

Extending Enterprise Architecture Modeling Languages: Application to Requirements of Information Systems Urbanization

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Abstract—The Information System (IS) is currently the main part of the business strategic dimension. The urbanization of information systems is necessary for a global vision of the IS architecture over space and duration for any computerization project. It proposes defining a coherent development plan in phase with the strategy, trades, and the processes. Many frameworks, methods and software tools of Enterprise Architecture (EA) are available on the market and have integrated the concepts of urbanization which are inspired by cities' urbanization. In addition, these methods may be provided in a different way from a tool to another. Some of these tools include the urbanization concepts; however other tools are lacking these concepts but allow the possibility of extension. It is in this context that the subject of this paper that allows customizing a modeling tool in order to take into accounts some concepts and specific urbanization's rules. Such customization is based on the previous work on the urbanization of enterprise's information systems and applied on a well defined tool that is Archi which is based on the Archimate framework after a study of the tools available on the market. In addition, this article shows how we can customize Archi tool for the needs of the urbanization of the information system.

Index Terms—information system, urbanization, Archimate

I. INTRODUCTION

The continued evolution of the market, the increased competition and the technical possibilities and economic issues prompt to perform a progressive complexity of existing legacy applications that generate disturbing difficulties for the setting up of a modern Information System (IS). The pertinent Decision - making, in this context, is not possible. Therefore, an eventual development of enterprise IS is presented as a primordial necessity. In this context, the enterprise's modeling has emerged as a powerful way to achieve better performance. Indeed, the Anglo-Saxon world has proposed the enterprise architecture as an efficient solution in terms of modeling business, organizations and enterprise processes. In France, they opted for an approach that represents the IS urbanization with the basis of a small number of concepts based on an urban plan often called

SOP (Soil Occupancy Plan), in analogy with the urban planning. The SOP consists in representing the IS based on its cartography and a division into autonomous capabilities in terms of zones, districts and blocks. Many frameworks, methods and tools for Enterprise Architecture (EA) which are intended for urbanization are available on the market, used by companies and organizations.

II. PROBLEMATIC

The urbanization aim is to make the IS more responsive, more flexible and less complex. It is to develop an architecture that [1]-[3] facilitates their adaptation to the strategic, organizational and technical developments and to monitor their evolution in the context of the adopted structure. Several tools of Enterprise Architecture modeling are available, such as the WinDesign of Cecima editor and Aris of IDS Sheer editor.

The majority of these tools do not take into account the concepts of urbanization and even those who contain these concepts are not open and they are not available for free so they require constraints to follow for a project of urbanization of IS. However, there are others that lacking these concepts but they have the potential for a possible extension. As part of this article we will focus on the Archimate modeling language of enterprise architecture. Indeed, this language [4] provides a notation to enable enterprise's architects to describe, analyze and visualize the relationships among business domains in an unambiguous way. ArchiMate, an open Group standard, is [4] an open and independent modeling language for enterprise architecture that is supported by different tool, vendors and consulting firms. The Archimate framework essentially is a matrix with three layers and three columns. It defines three main layers: business, application and technical. The columns in the matrix show [5]-[6] the following aspects: passive structure, behavior and active structure and behavior elements. There are various tools on the market that support Archimate framework. Archi is a free modeling tool among these existing tools. It allows creating ArchiMate models and sketches and is used by hundreds of enterprise's architects throughout the world. Our work is to build an extension for the Archi tool to customize it in order to reflect the concepts of

urbanization that are mentioned above. Our problem is then to understand how to add this extension with a conceptual and technical standpoint.

III. RELATED WORK

The major enterprises' concerns are to structure and optimize its information system architecture for a wholes synthetic and shared representation and to concept the target architecture design to implement the necessary changes. The urbanization is a concept that aims to simplify, mapping IS and control these changes while providing greater responsiveness and while increasing performance. Such approach is necessary when the enterprise has accumulated significant legacy applications with more or less redundancy [7] in order to achieve a rationalization of its information system while ensuring its proper functioning and making its use's change easier. To answer these questions, then specialized tools are needed to model these representations.

Different modeling tools find useful to define and implement an urban planning for an information system. Most of these tools offer solutions based on EA standards such as TOGAF, DoDAF, Zachman and ArchiMate, to describe and visualize the different architecture's domain and their relationships. Some of the existing tools have incorporated some aspects of urbanization. Among them, we can distinguish the SAP PowerDesigner from the editor SyBase that allows enterprise architecture modeling in three main types of layers: business, application and technology. It has integrated a diagram of urbanization at the business layer. This diagram [8] provides a graphical view of the enterprise's architecture using the metaphor of planning the infrastructure of a city with the aim of representing the organization of systems, applications, etc into architectural areas in the form of plans. PowerDesigner supports all the objects necessary to build urbanization's diagrams (architectural area, system, application, database, business functions). Thus, MEGA Architecture software is published by MEGA International for enterprises and other organizations to represent and document information systems. MEGA describes the IS with different points of view and allows creating two types of urban planning: the Functional IS and types of applications. In each type of urban planning, there is the list of the plan components. MEGA provides a division of the information systems at different levels: The Level Zone which is the highest. This is a combination of treatments. The level block is the basic component of urban planning. It is possible in MEGA to create sub-zones from a zone regardless of the level of development (zone, district or block). When we create a subzone from a Zone, it automatically becomes zone of the level district. When we create a sub-zone from a District, it automatically becomes "Block". The proprieties proposed for each urbanization level are [7]: The level of urbanism which is shown in a corresponding field. The color attribute gives another dimension to the urbanization diagram. The value given to this attribute changes the color of the shape of the zone, district or block and is displayed in the diagram. The urbanized

elements tab allows specifying the applications, databases, services or use concerned cases.

To summarize, we found that the inclusion of urbanization in power AMC is in the form of creating a diagram of urbanization in an existing EAM (Enterprise Architecture Model). This model [8] helps you analyze and document your organization and its business functions, with applications and systems that support them and the physical architecture on which they are implemented. In power AMC, diagrams are divided into three main layers: business, application and technology. The urbanization diagram is located at the business layer. PowerDesigner supports all the objects necessary to build diagrams of urbanization using the metaphor of a city infrastructure planning while MEGA integrates the urbanization through the definition of an urban planning. The functional IS and the types of applications are divided into different levels of urbanism: zone, district, and block. Each of the two tools has its own urban integration method. The goal of adopting such an approach is similar. Indeed, the two tools are trying to conceive an information system in the way of an urban planning to achieve an agile division of information system.

IV. PROPOSED SOLUTION

Through this article, we chose Archi modeling tool that is based on the Archimate framework as we have said previously. We chose Archi since it is a free tool and it has been designed to be extensible, allowing adapting the language to different settings and architectural approaches. Archimate offers two extension mechanisms which are adding attributes to Archimate concepts and relationships (profiles) and specialization of concepts and relationships. We consider the second mechanism. Specialization is a simple and powerful way to define new concepts based on the existing ones. A concept or a specialized relationship strongly resembles [4] a stereotype as it is used in UML. In UML, the stereotype [9], [10] is the basic mechanism for extending UML. It extends one or more existing meta-classes of the UML meta-model to allow their use in a specific domain. This technique [11] is performed via the concept of profile standardized by the OMG. This method is called as lightweight extension of UML.

In conclusion, we will use the specialization of Archimate concepts via stereotypes as a mechanism for extension. This is a light extension of UML that provides the extension's mechanism of specialization to extend the meta-classes of the meta-model of the selected tool with the desired concepts.

A. Intervention Level

Number citations Archimate defines three main layers which are business, application and technical and it does not consider the functional layer. In our case, we can be confined to the Archimate applicative layer for the implementation of the urban concepts for an applicative urban mapping. It is then necessary to define the concepts to be added to the Archimate applicative layer as well as

their roles and the different relationships with the existing concepts in this layer.

B. Identification of the Applied Concepts

It will be based on the same principle of similar works, using the metaphor of planning the infrastructure of a city. So the concepts to define are: The zone which expresses a very general layout and includes a set of applications and data, the district which allows grouping a set of applications around a common subject and the concept of block that corresponds to an application or an ERP module. After the study of Archimate concepts, we

noticed that the concept block is equivalent to the concept application component that is defined as [4] a modular, deployable, and replaceable part of a software system that encapsulates its behavior and data and exposes these through a set of interfaces. In this case, we will add only the concepts of zone and district. A hierarchical structure in terms of zone, district and block (application component) will ensure an urban applicative mapping [12], [13] which represent an overall allocation of organization’s applications to achieve communicating application blocks.

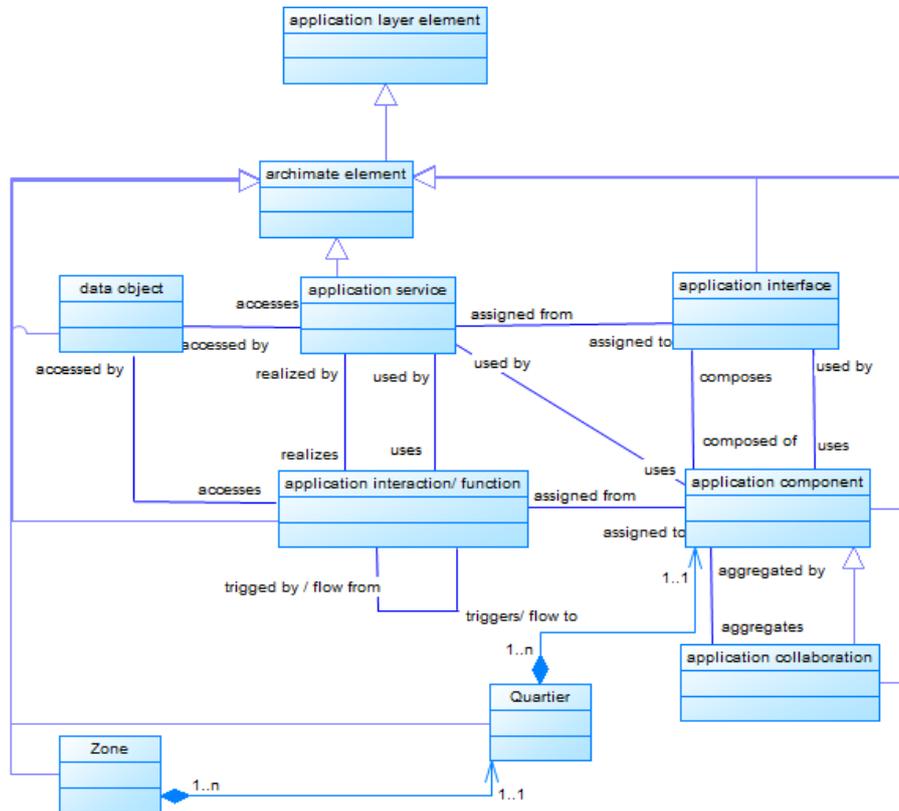


Figure 1. Proposed meta-model of the Archi application layer.

Then, these two identified concepts have their own properties and they necessarily have inter-relations and relations with other existing concepts (see Fig. 1). They will inherit from the ArchiMate element class. There is a composition relationship between district and application component as well as between district and zone. Therefore, a zone is composed of districts themselves composed of blocks as shown in the figure below which shows the future proposed meta-model for the Archi application layer. Also, according to the basic rules of IS urbanization [14] a block belongs to one and only one district, a district belongs to one and only one zone, so a block belongs to one and only one zone as shown below.

C. The Concepts Modeling

After identifying the various concepts to add, this part of work will focus on their graphic presentation. Many of ArchiMate concepts of the application layer [4] were inspired by the UML 2.0 standard. According to this

approach, we will represent the concept “District” as a classic package of the UML concept and the concept zone with the same manner as presented in WinDesign but with a different color. WinDesign is a suite of modeling that provides the module Business Process cartography SI which is designed to business users for business cartography and to IT services for functional and application urbanization and for infrastructure mapping. In Archimate, in each layer they adopted a specific concept color. The concepts color of the application layer is green, and then we will present these two concepts in green (see Table I).

TABLE I. STANDARDISATION CHARTER OF CONCEPTS TO ADD

Concepts	Representation
Zone	
District	

D. Extension Description

ArchiMate uses the EMF's Ecore language to define its metamodel. The figure below shows the EMF Profile Metamodel (Eclipse Modeling Framework) which is a modeling framework to create models and meta-models (see Fig. 2).

EMF is based on the Ecore metamodels. The main

elements of Ecore [15], [16] are EClass, EReference and EAttribute. An EClass instance defines an EMF metamodel element that represents a set of similar model entities. The characteristics related to the Eclass are EAttribute. EClasses can have EReferences (instances of EReference) which express unidirectional relationships between two EClasses.

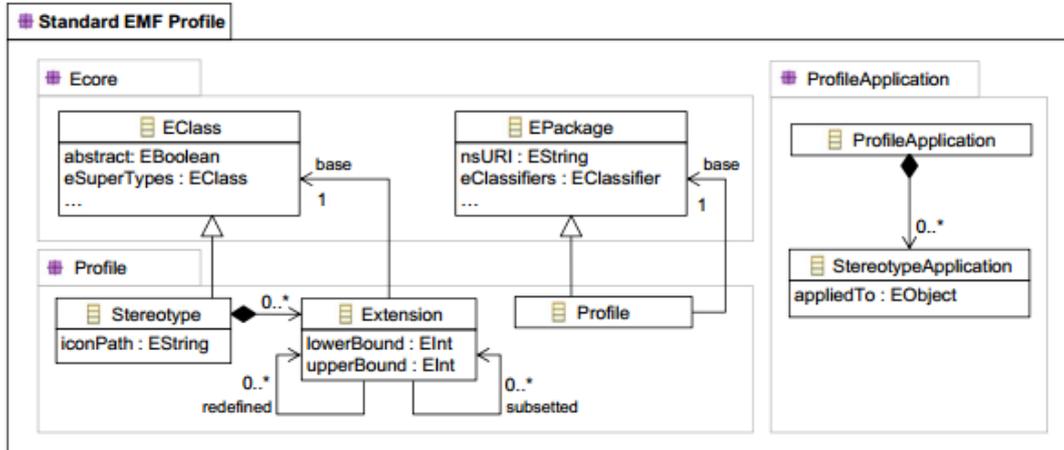


Figure 2. EMF profile metamodel.

In UML, a stereotype [17] is an extensibility mechanism of modeling languages, it allows derive new model elements from the existing ones. UML does not allow stereotypes to inherit from common metaclasses. EMF Profiles refrain from adopting this restriction. Thus, users may specify the stereotypes that are a subclass of common meta-classes (i.e., EClasses) to allow the stereotype inherits the modeling features from existing or newly created meta-classes. So in our case, it is possible to extend the model by adding the concepts of urbanization following the extension mechanism: Specialization concepts as mentioned above. The specialization concept is very similar to [4] a stereotype as it is used in EMF and UML profile. The stereotype class is an EClass specialization that can inherit from other classes, so it is clearly an UML light-weight extension.

V. SOLUTION IMPLEMENTATION

First of all, we need to import the Archi source code to be able to work on it. The Archi code is stored in a Git repository at GitHub. Git is [18] a distributed version of control system. It allows managing different versions of a software release and can be used to manage non software documents. GitHub is a web-based repository providing hosting services for software of development projects that use Git revision control system. It offers [18] social networking functionalities such as feeds, followers, wikis and a social network graph to display how developers work on their versions of a repository. Archi is built upon the Eclipse Rich Client Platform (RCP) version 4.4.1. Then it is necessary to install the appropriate version of Eclipse: Eclipse SDK 4.4. The Eclipse SDK includes [19] the Eclipse Platform, java development tools and plugin development Environment tools and plugins development

Environment including source and both user and programmer documentation. After installing the SDK we need to install the EGIT plug-in (Eclipse Git Team Provider) when configuring Eclipse to import the code. This is an extension for Eclipse that allows using Git.

Then we run the Archi code in our workspace already created. The code consists of a number of plug-ins (see Fig. 3). We said earlier that EMF has a meta-model. In fact, EMF is based on the Ecore meta-model that contains information about the defined classes.

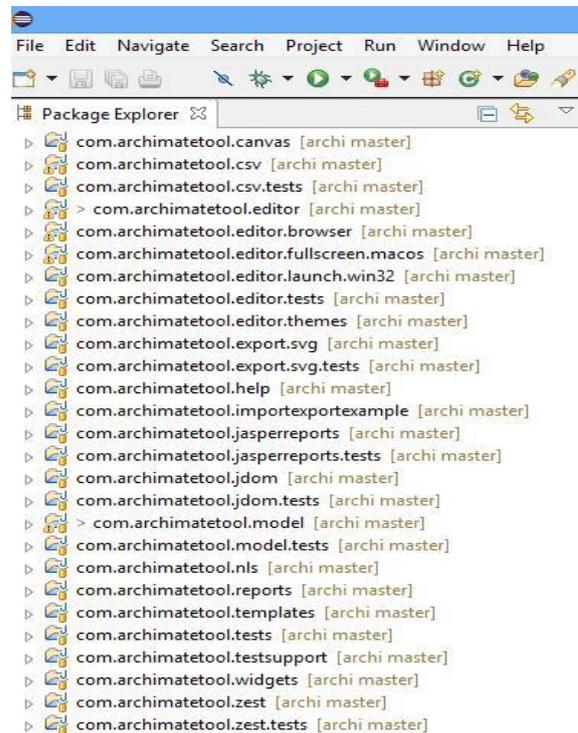


Figure 3. Archi source code project.

The underlying model in Archi is implemented as an Ecore model (see Fig. 4) in the Eclipse Modeling Framework. With the use of EMF, we can then modify the Archi meta-model and thereafter generate a part of the model code.

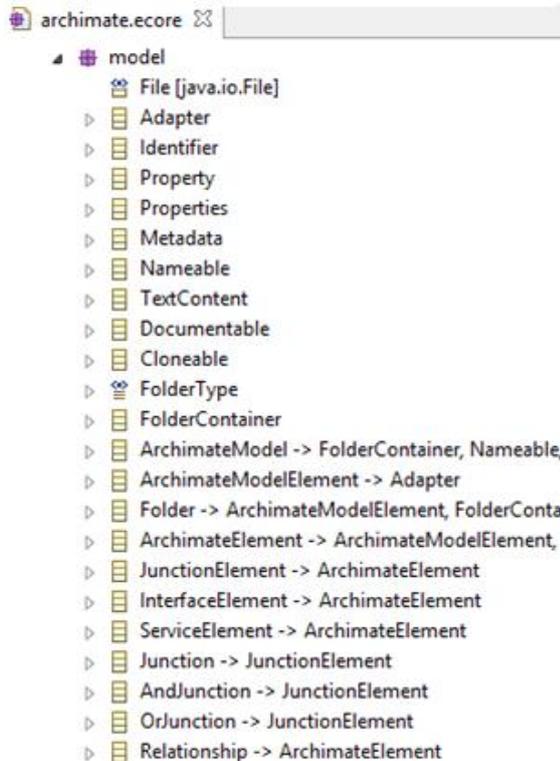


Figure 4. The Archimate ecore model.

For this reason, when configuring Eclipse, we installed the plug-in Eclipse Modeling Framework (EMF) SDK. At this stage the extension step of Archi model with the concepts previously mentioned will take place according to the following instructions:

- By using the plug-in and `com.archimatetool.model` exactly `archimate.ecore` file in the model folder, we will create a new Eclass and name it. It must inherit from the concerned layer which is in our case the application layer and that is through the property concept edition Esuper types.

The second EMF meta-model is GenModel which contains additional information for the code generation which is in our project the file `archimate.genmodel`. In the next step, we will generate entities of Ecore file, which are newly created from this file by selecting "generate model code" from the main menu in Eclipse generator. Also we found in the plug-in `archimatetool.model` the file `relationships.xml`.

- It is essential to add the new concept in this file because the Archimate language defines a strict set of rules for relations between concepts.

Then to appear the concept in the User Interface (UI), we should add it in the file `ArchiMate Modelutils.java`. Our work on the plug-in `com.archimatetool.model` is finished, now we focus on the plug-in `com.archimatetool.editor` to create the user interface for the new concept following these steps:

- Add an icon for the concept: That's why we installed the plug-in Eclipse Graphical Framework (GEF) SDK [20] which allows drawing in the Archi views. The GEF provided a technological framework for creating rich applications such as graphics editors under Eclipse environment.
- Add a figure GEF: Creating a figure class GEF for the concept in the package `com.archimatetool.editor.diagram.figures.application`.
- Add an EditPart GEF: Creating a GEF class EditPart for the item in the `com.archimatetool.editor.diagram.editparts.application` package. This class is responsible for linking the model to its representation and thus brings the changes to the model. EditParts are the objects with which the user interacts [21].
- Add an UI provider: Create an UI provider class for the concept in the `com.archimatetool.editor.ui.factory.application` package.

We should note that, for the Archi debugging, we need to tell Eclipse how to run Archi and what plug-ins to include and to exclude in the configuration. So, after the implementation of our extension, we run Archi to observe the final result. The Archi palette and specifically that of the application layer has become as shown in Fig. 5.

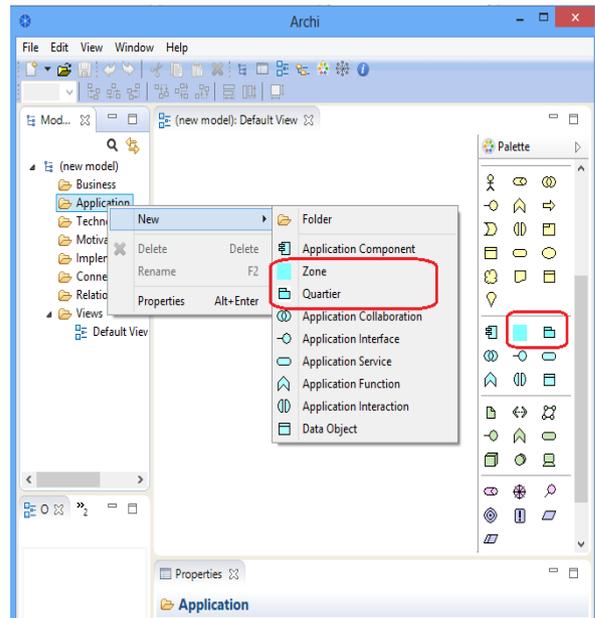


Figure 5. The extended Archi palette.

VI. CONCLUSION

Through this paper, we have adopted and implemented a lightweight extension following the extension mechanism Specialization concepts through the addition of stereotypes class on the Archi metamodel by working primarily on the plug-in model that contains the main Ecore file `archimate.ecore` and the model of generation `archimate.genmodel`. To accomplish this extension we used EMF to extend the meta-model with the adapted

concepts and GEF to create the user interface for these concepts. We obtained as a result the Archi with a new extension that allows an application urban mapping for a global and structured vision of informatics applications through a hierarchical structure in terms of zone, district and block. The purpose is to know the services that implement business functions. It should be emphasized that this special version of the built application and its additions would not be treated in the regular versions of the application.

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