Domain Oriented Meta-Modelling for change Management of Information System

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Abstract : This paper presents the first results of a research-partnership between Ecole Nationale Supérieure des Mines de St Etienne (G2I) and St-Microelectronics (Rousset - France). We explain the results of a first stage of research works which aim at developing a method for the management of the evolution of information systems. Our current contribution consists in a domain-oriented enterprise modelling approach. We justify the structure of the meta-model proposed and we show its links with evolution management

1 Introduction

The research works presented below focus on the evolution management of the Information System (IS) applied to a specific industrial field (the microelectronics industry). This research is a partnership (including the PhD of J.Chapron) between the Ecole des Mines de Saint Etienne (G2I department) and the Architecture and Strategy Team of ST-Microelectronics on the site of Rousset (France). The final aim is to define a methodology and tools for the management of the evolution of the information system, with the following requirements :

- Transparency of the information system : the ability to provide a global, coherent and useful model of the information system;
- Models of change process: Characterization of evolution situations, risk and impact analysis, formalization of the change process;
- Decision aid tools to master reactivity facing situations of evolution, and taking into account the specificities of the microelectronics field.

In the last 20 years, research on enterprise modelling has produced several descriptive methods aiming at providing a methodological and operational support for the design, the analysis and the reengineering of industrial firms : methodologies such as PERA [10], CIMOSA [1], GRAI [6], are based on distinct meta-models formalizing the information required for their specific enterprise models [7]. In order

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to integrate these approaches using their specificities in the best possible way (for instance a focus on life cycle for PERA or on decision system for GRAI), GERAM [7] intends to provide a global integrative framework on enterprise modelling. Research on GERAM is linked to normalization works which lead in Europe to standards like (ISO 14 258, ENV 40 003). After different European normative advances [3], UEML language [8] is the last normalization work intending to develop a unified language to support exchanges between currently existing modelling tools.

In spite of all these results, lack in enterprise modelling is still to be underlined concerning the management of the evolution of organisational structures and of their information systems. To fulfil such deficiency, Information System Urbanism [5] appears as an innovative industrial approach within the information system field. It provides the necessary structuring and basic concepts to build a real method for change management for information systems. Urbanism aims at transforming the information system to enable it to anticipate and to adapt to different kinds of changes within the firm (strategic, organizational, legal…). The approach requires an urbanistic program on the information system, including (i) the targeted information system, (ii) urbanistic rules insuring large possibilities of evolution for the new system, and (iii) the roadmap to reach the target system. A global methodology is already available, due to industrial experiences. However much scientific work remains to be done, in order to clearly formalize the concepts and methods, before being able to build up better scientific tools aiming at the management of information systems evolution.

This paper focuses on a first contribution to integrate the urbanism concepts into existing methodologies for enterprise modelling. In section 2, we develop a meta-model used to map the information system, taking into account the requirements for evolution management and linked with urbanism principles. The section 3 presents an application of this meta-model to the microelectronics industry.

2 Meta-model Proposal

The meta-model we elaborated puts forth two major partitions of modelling concepts. First we justify a partition between models of processes and the models of organisational environments : in an evolution perspective these two domains don't change with similar constraints and characteristics (§2.1). Thus, we specify the interface between processes and organisational environments, with generic concepts, independent for the operational constraints of the firm (§2.2). Secondly we explain a partition between an information-technology oriented modelling and a domain-oriented modelling (§2.3). This partition is namely justified by urbanism principles.

2.1 The Need to Separate Processes and Organizational Environment

Referring to CIMOSA [1] or more recently GERAM [7], we propose a conceptual partition between functional modelling (focused on processes models), and organizational modelling. Figure 1 highlights partition by a "business processes" modelling view and by an "organizational environment" modelling view. Each view

gathers various models, each of them gathering modelling objects. Here, we do not put all the modelling objects into detail.

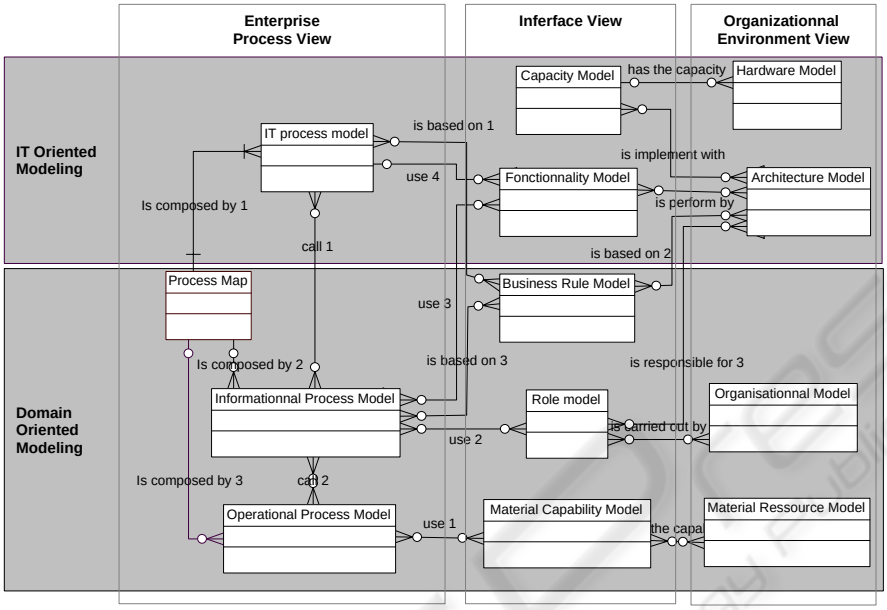

Fig. 1. Meta-model of our approach

The “business processes” view describes all the functional aspects linked with the processes, using different granularity levels. The central element of the view is the informational process used to represent management and control processes requiring informational and decisional activities (partially automated). The “organizational environment” view gathers the various models which represent part of the environment of the process. There are bi-directional interactions between the processes and their environment, the former including material resources, actors, IT resources (hardware, software, data, documents, …).

This conceptual partition will later be used for evolution management : it is important to clearly distinguish between changes in the processes themselves and changes in their organizational environment. For instance, a change among the firm’s employees, in the data base structures or even in the software can be introduced without any transformation of the process (i.e. its structure and model) in itself. Thus, this partition between processes and environment leads to a classification of evolution situations, but also to a better impacts analysis.

2.2 Interface View

We have just explained that the two previous views are built of several models. These models are dependent on each other, and one of the aims of the enterprise modelling approach is to manage these dependency links. The third “interface” view aims at

formalizing the inter-dependencies between models of the first two views. These inter-dependencies are formalized in a generic way, which means that they remain valid for various versions of the organizational environment.

Thus, the « interface » view will specify the requirements of the business processes as regards the organizational environment. For instance a “functionality model” will specify the dependency link between an information process model and an IT architecture model. The “functionality” model is a generic specification of IT tools meeting the requirements of the informational process. It remains independent from the existing IT architecture.

2.3 Partition between Domain-oriented Modelling and IT Oriented Modelling

Figure 1, shows a second conceptual partition between a “domain-oriented” modelling and an “information-technology” oriented modelling. These two modelling layers concern the three views presented above.

In order to manage the evolution of processes at ST Microelectronics, the partition between these modelling layers will allow the management of a progressive rationalization, aiming at transforming classical enterprise processes into computer supported processes. Indeed, the Microelectronics field is a high-technological environment with a high level of automation which never stops improving. This induces a permanent optimization of the management and control tasks. In this perspective, the evolution management aims at realizing a progressive encapsulation of the enterprise processes, based on Information Technology. Thus, at the global scale of the firm, the partition between domain-oriented modelling and IT oriented modelling gives the possibility to measure IT deployment level among the processes and to identify critical zones within the firm from that point of view.

Furthermore, for methodological requirements, it is necessary to figure out the frontier between what we could call the “business” world and “information technology” world [4], as well as their correspondence links. Indeed, several methodologies aim at managing information system evolution using the principles of urbanism applied to IT systems [5]. These methodologies insist on the necessity to manage the consistence between these two “worlds” : the IT urbanization zones in the firm must be formally related to organizational zones.

3 Meta-model Implementation on the Microelectronic Domain

This study is based on the industrial needs of ST Microelectronics. Indeed, the microelectronics industry is characterized by fast and dramatic evolutions of products and processes. In this section, we illustrate our approach with an existing operational process named “control card management” from STM. The control cards are used to test the electrical functionality of silicon wafers (on which the integrated circuits are produced). These cards test the validity of the chip and represent an essential step in the production process.

In fig. 2, we show a part of the application of the meta-model to the “control card management” process. It was developed using Adonis, a tool developed by BOC

GmbH. Adonis offers the possibility of changing its meta-model. This process occurs in a complex environment (simplified in fig. 2) and it is characterized by its interactions with (i) other processes and sub-processes (these interactions are modelled in the process map), (ii) actors and organizational structure (depicted in fig.2 by the models “Organization” and “role”) and (iii) the information technology architecture and infrastructure (shown in fig.2 by the models “Function” and “IT system”).

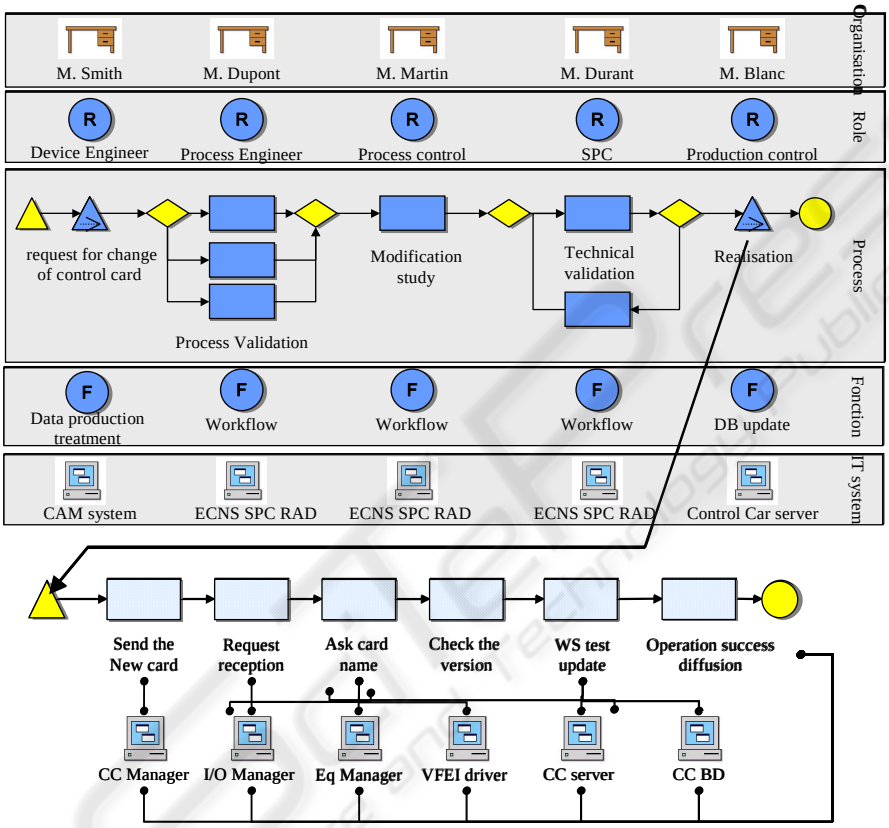

Fig. 2. Example: part of the process “Control Card Management”

This process provides an example of a situation of evolution. Indeed, at the information system level, a study of the process has shown the importance of implementing a workflow system to support the process which was previously manual. A change like the implementation of a workflow will have impact on other areas such as the database by trying to access data not yet available and interact with other existing application. By modelling the IT infrastructure and architecture we will be able to manage the evolution of this system and control any eventual perturbations.

The complete meta-model is currently being implemented by ST Microelectronics in a pilot project. Of course it will with other types of changes: at a basic level, an evolution may occur in the architecture of the database or in the structure of the data.

The model allows us to analyze the quantitative and qualitative impacts of such a change on all the processes. At the organizational level, internal restructuring are quite frequent. The organizational models linked with the process models allows a better management of the correspondence between the actors and the process.

4 Conclusion And Perspective

This paper focuses on how we can take into account the evolution perspective within enterprise modelling. The first results discussed above, show a meta-model intended to fulfill our requirements. The structure of this meta-model constitutes a first step towards evolution management. However, as far as enterprise modelling is concerned, additional modelling concepts are still to be formalized in the future, like evolution events, process transformation, evolution scenario, or evolution processes…. Such concepts will certainly be necessary to fulfill our goals [2].

Furthermore, such a meta-model provides only the first step towards evolution management. The structure of the meta-model and the associated methodology are the starting point that are used in order to develop further a decision aid approach for IS evolution management. In this perspective, the meta model is currently used on a pilot project in order to generate a chart of the enterprise (with all the necessary models) focused on a limited pool of the firm's processes. This data will be used to develop two types of evolution management tools : (i) tools to define consistent processes pools to be jointly managed within change scenarii ; (ii) tools to diagnose the impacts and risks related to a selective change situation.

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