be prepared to react quickly to threads and opportunities. However, the challenge to react quickly is increased by the complexity of today's IT. According to Dietz [13] the most dominant problem identified in scientific as well as in popular science on enterprise management, is complexity and how it can be managed. He claims that because of the complexity of

[1] Reichert and Weber call it "flexibility" but here the term "agility" is used in order to be consistent in naming.