A Combined Approach for Maintaining the Scalability of Information System

Yemna Sayeb, Sihem chabchoub, Imene Hamdoun and Henda Ben Ghazela

Research laboratory RIADI-GDL, Manouba, Tunisia

Abstract. The urbanization of information systems is a new discipline that is still young consequence of the ever-changing of information's technologies and the rapid development of information systems. It certainly comes to maturity, but limits remain. Currently, companies are facing new problems related to the complexity of their information systems. This complexity may be related to human resources, process methodology or technology. In this communication, we propose a method of urbanization of information systems based on a mapping between the model of urbanization and the approach adopted for the model driven architecture in order to maintain the scalability of the SI and the coherence between its various subsystems.

Keywords: Information system, urbanization, scalability, strategic alignment, mapping, MDA, models.

1. Introduction

The continuous market changes, the increasing competitiveness and the technology evolution, require companies to transform themselves to deal with these challenges and new realities. An information system can be defined as an organization comprising a group of actors sharing information and having goals and rules which determine its informational function [1]. The scalability of an information system can be defined as the ability to handle growing amounts of applications in a graceful manner or the ability to be enlarged to accommodate that growth. In order to control the scalability of its information system, reduce its complexity and increase the degree of its adequacy with the business strategy, the company is pushed to adopt solutions which aim to ensure that its information system responds well, today and tomorrow, to the expectations of internal and external stakeholders: users, customers, sponsors, designers and technicians. There is no doubt that information system supports decision making, coordination, control and may also help managers and workers analyze problems, visualize complex subjects, and create new products [2] [3]. But, experiences have shown the lack of integration of different views of an Information System, the lack of methodological processes to guide the process, the lack of formal definition and the lack of dynamics. The MDE (Model Driven Engineering), by nature, handles much formalism that belongs to various technological spaces at various levels of abstraction [6] and provides better control of changes by reducing the distance between the logical and technical aspects. MDA (Model Driven Architecture) is a particular variant of the MDE whose major objective is the development of independent models of technical details and the automatic generation of specific models for the development and maintenance of software-intensive systems. In fact, the main feature of the MDA approach is the ability to switch from one model to another. The question of using this type of engineering, specifically the MDA (Model Driven Architecture) approach, as a solution for our problem of urbanization of information system seems legitimate.

In this paper, we try to propose a new approach combining the urbanization of information system and the MDA approach to help companies to grow and evolve serenely. We will begin by a recall of the foundations and concepts of urbanization process and relate it to its general framework which is the

enterprise architecture (EA), based on a literature review. And finally, we will expose and explain our combined approach for urban development project.

2. Enterprise Architecture and Urbanization of Information System

In this section, we will try to present and define the urbanization of information system in its frame.

A commonly used definition of architecture in the IT world is the one of the IEEE standard 1471-2000: "Architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principle guiding its design and evolution". The term "Enterprise Architecture" has been defined by (Zachman, 2005) as "the set of primitive, descriptive artifacts that constitute the knowledge infrastructure of the company"[11] [12]. Another definition is proposed by Infocitizen "an EA is a structured knowledge that includes the analysis and description of business, design and development of project engineering and operation of the company"[13]. Enterprise architecture is then a conceptual model that defines the structure and functioning of an organization. The enterprise architecture allows companies to model their business, their organization, processes, and urbanize their information systems. It formalizes the company and controls their evolutions better by managing their risks, establishing an urban development plan and optimizing the existing. The enterprise architecture treats the same issues as the urbanization of information system. It deals extensively with all issues related to engineering projects and exceeding the scope of conventional approaches related to information system. Thus, planners of the information system and enterprise architects are facing the same issues and share similar approaches which are intended to be mutually enriching. To deal with EA, the urbanization of information system uses the metaphor of the planning cities. In fact, "Zachman" considered that the urbanization of information system exploits the idea that multiple perspectives are needed for modeling in order to produce a rich picture of the company and its IS [14]. Based on an analogy with the concepts of urban development, urbanization of information system is used to describe all fields of activities within an organization and improve performance, agility and flexibility of business by minimizing duplication and enhancing modularity. On the one hand, this approach consists on studying and understanding the different functional areas of the company in order to realize the mapping of the existing system and on the other hand designing the architecture of the target system and defining the rules for its alignment with company's priorities[15]. The strategic alignment of information systems is a key factor in any project of urbanization. It consists on making coherence between the strategies of the information system and the business strategies then planning a multi-year perspective [16].

3. Our combined approach: MDA in the service of the IS Urbanization

3.1. Urbanization Model Still Insufficient

Urbanization has become a critical concern for enterprises wishing to restore agility to their information systems. The process of urbanization consists in studying and understanding the different functional areas of the company, realizing the mapping of the existing system, designing the architecture of target system and defining the alignment's rules.

The meta-modeling allows the modeling of concepts describing the views associated to the urban project and their relationship. Thus, the urban model becomes a functional tool which aims to improve the business and the effectiveness of the information system. It is built around four views, or visions, which represent additional levels of theoretical design of an information system. The business view indicates the "Why?" of the development, the functional view specifies the "What", the applicative view explains the "How?" and the technical view describes the "With what?" [17].

- The business view: models the strategic objectives of the company as business process. Also, it lists the external and internal stimuli of the company, the manner with which these stimuli are processed, the documents used in the process and finally involve actors in the process. So it focuses on the analysis of business processes and describes the essential business processes of the organization.

- The functional view: is a conceptual view that handles the processing of information necessary in business by identifying features that should be supported by the information system. So in this level, we consider the sets and areas to group related functions by functional blocks.
- The applicative view: performs a unique and comprehensive inventory of all applications (software programs, databases, etc) in order to automate some functions defined in the functional view.
- The technical view: includes both information technology (platforms for implementation, languages, standards, etc) and computer components (networks, servers, etc).

Thus, the pattern of urbanization can specify different levels of abstraction, helping to manage the complexity of the information system, but it neglects the relationship between these levels. Furthermore there is no method of urbanization which describes the entire process, each company sets its own methodology of urbanization according to the context and the objectives of such a project. In some methodological frameworks, all levels of concern are not covered. Some other methods are fairly well done on the definition of processes and its alignment with the strategy and on the organization of the joint MOA / MOE but offer few elements of framing for the transition to the functional architecture and ignore technical levels of concern (technical and application architectures) [18]. The realization of an urban project is based on new technologies which are often unstable, immature and pose problems for performance and durability. An urbanization project defines a plan to monitor and governance rules to be respected but some plans are not feasible from a technical point of view and do not ensure traceability between the strategic and technical levels so that all decisions be guided by strategic intent. Hence the need for an urban development that takes into account the different levels, of concern and provides traceability between strategic objectives and different levels of information system.

3.2. MDA

It is an approach proposed by the OMG (Object Management Group) in November 2000 for development and maintenance of software-intensive systems. This is a particular variant of the Model Driven Engineering based on UML standard, whose major objective is the development of independent models of technical details of the execution platform and the automatic generation of specific models. The three main goals of MDA are portability, interoperability and reusability (...).
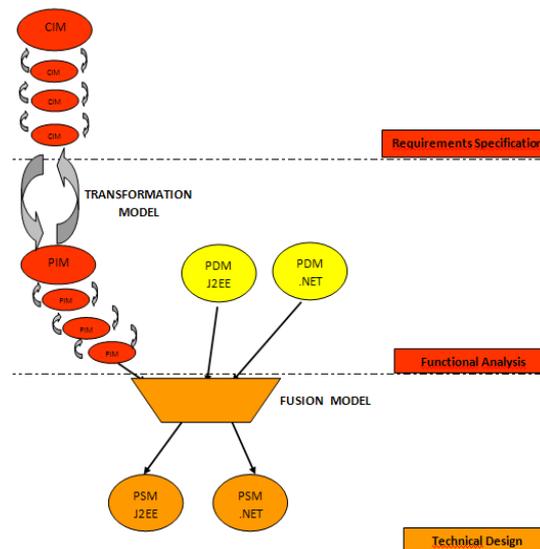

Fig. 1: The model of Information System Urbanization.

Unlike to the process of software development focused on the traditional code, MDA considers no longer the executable code as reference. It offers a succession of models ranging from analysis to deployment. We begin the development cycle of MDA, as shown in figure 1, by a CIM (Computation Independent Model) which represents the result of the analysis phase and which contains the functional requirements of the system to be developed. To the CIM, we add some necessary information in order to obtain the PIM (Platform Independent Model). Then PIM is transformed into PSM (Platform Specific Model) by projection

on the target technical architecture which is the PDM (Platform Description Model). The transformation of the PIM to PSM in the MDA approach is the passage of the overall system design to detailed design. Finally, from a PSM we can generate source code to deploy.

3.3. Our Combined Approach

We propose an approach which implements the MDA architecture as a support for urban project in order to ensure the scalability of the information system. This approach uses the paradigm of mapping between urbanization model and the MDA process to guarantee the interoperability of models within the information system, taking into account different levels of concern and the traceability between them. MDA is based on the separation the business logic from source code. It allows the structuring of the migration process and facilitates the change in infrastructure while capitalizing on the work of analysis and design. Being at the heart of MDA, the model can simulate physical systems by providing a simple way to list information system elements and their relationships [8]. So even if the models are at different levels of abstraction, it is possible to express the refinement relations between them. Real traceability links and relationships ensure the coherence of a set of models involved in a single application [8]. MDA uses recognized, open and tested standard. The use of these standards ensures different benefits such as harmonization of the activities of urbanization and time saving. In addition, the standards provide a unified and unambiguous terminology which facilitates information exchange.
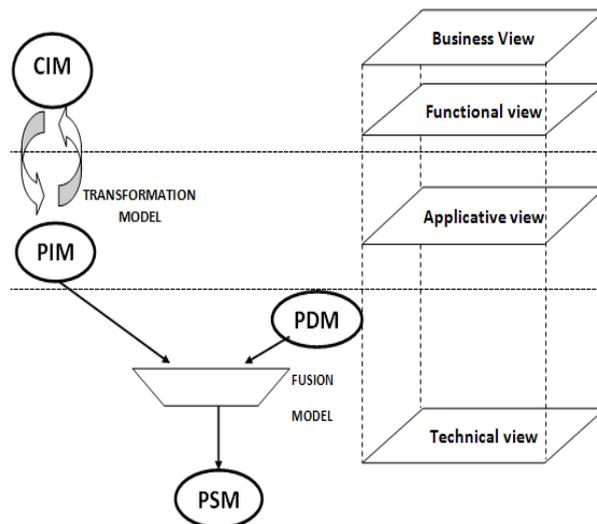

Fig. 2: Mapping between MDA approach and urbanization model.

- Mapping CIM-Business view/functional view: The CIM is independent of programming and represents the application in its environment. It contains the expression of needs and customer requirements as business process independent of any automation which will then allow defining links between analysis and design models. Thus, the planner determines processing needed for careers in business by identifying information and features that will be supported by the information system.
- Mapping PIM-Applicative view: The PIM is the detailed functional analysis and is independent of the technical architecture and the target language. It includes the business entities, business services, user interfaces, transactions, navigation and management rules. Concepts those are similar to those of the applicative view of an information system, which lists them as software packages, databases, etc... allowing automation some functions defined in the functional view. The passage of the applicative view of the information system to its technical one.
- Mapping PSM / PDM-Technical view: The PDM is specific to a technology and describes the various technical details supporting the passage of PIM to PSM. Thus, the PSM model is the engineering design obtained by transformation of the PIM. It is primarily used as a basis for the generation of executable code.

At this stage, we choose the computer components that enable better meet the needs of the urban development project and the platform implementation, standards development and programming language.

3.4. The Role of the Proposed Approach for Maintaining Scalability

Scalability is a characteristic that describes the capability to cope and perform under increased demands. As a property of an information system, scalability is the ability to enhance the system by adding new applications and functionalities. We consider a system to be scalable if there is a straightforward way to upgrade the system to handle an increase in interactions while maintaining a consistently acceptable level of performance. By straightforward we mean that no architectural changes are required to scale the system [19].

So, in the case of strategic, business, organization or technology change that requires the addition of several functionalities and integrating new technologies, scalability of the information system is ensured by the combination made in our approach between the urbanization model and the MDA approach. In fact, in the one hand, the urbanization approach allows the concentration of efforts on the development of new functions with a high added value and the reuse of the existing system for the most part. It is the key for safeguarding coherence and improving the efficiency of the information system. The concept of urbanization has developed gradually over le last ten years until it became illusory to replace one information system with another more recent system at one go[5]. In the other hand, techniques for model transformation are at the heart of the MDA and transformations can be manual, assisted or fully automated [7], allows the transformation of models of different levels of abstraction to study the impact of changes on different levels of design information system.

4. Conclusions

Every modification to an enterprise architecture introduces change to the underlying technical infrastructure, whether new hardware, software, or telecommunications platforms, or just parametric changes. Individual project managers may understand the impact of such changes on local platforms, but often do not understand the impact of changes on other platforms. Change induces stress in architecture.

That's why we have presented in this paper our approach based on combination between MDA architecture and urbanization of information systems. This approach takes into account the different levels of concern and provides traceability between strategic objectives and different levels of an IS based on a mapping between the model of urbanization and the process of MDA.

However, it is necessary to formalize this mapping to ensure consistency of semantic concepts modelled. This formalization is the subject of work not yet finalized.

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