A new content framework and metamodel for Enterprise Architecture and IS Strategic Planning

Mouhsine Lakhdiss, Bouchaib Bounabat

Al Qualsadi Computer Science Laboratory, ENSIAS, Université Mohammed V – Souissi BP 713, Agdal – Rabat, Morocco,

Abstract— IS Strategic Planning and Enterprise Architecture are two major disciplines in IT Architecture and Governance. They pursue the same objectives and have much in common. While ISSP has benefited from business strategic planning methods and techniques, it has not evolved much since the 90s and lacks from formal, tooled and standard methodology. In the other hand, Enterprise Architecture has known a very fast progression in the last years helped in that by market's needs and research in the domain of Entreprise Modeling. The basic component underlying both fields is the content framework and metamodel necessary to describe existing and future state. The aim of this paper is to present a new EA content framework and metamodel taking into consideration ISSP concerns and bridges the gap between these two fields.

Keywords- IS Strategic Planning, Enterprise Architecture, Methodology, Metamodel, Content framework

I.   BACKGROUND

With the complexity of today's information systems and the necessity to make the existing IT assets more agile to provide for the constant business change, the task of governing and planning for IT assets become a key success factor for IT.

Information Systems Strategic Planning is the discipline that deals with this task. Unfortunately, it hasn't evolved with the same speed as other fields in the IT sphere. Most of the techniques, approaches and methods related to IT Strategic Planning date back to the 80s or 90s and are most often oriented business strategic planning rather than IT strategic planning [1}. As a matter of fact, they don't take into account the complexity of today's information system and their diversity. Furthermore, this field lacks from a formal, rigorous and agreed upon methodology and suffers from the absence of tools to support, structure and industrialize the discipline

Enterprise Architecture is a really promising discipline aimed at capturing the as-is architecture of an enterprise, defining the target and the roadmap to get from existing to desired state. In that way, it is tightly related to ISSP and it can provide a framework to fill the gap and contribute in structuring and formalizing ISSP field. Enterprise Architecture benefits from a standardization effort as well as from tool support. Deliverables and artifacts are generally well defined and structured in the existing frameworks.

Existing Enterprise Architecture frameworks are of different types. While some frameworks like Zachman [2] define a taxonomy for architecture artifacts, others like TOGAF [3], tend to describe a process to produce architecture deliverables [4]. The main concept underlying both the process and the taxonomy is the metamodel to describe architecture elements and to produce architecture deliverables.

This metamodel is often either very poor to describe fully the architecture or not well structured to define the dependencies and the relationships between elements. We think that in order to define a more rigorous and structured methodology for ISSP, it is necessary to define a rich and structured metamodel covering both architecture elements (processes, applications, data..) and transformation elements (programs, projects, budgets). This metamodel is the main focus of our work aimed at defining a new methodology for ISSP.

Our aim in this paper is to demonstrate the insufficiencies, deficiencies and inconsistencies in existing ISSP methods and show how a new methodology based in part on the Entreprise Architecture practice could be proposed to address these problems. The metamodel we project to define could be used as a platform for describing the architecture, evaluating it and defining the needed transformations and planning them in term of programs/projects.

The second section presents ISSP and EA, compares the two disciplines and tries to bridge the gap between them. The content framework and the underlying metamodel is introduced in the the third section as a way to combine ISSP and EA. The fourth section describes the suggested metamodel and content framework. A comparison is made in the fifth section with existing metamodels before presenting future work and directions.

II.   IT STRATEGIC PLANNING AND ENTERPRISE ARCHITECTURE

A.   IT Strategic Planning

Strategy is defined by Chandler as "The determination of the basic long-term goals and objectives of an enterprise and the adoption of courses of action and the allocation of resources necessary for carrying out these goals" [6] and by Porter as "The art to build durable and defendable competitive advantage"[7].

One of the most complete definitions was given by [8], "A fundamental framework for an organization to assert its vital

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continuity, while, at the same time, forcefully facilitating its adaptation to a changing environment.''

For most of the definition, strategic planning is focused on three main questions:

- Where we are?

- Where we want to go?

- How to get there?

IS Strategic planning has been defined by [9] as the process of identifying a portfolio of applications/projects that can help an organization achieve its business strategy. Its focus is on defining the IT roadmap in term of key initiatives, projects and transformations to be made on the existing information system with two main intentions:

- How to align information systems with business needs and overall strategy?

- How to use information technology to change and impact the business?

Due to the complexity of today's information systems and the diversity of enterprise's technology approaches, many methods have been defined to structure the ISSP process and techniques have been defined to address some aspects of the discipline. [10] classifies ISSP methods into two categories:

- Impact methods : trying to make It help create a positive impact and drive the change of the business

- Alignment methods : where the main focus is on aligning IT to respond to business needs and to help achieve strategic goals

Among the methods used in IT Strategic Planning we can cite Critical Success Factors (CSF) [1] which could be considered as an impact and alignment method, Business Systems Planning (BSP) [1], Porter's Value Chain [7], and Scenarios [1]. Methods can be grouped together to constitute a methodology. Methodologies used for ISSP include those of the CCTA (12) and Boar (13).

Many IT vendors and consultancy organizations use proprietary methods and/or methodologies, some of which are adaptations of open source approaches. Examples are Arthur Andersen's Method/1 and Coopers and Lybrand's Summit [9]. It is also well known that organizations often develop their own in-house methodologies, often based on open or proprietary methods or approaches [9]

B. Enterprise Architecture

ISO/IEC 42010: 2007 defines ''architecture'' as: ''the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.''. The Open Group defines it as [3]:

"A formal description of a system, or a detailed plan of the system at component level to guide its implementation"

"The structure of components, their inter-relationships, and the principles and guidelines governing their design and evolution over time"

An architecture is typically made up of:

- a picture of the current state

- a blueprint, vision or detailed description for the future

- a road-map on how to get there

Enterprise Architecture appeared in the eighties thanks to John Zachman who introduced the framework that bears his name. This framework consists of taxonomy for producing architecture artifacts from different viewpoints and perspectives. As a matter of fact, Enterprise Architecture has been defined by Zachman [2] as a "set of descriptive representations (i.e. 'models') that are relevant for describing an Enterprise such that it can be produced to management's requirements (quality) and maintained over the period of its useful life".

Several other frameworks appeared subsequently, most of them initiated by government bodies like TAFIM (Technical Architecture Framework for Information Management), DODAF, MODAF or FEAF especially due to the requirement of the Clinger-Cohen Act.

IT consulting firms created their own EA frameworks, based on the feedback from projects they undertook. Gartner as well as Cap Gemini or Accenture have their own EA frameworks which could be more accurately considered as EA practices as stated by [4].

The Open Group Architecture Framework (TOGAF) started with TAFIM and reproduced practices and techniques used in other framework to constitute an EA framework of reference in the IT industry. TOGAF is with Zachman the two most used EA frameworks according to [5].

TOGAF consist of:

- A architecture development methodology describing the process

- A set of guidelines and techniques supporting the methodology

- A content framework with a metamodel describing the products (deliverables)

- Reference models that provide best practices to compare with

- A structure and description of the architecture repository (enterprise continuum)

- A capability framework for architecture governance and implementation

	Enterprise Planning	Enterprise Architecture
Period of development	1970-1995	1987-2010
Target	IT/IS	Business and IT/IS
Nature	Business oriented	Business and IT oriented
Representation	Program project stages	Four views belonging to Business and Technic
Strategy support	High	Medium to low
Teamwork and modelling	Techniques	Techniques, modeling
Repository	No	Yes
Tool support	Rare	Numerous

TABLE 1: COMPARISON BETWEEN EA AND ISSP

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TOGAF could be used in combination with Zachman where TOGAF defines the process and Zachman the deliverables. Archimate [11] defines a notation for architecture elements but also defines its own metamodel for architecture description.

Enterprise Architecture could be used for different needs and in various contexts. It can operate as:

- A method to describe the enterprise as a whole with different levels and views of enterprise elements and their relationships. In this way it relates to Enterprise Modeling as was stated by Lillehagen et al.[17]

- A way to align the IS environment with the business reality and the strategic goals or to assess this alignment as described by Bounabat[18] and Elhari[19]

- A modelling structure to define the vision for IS evolution or to describe in detail the IS to-be state

- A process to plan the migration between the as-is situation and the to-be state.

All these EA use cases could be related to a step or a phase in term of process or deliverables of ISSP.

C. Comparison and correlation

A theoretical comparison of IT Strategic Planning and Enterprise Architecture was conducted by Wilton [20] and Beveridge and Perks [21]. These comparisons concluded that both ISSP and EA share the same intent and scope. Wilton [22] gave a more empirical comparison based on a survey which led to establishing a significant correlation between the two activities in term of topics they cover.

The main difference that was highlighted by Wilton [22] is that ISSP tends to be process-oriented with little specification of deliverables and content while EA is product-oriented in that it defines the way the as-is and to-be state are described and modelled.

We think that this difference tends to disappear due to the progress made in the field of Enterprise Architecture. As a matter of fact, with frameworks like TOGAF the gap is being bridged with a detailed process to produce architecture deliverables.

Furthermore, we think that other differences are to be considered. They are summed up in the table below

One of the main differences that still exists and that is related to the Enterprise Architecture practice is the fact that there is no concrete link between the architecture description and the programs/projects defined in the roadmap. This lack of correlation makes it difficult to address the strategic planning main objective which is planning for IT transformations with existing Enterprise Architecture frameworks.

D. Bridging concept: Transformation

A project is defined by (PMBoK) as "A project is a temporary endeavor undertaken to create a unique product, service or result.".

This definition underlines the fact that a project is intended to create a product/service or result.

It doesn't mention the elements that the project will impact whether they are new elements created or existing element transformed.

A project –in the context of ISSP and EA- could be defined as a set of transformations (including creations) applied on architecture elements. These elements could be business elements, application elements, data elements or technical elements or a combination of them.

Elements are the basic constituents of architecture like applications, processes, servers, databases...etc. These elements are combined to create architecture models and diagrams. The transformations of these elements are combined as well to create ISSP's projects and programs.

III. IMPORTANCE OF A FRAMEWORK AND METAMODEL

The ISO/IEC 42010: 2007 definition of architecture as "the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.'' highlight unequivocally the importance of the organization of elements and their relationships. This structure is defined through a metamodel of architecture elements. Enterprise Architecture is supposed to produce architecture artifacts. These artifacts are based on an architecture content framework as defined by TOGAF or an architecture map.

A. Content framework

The content framework defines the layers, views, questions and aspects that architecture description deals with. The importance of this framework is that it organizes, classifies and links architecture elements and artifacts. It is also interesting because it ensure the coherence and exhaustively of the metamodel.

The content framework is classically defined as a bi-dimensional grid with lines representing layers or views and columns representing concerns and classifications.

The content framework defines elements of the metamodel in a high level way emphasizing the global structure rather than the detailثي model.

B. Metamodel

The metamodel is the backbone of architecture description and methodology. The metamodel guarantees the exhaustiveness of overall architecture work and the coherence and alignment of architecture layers.

It is similar in form to a Conceptual Data Model or a Class Diagram in UML. It is important in term of objects definition, attributes definition and relationships.

- Objects definition ensures the exhaustiveness and coverage of aspects as standardization and integration.

- Attributes provide the way to perform diagnosis and analysis on existing and future assets. Attribute can also cover aspects like security and performance necessary to the evaluation process.

- Relationships are very important to perform Gap Analysis inside the same layer and for alignment needs between layers.

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IV. EXISTING CONTENT FRAMEWORKS AND METAMODELS

Many metamodels have been defined explicitly or implicitly by EA frameworks. They are of different natures and focus depending on their intent. Some of them are poor in term of business or IS content. Others don't take into account some aspect tightly related to EA and ISSP like:

- Requirements

- Strategy

- Standards

- Program and projects

We described in our paper [23] each metamodel (TOGAF, Zachman, Archimate, EA Tools) with a critical view of each one. The summary of this analysis is presented in table 2.

V. PRESENTATION OF A NEW CONTENT FRAMEWORK AND METAMODEL

A. New Content Framework : NEOXIA Architecture Map

We introduce here a new content framework that is based on feedback from consulting projects on EA and ISSP. We call it NEOXIA Architecture Map. In this content framework we differentiate between

- Static element : tending to describe an element in a static most often hierarchical way

- Dynamic element : focusing on the dynamic view of the same element

We also distinguish between three natures of element:

- Structure elements: like organization and network

- Function elements: like services or functions

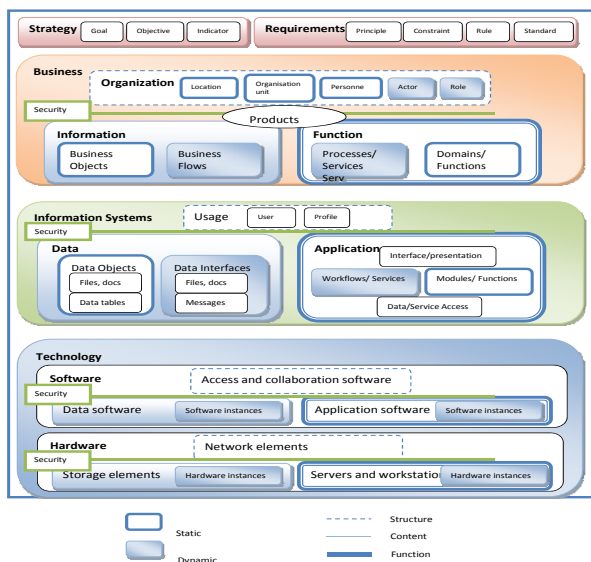- Content element: like data or storage

Figure 1.   New content framework: Neoxia Architecture Map (NAM)

B. New Metamodel: NEOXIA Content Metamodel

The content metamodel is the mechanism by which we suggest to mix architecture and strategic planning element base on transformations. The content metamodel follows the overall structure of the content framework and could be illustrated as in the figure below.
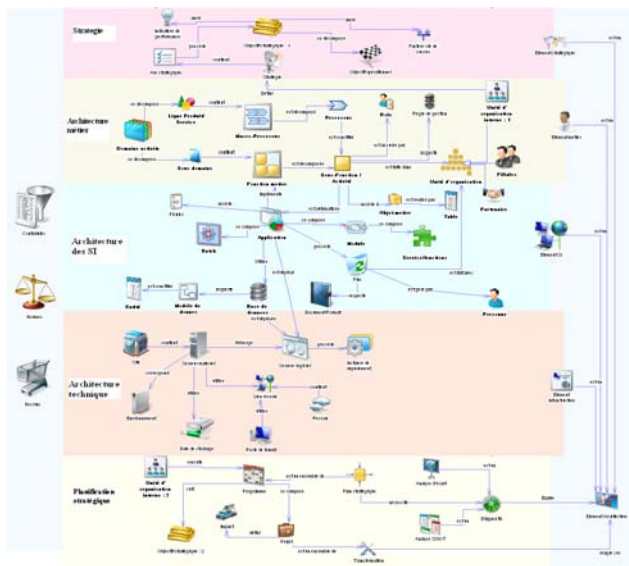

Figure 2.   New Metamodel : NEOXIA Content Metamodel (NCM)

The suggested metamodel is composed of five layers:

- Strategy

- Business

- Information Systems

- Technology

- Strategic planning

All layers are interrelated with static and dynamic element of the three natures: function, structure and content. Every layer is connected with the layer below with a realization link. A process is automated in an application which uses a database and are both deployed in a server. This dependence is fundamental to align the IS with the Business Architecture and the Technology with the IS Architecture. This link allows us also to analyze the gap between layers in term of coverage to make it possible to fill this gap in the strategic plan.

The metamodel could be also represented as package and class diagrams. We focus below on the strategic planning layer.

Figure 3.   Highlevel class diagram of the package "IT Strategic Planning"

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The central concept is "Transformation" which is a migration from an as-is state to a to-be state of an architecture element. An architecture element could be any architecture object of the metamodel (ex: process, application, Hardware server...etc).

A transformation is operated either:

- A realization of a strategic objective : this allows us to align the to-be IS situation with the strategy and to justify the strategic plan investments
- A consequence of an IT or business requirement (principle, standard, rule, constraint) defined by the organization
- A result of a gap analysis: in that case the gap is observed on one or more architecture elements and the transformation is a way to fill the gap.

We have as a result three types of transformations :

- Alignement transformation
- Requirement transformation
- Gap transformation

Many transformations are grouped into projects which are managed through programs.

VI.   COMPARISON WITH EXISTING CONTENT FRAMEWORK AND META MODELS

The suggested metamodel defines the detailed structure and relations of architecture elements starting from strategy and requirement and going through the different levels (Business, Information Systems and Infrastructure) with the necessary link with Strategic Planning element like gap analysis, program and project.

In addition of giving a more detailed structure for IS and infrastructure levels which are often poorly defined, the main contribution of this metamodel is the link it establishes between architecture elements and strategic planning elements.

We summarize a theoretical comparison of our metamodel with existing metamodels presented in section 4.

	New metamodel NCM	TOGAF	Archimate	Zachman	EA Tools metamodels
Requirement	Yes	No	No. Undergoing	Partially	Yes
Strategy	Yes	Yes	No	Yes	No
IT Planning	Yes	No	No	No	Yes. To some extent
Link between projects and architecture	Yes	No	No	No	No
Standards	Yes	No	No	No	Yes. (Not native)
Strategy definition	Yes	Yes	No	Yes	Yes
Business description	Detailed	Detailed	Detailed	Average	Poor
IS description	Detailed	Poor	Average	Detailed	Detailed (Depending on tool)
Infrastructure description	Detailed	Poor	Average	Detailed	Detailed (Depending on tool)
Tool support	No	Partial	Yes	Partial	Yes
Methodology support	No. Undergoing	Yes	Yes	No	No
Independence	Yes	Yes	Yes	Yes	No

Table 2: Comparison of the new metamodel with existing ones

VII.   CASE STUDY AND IMLEMENTATION

The framework and metamodel described above were used in a IT Strategic Plan in the financial market regulation agency to describe as-is and to-be IT state and to define the migration plan in term of projects and transformations. The IS Strategic Plan was part of an e-government strategy to make all interaction between stakeholders in the market based on internet and Electronic Data Interchange which make the underlying architecture complex enough to provide for a good testing environment.

The whole existing and future information systems component and architecture were described and modeled based on the content framework described above and using the proposed metamodel. This description leaded to a thorough visibility on existing and future state for all stakeholders of the project which was necessary to take the right decisions concerning the evolution scenarios. Moreover, a program of project was defined with for each project a set of transformations of architecture element from an existing to a future state. This was very beneficial for impact analysis, projects dependencies and load estimation of the projects.

Implementation

The implementation in our context has a double goal:

- To make sure the metamodel is realist and feasible

- To constitute a platform for a future ISSP tool (which is a much needed tool in IT Governance)

The idea is to build a tool that makes it possible to :

- Describe graphically and in term of properties all architecture elements of our metamodel

- Define the dependencies and links between these element based on the metamodel

- Store all elements and their dependencies in a repository

- Generate inventories, matrices and reports from the repository

Two scenarios of implementation were possible:

- Customize the metamodel and content framerwork of an existing EA tool

- Implement a new tool probably based on an open source existing one

We explored both options with the e-Government Regulation Agency case study which allowed us to measure the degree relevance of the metamodel.

The first option was carried out through a customization of Sybase Power AMC aimed at adapting its metamodel to NCM. Even if the tool is quite flexible, we have encountered a problem concerning the predefined objects of Power AMC which are difficult to customize as well as some dependencies which are hard to implement. Figure 4 shows some screenshots of the customization screens.
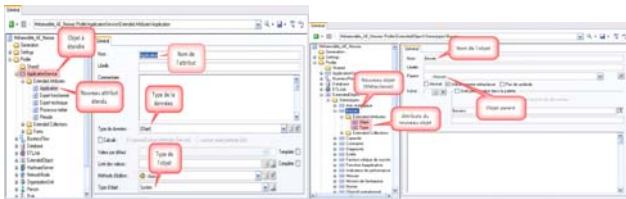
Figure 4.   New Metamodel : NEOXIA Content Metamodel (NCM)

We then explored building our specific tool based on the Eclipse Platform (Eclipse RCP, EMF and GEF). The tool is based on an XML storage of the model (values of attributes of objects). In Figure 5, are displayed some screenshots describing how we can create an architecture element with its graphical representation and its properties.
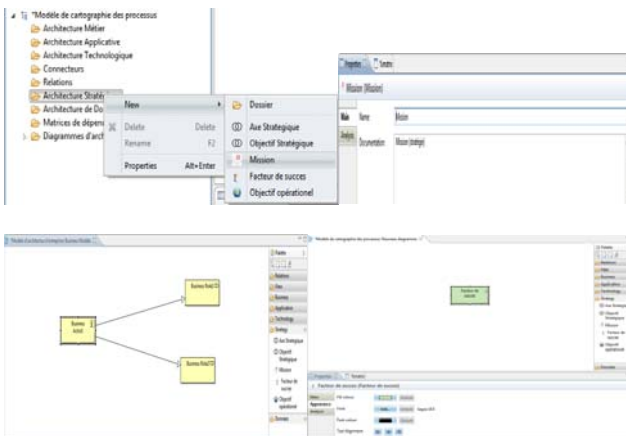

Figure 5.   New Metamodel : NEOXIA Content Metamodel (NCM)

VIII.   CONCLUSION AND FUTURE WORK

We think that based on this proposed metamodel, a new methodology could be defined to cope with the needs of ISSP and to complement and enrich existing EA metamodels. The metamodel described was already used successfully in consulting projects in the public and private sector and was able to capture more meticulously architecture element and to support the process of IS Strategic Planning.

The metamodel could be enriched to highlight crossover architecture aspects like security, performance and integration. These aspects are very important in evaluating existing IT assets and in defining their target state.

A planned continuation of this work is to continue on developing a basic modeling tool (or adapt an existing one) based on this metamodel and content framework with support to Enterprise Architecture as well as IS Strategic Planning techniques and activities. The tool will allow to put into practice the Metamodel and to demonstrate the added-value of the methodology.

Another extension is to formalize diagnosis and evaluation techniques into the meta model to make sure the whole IS Strategic Planning process is automated.

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