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A SYSTEMATIC EVALUATION OF THE SAM ACCORDING TO ENTERPRISE ARCHITECTURE FRAMEWORK REQUIREMENTS

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ABSTRACT: Business/IT alignment is nowadays an essential research stake. The works around this issue are various and numerous. On the one hand, Enterprise Architecture based approaches represent a current and relevant trend. On the other hand, the SAM (Strategic Alignment Model) is one of most widespread model for BITA. In this boarder, the target of this paper is to analyse the links between the Enterprise Architecture approach and the SAM. Therefore, we analyse systematically and rigorously the SAM in the view of the ISO 15704 standard on requirements for Enterprise Architecture frameworks. The underlying idea is to check the SAM’s compliance with this standard in order to identify its strengths and weaknesses, easing its integration with other Enterprise Architecture frameworks. Our analysis shows that the SAM satisfactorily meets the “applicability and coverage” requirements and concerning the “concepts”, it covers quite well all required aspects from ISO 15704 (human, process, technology, mission-fulfilment, control fulfilment) and provides additional ones specific to BITA (mainly business scope and distinct competencies). However, the SAM provides no “ methodology, modelling language and tool”. At last, this analysis is put in perspective with related works on Enterprise Architecture for Business/IT Alignment in order to identify future research steps.

KEYWORDS: business/IT alignment, enterprise architecture, analysis framework, strategic alignment model, SAM, ISO 15704

1 INTRODUCTION

Business/IT alignment (BITA) is nowadays an essential stake for many companies seeking better performance through the implementation of Information Technologies (IT). BITA can be defined as “the degree to which IT applications, infrastructure and organization enable and support the business strategy and processes, as well as the process to realize this” (Chan & Reich, 2007 ; Silvius, de Waal & Smit, 2009). Although the challenge was identified some years ago, it remains hard to address in practice and the issues to be solved are varied.

One of the first models proposed to scope and tackle BITA is the Strategic Alignment Model (SAM) (Henderson & Venkatraman, 1993). It has attracted a great deal of interest in the research community and remains one of the most widespread and accepted frameworks of alignment (Wang, Zhou & Jiang, 2008) and has been used to evaluate and analyze existing works on alignment, for instance in (Avila, Goepp & Kiefer, 2009 ; El Mekawy, Rusu & Ahmed, 2009 ; Silva, Plazaola & Ekstedt, 2006). The structure the model proposes reflects a shared vision of the elements to be taken into account for BITA. Moreover, the notion of “alignment perspective” allows for the integration of a dynamic view into IT/business field by defining various alignment processes and scenarios. In this way it is acknowledged that alignment can be performed not only through execution of the business strategy but can also originate from IT. The model is primarily dedicated to help managers defining the way to ensure BITA. However, the model remains particularly abstract and the four alignment perspectives are mainly descriptive of the companies’ strategic behaviour regarding their use of information and communication technologies.

In recent years, IT researchers and practitioners have proposed solutions, usually relying on modelling approaches, to improve the fit between business and IT. One such trend is Enterprise Architecture based approaches. “Broadly speaking, an Enterprise Architecture (EA) is a kind of blueprint that makes explicit what the enterprise does, what it knows, what it produces or uses, who does what and when, who is responsible for what as well as the relationships among these components. It is a construction made of a set of models that describe or even specify the enterprise structure, functionality and behaviour” (Vernadat, 2007). Aside from other objectives such as strategic planning and IT governance, IT assets management, enterprise engineering or Business Process Management, EA frameworks (EAFs) are useful for BITA in that they generally allow representation of the business objectives and processes and tracing them down to the needed IT
systems and processes (Lankhorst, 2005 ; Vernadat, 2007). Although not qualified explicitly as such, the SAM can be considered as an EAF because it proposes the construction of a blueprint of an enterprise in support of BITA. However, only a few EAFs explicitly rely on the well-known SAM. Exceptions are the generic framework (Maes, 1999), the IAF (Integrated Architecture Framework) (Goedvolk, van Schijndel, van Swede & Tolido, 2000) and the unified framework (Maes, Rijsenbrij, Truijens & Goedvolk, 2000) that couples the generic framework and the IAF. Through our analysis of several current proposals of EAFs for BITA (some will be discussed in Section 5) we have discovered that many of them do not include some basic principles present in the SAM. These basic principles include for example the co-existence of the business and IT domains as two independent entities that should be aligned and the existence of various “alignment perspectives” indicating that IT should not only be considered as a support for the business but can also be a driver for influencing the business strategy. For this reason, we claim that the initial SAM has some “forgotten” values that are worth considering in the definition of an EAF for BITA and that it includes elements that could potentially be integrated with other EAFs currently proposed for BITA.

Such integration requires identifying in a systematic way the common and distinct elements of the SAM and of existing EAFs and the precise relations that exist among them. This can be done by systematically comparing the SAM with the specific target EAF. However, this is a difficult task because most EAFs (including the SAM) use their own vocabulary and structure. Additionally, comparing every pair of EAFs can be time consuming. Therefore, rather than comparing the SAM with every specific EAF, we propose to use a reference model for EAFs, in order to identify the strengths of each EAF and to ease their later integration. Using a single pivot reference model makes the identification of their commonalities and differences easier and more systematic and objective. We have chosen to use the ISO 15704 (2000) standard as this reference model for EAFs. The motivation for this choice will be further explained in Section 3.

In this paper, we make a first step in the direction of integrating the SAM with other EAFs by investigating the relation between SAM and the ISO 15704 EA reference framework and try to answer the following research questions: (1) Considering SAM as an EAF, how does it meets the requirements of an EAF? (2) What elements of the SAM are relevant to be integrated in an EAF for BITA? In order to answer these research questions, we apply the following research method: (1) we identify general requirements and elements for an EAF by reusing those identified in the ISO 15704 (2000); (2) we systematically and rigorously evaluate the SAM with respect to each requirement and (3) we identify requirements that are satisfactorily addressed by the SAM as elements that should be included in a good EAF for BITA, and requirements that are unsatisfactorily addressed as potential improvements to the SAM and elements that should be sought in other EAFs.

This paper further elaborates on our previous effort reported in (Goepp & Petit, 2013) where some initial conclusions of the SAM analysis were presented. We deepen the analysis by presenting detailed explanations and a refinement of the correspondences between SAM and ISO 15704 (2000) concepts based on two additional standards, namely the ISO 19439 (2006) (Framework for Enterprise Modelling) and the ISO 19440 (2007) (Constructs for Enterprise Modelling).

The paper is structured as follows. In section 2, we give an overview of the SAM model. In section 3, we describe the requirements of the ISO 15704. Then in section 4, we analyze the SAM in the light of each ISO requirement. In section 5, we review related works. In section 6, we conclude on insights gained both regarding the SAM and the ISO 15704, and list intended future works.

2 SAM OVERVIEW

The SAM, detailed in (Henderson et al., 1993), is an attempt first to refine the range of strategic choices managers face to achieve strategic alignment; and secondly to explore the way these choices inter-relate in order to guide management practices (Smaczyń, 2001). In comparison to other strategic alignment models, like the MIT’s90 framework of Scott Morton (1991), the SAM explicitly draws a distinction between the external and the internal levels of IT. In this way, it elevates IT from its traditional role as a purely internal support mechanism (Henderson & Venkatraman, 1989) and it recognises the potential of IT to both support and shape business policy (Millet, Schmitt & Botta-Genoulaz, 2009).

The SAM is defined in terms of four areas of strategic choices (business internal and external levels; IT internal and external levels). Each area consists of three components: scope, competencies and governance in the external level; infrastructure, skills and processes in the internal level (cf. Figure 1). The components can be described as follows.

First, for the business in the external level:
- Business scope: choices pertaining to product-market offerings in the output market;
- Distinctive competencies: elements of strategy that contribute to a distinctive competitive advantage of a firm over its competitors;
• Business governance: make versus buy choices, complex array of inter-firm relationships such as strategic alliances, joint ventures, etc.

Second, for the business in the internal level:
• Administrative infrastructure: choices within the internal business strategy arena to articulate the administrative structure of the firm dealing with roles responsibilities and authority structures;
• Processes: choices related to the design of business processes that support and shape the ability of the firm to execute business strategies;
• Skills: decisions related to the skills required within the business domain to execute a given strategy.

Moreover, the SAM does not consider BITA as only the integration between the internal IT and business domains as a response to business strategies. Therefore, the model conceptualizes two links between the domains: (i) Strategic fit: the interrelationships between external and internal levels of a domain and; (ii) functional integration: integration between the “Business” and the “IT” domains.

In other words, the logic of strategic alignment requires a balance between the choices made across all four domains. It recognizes the need for cross domain relationships. Neither strategic fit nor functional integration is sufficient for an efficient strategic alignment. As a result, Henderson and Venkatraman detail alignment perspectives that work on the premise that strategic alignment can only occur when at least three of the four domains are in alignment. They provide four alignment perspectives: strategy execution, technology transformation, competitive potential and service level.

3 ISO 15704:2000 OVERVIEW

The ISO 15704 (2000) standard defines the requirements for EAFs. The requirements detailed in this standard allow a specific enterprise-architecture and methodology to be checked for completeness with respect to its current and future purpose. In other words, the standard will help in the development of the architecture. The standard may also be used to guide the choice or the creation of a given EAF.

There are other standards dealing with architecture such as the (ISO/IEC/IEEE 42010, 2011) or (ISO/IEC 10746-3, 1996). The first focuses on the architecture description in software and system engineering. It specifies the manner in which architecture descriptions of systems are organized and expressed. Thus, it specifies architecture viewpoints, architecture frameworks and architecture description languages for use in architecture descriptions. The second deals with information technologies and open distributed processing that are detailed in terms of technological concepts such as distribution, interworking or portability. Our scope does not deal neither with software and system engineering nor with open distributed processing but with BITA. From this viewpoint the ISO 15704 (2000) standard fits the best to our scope because BITA can be considered as a sub-problem of enterprise engineering, the activity that enterprise reference architectures and methodologies aim at supporting (see Section 4.1). We will therefore use it in the first step of our research to analyze the SAM in terms of EAF requirements fulfillment. The ISO 15704 (2000) standard is structured around three kinds of requirements (see Table 1).
### Concept requirements: covered aspects

According to the standard, an EAF should cover different relevant aspects (human-, process-, technology-, mission-fulfillment and control-oriented aspects) for which the standard gives definitions. For example, the human aspect is detailed through the following concepts: organizational/operational role, capabilities, skills, know-how, competencies, responsibilities and authorization. Based on these definitions, we defined a detailed mapping to the SAM’s components. We use the following rules for the mapping: (i) since the SAM deals principally with decisions, we consider the results or impacts of the decisions related to the components of the SAM; (ii) we look for the concepts a given decision fixes or impacts as stemming from the SAM’s detailed description of the decisions. The mapping we performed is detailed in Table 2.

There are four levels of mapping shown in Table 2: (i) perfect mapping (“x”) meaning an established semantic correspondence; (ii) possible mapping (“o”) meaning the semantic correspondence is highly probable but not detailed as such in the SAM; (iii) no clear mapping (“?”) meaning that no clear conclusion could be reached by the authors because the description of the components are too fuzzy and (iv) no mapping (cell left empty) meaning that there is clearly no semantic correspondence.

Easily mapped concepts include the processes in the business and IT domains that correspond to the functionality and behaviour concepts of the standard process aspect but also to the mission and control-fulfilment aspects of the standard. In this way, the process components of the SAM encompass more elements than the process aspect of the ISO 15704 (2000) standard. In the opposite way, the technology aspect of the standard is mapped to three different components of the SAM IT domain: technology scope, systemic competencies and architecture. Technology scope and IT architecture are clear technology focused components. Indeed, the IT architecture focuses on the portfolio of applications, the configuration of hardware, software and so on. For the systemic competencies component, the result of the mapping is more surprising as it could include human aspects. However, we base our mapping on the definition of (Henderson et al., 1993), where the systemic competencies are described as

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### Table 1: Reference EAF requirements adapted from (ISO 15704, 2000)

<table>
<thead>
<tr>
<th>Type of requirement</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicability and coverage</td>
<td>Scope of an EAF: generality, enterprise design and/or operation</td>
</tr>
<tr>
<td>Components</td>
<td>Elements that compose an EAF: type of model supported, methodologies, modelling languages, tools</td>
</tr>
</tbody>
</table>

4.2 Concept requirements: covered aspects

The SAM fulfills these requirements. Indeed, its scope is clear: “defining the range of strategic choices managers face, during business IT/alignment, and exploring how they interrelate” in order to provide alignment perspectives that define the role of management. In other words, it is targeted at all classes of enterprises for the specific BITA concern. It is design driven as it provides management practices.

4.1 Applicability and coverage requirements

The applicability and coverage requirement consists of three sub-requirements. The generality requirement describes what an enterprise reference architecture shall enable its users to do and details if it is specific to a class of enterprises or not. The two other requirements enterprise design or enterprise operation detail whatever the EAF is dedicated to manage, conceive/define, describe, design, implement, maintain and decommission any enterprise entity (enterprise design) or to identify the activities needed to use the results of enterprise engineering in the operation itself.

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Table: Reference EAF requirements adapted from (ISO 15704, 2000)


To work out our analysis we compare the SAM definition detailed in (Henderson et al., 1993) to the requirements of the ISO 15704 (2000) standard. The research method that we used for doing so is the following. We consider the requirements proposed by ISO 15704 (2000) one by one and analyze how the SAM meets each requirement. The analysis is based on the original expression of the requirement as described in the ISO 15704 (2000) text and on the definitions of the SAM as described in the original SAM paper (Henderson et al., 1993). Since evaluating each requirement satisfaction requires interpretation of descriptions of these two inputs, decisions were made based on a discussion among the authors, who both have a good knowledge about the SAM and the ISO 15704 (2000) standard. When a divergence among authors occurred, a more careful look at the original sources was taken and a common interpretation was sought. When an agreement on a common interpretation could not be reached, we considered that some ambiguity was remaining in the definitions and kept trace of this inconclusive situation. We believe that this careful process reduced potential bias and misinterpretation of definitions, but some additional validation with more experts is evidently needed. This further validation is part of our future work.

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```sql
<table>
<thead>
<tr>
<th>Type of requirement</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicability and coverage</td>
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<tr>
<td>Components</td>
<td>Elements that compose an EAF: type of model supported, methodologies, modelling languages, tools</td>
</tr>
</tbody>
</table>
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“attributes of IT strategy (system reliability, cost-performance levels, interconnectivity, flexibility) that could contribute positively to the creation of new business strategies or better support of existing business strategy”. Strictly speaking this definition does not encompass human aspect of IT that could also be relevant. In this sense the SAM is restrictive.

<table>
<thead>
<tr>
<th>ISO 15704 Concepts</th>
<th>SAM Components</th>
<th>Business</th>
<th>I/T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>Organisational/operational role</td>
<td>?</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Capabilities</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Skills</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Know-how</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Competencies</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Responsibilities</td>
<td>?</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Authorisation</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Process</td>
<td>Functionality</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Behavior</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Technology</td>
<td>Technology employed in enterprise operation</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Mission-fulfillment</td>
<td>Processes + activities for mission</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Control-fulfillment</td>
<td>Processes + activities for management and control of the mission</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Table 2: Mapping made by the authors between the SAM components and the covered aspects requirements of (ISO 15704, 2000)

Concerning the skills components in the IT and business domains, we could not conclude if the skills as described in the SAM correspond perfectly to the concept of skills as described in the ISO 15704 (2000) standard. Therefore, we mark as possible the mappings to the capabilities, know-how and competencies of the standard.

Some components can partially be mapped to the standard. This is the case of the administrative infrastructure and IT governance components. A part of their description fits perfectly to some concept aspects of the standard. For example, the administrative infrastructure deals explicitly with organisational / operational roles and responsibilities. It could also perhaps deal with authorisation as the authority structures are included in the definition of the component.

The components that are the most difficult to map are the external business components of the SAM. Indeed, these components deal with high level aspects of the business. Thus, the business scope finds no equivalence within the standard. This is not surprising as the SAM is BITA focused. This implies to take business strategy elements into account whereas the ISO 15704 (2000) standard focuses rather on internal engineering aspects of a company. Similarly, the distinctive competencies and business governance could perhaps find equivalences in the human and technology aspects. This is not explicit in the SAM but the distinctive competencies are described as: “attributes of strategy (pricing, quality, value added service, superior distribution channels) that contribute to a distinctive, comparative advantage to a firm over its competitors” and the governance is detailed in the following way: ”make versus buy choices, complex array of inter-firm relationships such as strategic alliances, joint ventures, marketing exchange.
technology licensing”. The corresponding attributes can be modelled with both human and technology oriented concepts.

Even if the business and IT domains have the same component structures, the concept mapping can be different. For example, the IT architectures focus on the portfolio of applications, the configuration of hardware, software and so on. Therefore, we map this component with technology. In comparison the administrative infrastructure focuses exclusively on human oriented concepts.

As a synthesis, our analysis shows that the concepts the standard provides allow clarifying the underlying meaning of the SAM’s components. Indeed, for the covered aspects, the standard is more accurate than the SAM. For example, the human concept covers seven aspects whereas in the SAM only operational roles and skills are mentioned as such. However, because of the fuzziness of the skills components in the SAM they can potentially cover several aspects of the standard human concepts. Last but not least, the standard does not provide any concept for the business components in the external level.

### 4.3 Concept requirements: framework for enterprise modelling

The concept requirement linked to the framework for enterprise modelling encompasses four sub-requirements: genericity, modelling views, life-cycle and life-history.

According to the genericity requirement, a model based EAF shall provide the capability for representing generic enterprise elements, partial enterprise models and particular enterprise models. The SAM has this capability. Even if it is based on natural language and could maybe not be considered as a modelling framework per-se, it can be exploited to represent the decisions of a set of company from a same functional domain for example (partial level) or the set of decisions of a given company (particular level).

The modelling view requirement is very interesting. It states that an EAF shall provide concepts for representing different views. It allows reinterpreting the way the SAM is organized into domains (business/IT), levels (internal/external) and components (three for each sub-domain). Indeed, a modelling view allows representing different subset of an integrated model to the user. These subsets allow for highlighting relevant questions while hiding others. From this point of view, the domains, levels and components can all be considered as modelling views. These are not properly speaking integrated but put side by side, they provide a complete model of the strategic choices linked to BITA.

The domains and levels can be considered as views that are useful either for a particular purpose (e.g. define strategy, design internal organization) or for a stakeholder role (e.g. top business, IT or operation managers). Inside these sub-domains we interpret each of the twelve components of the SAM as a model-content based view (focusing on some specific type of model content).

The standard states that a model-based EAF shall include at least four of such views: function, information, resource and organization. These views are not detailed in the ISO 15704 (2000) standard, therefore we use the definition and related modelling constructs provided in the (ISO 19439, 2006) and (ISO 19440, 2007). The views and their constructs can be defined as follows:

- The function view allows for the representation of the processes and activities of the enterprise. This view has four constructs: domain, business processes, enterprise activity and event.
- The information view allows for the representation of the enterprise information used and obtained during enterprise operation. For this view there are the following constructs: enterprise object (with attributes) and object view. The enterprise object construct can be specialised into order and product.
- The resource view allows for the representation of the enterprise assets needed for carrying out the enterprise operations. This view has one construct resource and its specialisation functional entity.
- The organisation view allows for the representation of the organisation, organisational relationships and the decision-making responsibilities in the enterprise operation. This view consists of two constructs: capability and organizational unit.

We exploited these elements to map them to the components of the SAM (see Table 3). The meaning of the cells content is the same as for Table 2. We made the analysis view after view.

Concerning the function view, it is only included in the internal level of the SAM through the business and IT processes. It is logical that the function view is not included in the external level because in this level the SAM intends to describe the arena in which the company competes. For the constructs, we are sure that business processes are represented in the SAM. The description of the SAM is not detailed enough to be sure that the domain, enterprise activity and event are also included. This depends on the level of detail used to describe the processes of the business and IT domains.

The information view concerns two kinds of components: the business and IT scopes, on the one hand, and the IT architecture, on the other hand. The business scope can be partly modelled through enterprise objects corresponding to products but also through
object views merging a set of products. In the same way, a part of the technology scope can be defined with enterprise objects. For the IT architecture, considering that the data architecture has to be defined, enterprise objects have to be described and in turn modelled.

The resource view concerns almost all the components of the SAM. The skills in the business and IT domains are directly related to the resource construct. Indeed, they represent the human resources, on which the IT architecture and business infrastructure can rely. These components could also be linked to the functional entity if we consider that the description of the skills goes beyond the description of the resources and also apply to functional entities. The technology scope and IT architecture are also defined through resources added to the enterprise objects also described previously. Here, technological resources are described. We consider the systemic and distinctive competencies as resources. Indeed a resource has all or part of the capabilities required to perform the activity of a company. This is consistent with the definition of the systemic and distinctive competencies which are attributes of the business and IT strategies that provide comparative advantages for the firm over its competitors. The resource mapping is interesting as it underlines the fact that the SAM focuses on the resources required to perform an efficient BITA.

The organization view concerns the business and IT governances as these components detail the kind of relationships the enterprise has with other partners. Here, the organization view is considered in terms of capabilities that the company requires to perform the business and IT functions efficiently. The administrative infrastructure deals, of course, with the organizational units. Indeed, this component details the administrative structure of the firm dealing with role responsibilities and authority structures. If one considers that the IT architecture has a hierarchical structure, the functional entity construct could be mapped to this component.

Similarly to the results of analysis of the aspects of concepts (Section 4.2), the views are not tackled symmetrically within the SAM components. For example, the business and the technology scopes do not address the same views. The business scope encompasses only the information view whereas the technology scope encompasses information and resource views.

The life-cycle and life history requirements are not...

<table>
<thead>
<tr>
<th>ISO 15704 Modelling View</th>
<th>Business Scope</th>
<th>I/T Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Distinctive competencies</td>
<td>Processes</td>
</tr>
<tr>
<td>Business processes</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Enterprise activity</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Event</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Information</td>
<td>Enterprise object (EO attribute)</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Order (EO specialization)</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Product (EO specialization)</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Object view</td>
<td>x</td>
</tr>
<tr>
<td>Resource</td>
<td>Resource (R)</td>
<td>? x ? x ? x ? x ? x x x</td>
</tr>
<tr>
<td></td>
<td>Functional entity (R specialization)</td>
<td>?</td>
</tr>
<tr>
<td>Organisation</td>
<td>Capability</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Mapping made by the authors between the SAM components and the modelling view concept requirements of (ISO 15704, 2000) standard
explicitly addressed in the SAM. It would be possible to elicit life cycle activities from the description of alignment perspectives and the role of each domain in the perspective (anchor, pivot, impacted). In this way life-cycle phases that are pertinent for BITA could be defined independently from the levels avoiding the confusion between internal/external and abstraction levels. Concerning life-history the evolution of the alignment perspectives along time should be kept in order to exploit them again if required.

The SAM does not fulfill the other component requirements of the standard: it includes no methodology, no modelling language and no tool.

5 RELATED WORKS

The works related to BITA and EAF are numerous. To compare it to our work we made a coarse mapping between them and the (ISO 15704, 2000) requirements (see Table 4). We identify three main streams of research: (i) SAM extensions, (ii) specific EAFs for BITA, (iii) extension of existing EAFs for BITA.

The first research stream consists in extending the SAM structure through splitting the domains and levels or through integration of additional dimensions. This is the case of the generic framework (Maes, 1999), the IAF (Integrated Architecture Framework) (Goedvolk et al., 2000) and the unified framework (Maes et al., 2000) that couples the generic framework and the IAF. These proposals do not integrate the alignment perspective concept of the SAM. Furthermore, the proposed additional domains and levels are not described very precisely making the mapping to the concept requirements of the ISO 15704 (2000) standard difficult. Table 4 shows also that the requirements for framework for enterprise modeling are not addressed. The proposition of (Wang et al., 2008) is also based on the SAM and completed with an enterprise architecture design method. This proposition integrates a methodology and a limited set of concepts that are not defined in terms of modelling constructs but retrieved from the methodology description.

The second research stream proposes specific EAFs for BITA. The number and kind of layers vary from a proposal to another. Generally these sets of layers are coupled with specific processes dedicated to guide the achievement of BITA. (van Eck, Blanken & Wieringa, 2004 : Wieringa, Blanken, Fokkinga & Grefen, 2003) define the GRAAL framework in order to operationalize the business/IT problem for software architects. BITAM (Business IT Alignment Method) (Chen, Kazman & Garg, 2005) couples business analysis and architecture analysis. SEAM (Systemic Enterprise Architecture Methodology) (Wegmann et al., 2007) is structured in organizational levels. Notably, all of these approaches, contrarily to ours, do not motivate their proposals by referring to commonly agreed requirements (such as the ones of (ISO 15704, 2000)). They are not based strongly on the SAM and all of them propose a different structure that does not make explicit the existence of two orthogonal dimensions (domains and levels) as the SAM does. Also, none of these approaches include explicitly the notion of alignment perspective. Most of them presuppose a particular alignment perspective (usually “strategy execution”), SEAM being a noteworthy exception because it does not prescribe any order in the definition of views. Apart from SEAM they do not address human and mission control oriented concepts. GRAAL and BITAM recommend the use of modelling languages such as UML (Unified Modelling Language). In BITAM the working out of scenarios allows for the description of the life-cycle activities of the considered business and IS.

Finally, some approaches consist in extending existing EAFs and using them to support BITA. (Fritscher & Pigneur, 2011) propose an EAF by extending the ArchiMate EAF (Lankhorst, 2005) in order to incorporate lacking business model concerns, such as those tackled by the Business Model Canvas (Osterwalder & Pigneur, 2010). The resulting architecture is richer than ArchiMate for dealing with business aspects but does not covers the IT strategy domain of the SAM. The approach also does not provide a precise method for ensuring alignment among layers. Again, the motivations for proposing this new EAF is not referring to precise requirements and are not fully integrating the SAM basic ideas.

(Cuenca, Boza & Ortiz, 2011) aim at completing existing EAFs in order to enable them to support BITA. Similarly to our work the authors use the ISO 15704 (2000) standard to evaluate several EAFs. However the mapping made remains fuzzy. As a result, a set of five IS/IT components and the corresponding building blocks are proposed. However, their proposition is not thoroughly justified. The methodology proposed relies on existing EAFs. The corresponding languages and tools are not detailed.

6 CONCLUSION

In this paper we exploit the ISO 15704 (2000) standard to analyze the conformance of the SAM to the requirements of EAFs. Strengths of the SAM are that:

• It satisfactorily meets the applicability and coverage requirements.

• Concerning the concepts, it covers quite well all required aspects from ISO 15704 (human, process, technology, mission-fulfilment, control fulfilment) and provides additional ones specific to BITA (mainly business scope and distinctive competencies).

• It provides different areas (business and IT, internal
Weaknesses of the SAM include:

- the absence of methodology, modelling language and tool. This is consistent with the SAM’s limitation already identified in the literature. Our analysis makes these limitations more explicit, structured and objective. Those components should be looked for in another EAF.

- The definitions for the aspects to be modelled in the different components require the definition of modelling constructs but must also first be clarified. This is particularly the case for the concepts related to the external level (scope, competencies and governance) for both Business and IT, and to the skills in the IT and administrative infrastructure. Another example is the definition of processes (both business and IT) for which it is unclear if resource and information aspects are to be described in the SAM.

- According to (Henderson et al., 1993) the business and IT domains of the SAM shall have the same structure, but our analysis shows that they do not exactly address the same aspects. This should be clarified.

Indeed, the various alignment perspective suggest some analysis phases to go through in order to improve BITA. The further analysis of the relation between these two notions provides an interesting future research direction. The notions of life-cycle and life-history of (ISO 15704, 2000) are rarely addressed in EAFs mentioned in Section 5. Only BITAM proposes a notion of scenario that could be related to the notion of life-history but at a high abstraction level.

Table 4: Coarse mapping between studied related works and the ISO 15704 (2000) standard

<table>
<thead>
<tr>
<th>ISO15704 requirements</th>
<th>Applicability and coverage</th>
<th>Concepts</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAF</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Generic Framework</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Unified Framework</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Wang et al.</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>GRAAL</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>BITAM</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>SEAM</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Fritscher &amp; Pigneur</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Cuença et al.</td>
<td>all</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Our ultimate long term research goal is to propose an approach to define an EAF for BITA by reusing fragments of existing EAFs like proposed in method engineering approaches. Therefore, in the future, we plan to further analyse the other approaches mentioned in the paper in section 5 with the ISO 15704 (2000) standard. In this way their comparison and the evaluation of their conformance to the standard requirements will be possible, leading to the identification of their strengths and weaknesses and of clear directions for their improvement or selection for integration with other EAFs. In the first step of our research, we have focussed on the specific EAFs proposed explicitly for BITA mentioned in section 5, but most EAFs (including notably standards such as TOGAF) can contribute to BITA, and should also be considered for detailed analysis. One interesting insight of our analysis is also that the ISO 15704 (2000) standard does not include concepts for the SAM business scope component. In our future work, we will take this fact into account by using an extended version of (ISO 15704, 2000) including this aspect for our analysis of other EAFs.
REFERENCES


