Using ArchiMate to Model a Process Assessment Framework

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ABSTRACT
The Tudor IT Service Management Process Assessment, also known as TIPA, is a process assessment framework that meets two standards: the ISO/IEC 15504 Process Assessment and ITIL. The main benefits of a TIPA for ITIL assessment are to provide an IT service management plan and a management framework for process improvement. However, this framework does not have any relationship between EA principles that are useful in understanding organizations and the business. Meaning, it is difficult not only to assess the process maturity based on EA principles but also to relate the process improvement plan presented in TIPA with these EA principles. By using the EA modeling language ArchiMate, we can provide a graphical notation and therefore, a bridge between EA and this framework becoming easier for organizations to improve their processes and achieve desired process maturity levels.

Keywords
EAMS, EA, ITIL, TIPA, PAM, PRM, ArchiMate, Modeling, Process Assessment, Process Improvement.

1. INTRODUCTION
TIPA (Tudor’s ITSM Process Assessment) is the result of ten years of research work, including experimentation on combining ITIL with the ISO/IEC 15504 (Process Assessment Standard) that resulted in a framework to measure maturity levels of organizations based on ITIL [1]. The goal of the TIPA framework is to prepare the basis for improving the management of IT services provided by an organization and to provide a measurement framework for continuous improvement [1].

Enterprise Architecture (EA) is a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise organizational structure, business processes, information systems, and infrastructure [2].

However, TIPA does not ensure the alignment between service management and the organization’s concepts and artifacts in a standardized way, therefore becoming isolated and, eventually, turning obsolete.

This paper’s goal is therefore to enhance TIPA with a EA-related notation with the purpose of mitigating this issue and to aid discussion and validation by the EA, Process Assessing and even the ITIL community itself. To achieve this, we have chosen ArchiMate as the EA standard modeling language.

The methodology applied across this paper is Design Science Research, where we develop and validate a proposal to solve our problem [3]. The following sections follow the methodology’s steps: “Background” covers the aims and objectives as the awareness and recognition of a problem from a state of the art review giving us the issues that must be addressed. Afterwards, “Research” presents a proposal as an attempt to solve the problem described previously. Then, we present a “Demonstration” of our research inside a real organization followed by the “Evaluation” using mapping techniques and interviews regarding the research utility and to conclude, we show an overview of our work, limitations and themes for further work.

2. BACKGROUND
Here we present a literature review of the main concepts and research areas related to our work. We start to introduce the IT Infrastructure Library (ITIL), a best practice model to IT Service Management. Then, we will present an ITIL Process Assessment Framework based on the ISO/IEC 15504 (Process Assessment Standard) by the Public Research Center Henri Tudor known as TIPA. Finally, we describe the EA modeling language (ArchiMate) that provides a uniform representation of the organization’s EA.

2.1 ITIL
Enterprises need to manage the delivery of services that support users in the context of business processes [4]. ITIL is a common-practice model possessing the character of a branch standard [5]. While the first version was mainly based on experience in data centers running big mainframes, in 2000 a revised version (ITIL v2) was launched, becoming the worldwide de facto standard for IT Service Management [6]. In 2007, ITIL V3 introduced the Lifecycle principle, whereby the provisioning of services was considered to be a continuous process in which new services are brought into existence whilst others are phased out [6].

The ITIL Core consists of five publications: Service Strategy, Service Design, Service Transition, Service Operation and Continual Service Improvement. Each book covers a phase of the Service Lifecycle with ITIL’s processes which are always described in detail in the book in which they find their key application [7].

2.2 TIPA
TIPA (Tudor’s ITSM Process Assessment) is the result of ten years of research work, including experimentation on combining ITIL with the ISO/IEC 15504 (Process Assessment Standard).
TIPA is a standards-based approach to ITIL (“v2, v3 and 2011”) assessment that can address the challenges (posed by improving the quality of product manufacture or of IT processes) in several important ways, by providing a repeatable, consistent method for conducting process assessment [1].

A TIPA assessment provides more than just a simple determination of process maturity. It pinpoints the current level of maturity a given process has achieved and calls out specific deficiencies which, if corrected, would advance the process to the achievement of the desired level of maturity [8].

The goal of any organization that relies on these assessments is to obtain the process maturity level that best satisfies its requirements. One of the primary goals of ITSM is to continually improve the quality of service delivered and mature processes should help ensure service quality [8].

2.3 ArchiMate

The ArchiMate EA modeling language was developed to provide a uniform representation for architecture descriptions. [9] It offers an integrated architecture approach that describes and visualizes the different architecture domains and their underlying relations and dependencies [9]. The goal of the ArchiMate project is to provide domain integration through an architecture language and visualization techniques that picture these domains and their relations, providing the architect with instruments that support and improve the architecture process [10].

The domains of business, application and infrastructure are connected by a service orientation paradigm, where each layer exposes functionality in the form of a service to the layer above [11]. Besides this, it also distinguishes between active structure, behavior and passive structure elements, having also another distinction between internal and external system view. On top of this, ArchiMate is a formal visual design language, supports different viewpoints for selected stakeholders and is flexible enough to be easily extended [11].

2.4 Why ArchiMate

Our approach since the very beginning was to use an EA modeling language, because it specifies a formal representation of enterprise architecture for organizations whose business model is the management of IT services.

Lankhorst [2] enumerates several languages for modeling IT and business. There’s IDEF (Integrated Computer-Aided Manufacturing (ICAM) DEFINition), a group of methods for functional, process and data modeling; BPMN, which is restricted to process modeling; Testbed, a business modeling language and method that recognizes the domains actor, behavior and item; ARIS (Architecture of Integrated Information Systems), a business modeling language (supported by a software tool) known as event-driven process chains and finally UML (Unified Modeling Language) for software systems.

However, Lankhorst also identifies common issues among them all, like poorly defined relations between domains; models not integrated; weak formal basis and lack of clearly defined semantics; and most of them miss the overall architecture vision being confined to either business or application and technology domains.

ArchiMate, on the other hand, provides a uniform representation for diagrams that describe EAs. It offers an architectural approach that describes and visualizes the different architecture domains and their underlying relations and dependencies [11]. Moreover, is a visual design language, supports different viewpoints for selected stakeholders and is flexible enough to be easily extended [11]. Therefore, it seemed to fill all the other languages’ gaps and stood out as the one we were looking for to model TIPA.

3. PROBLEM

Organizations focused on providing their clients the best IT services are always concerned about the correctness and efficiency of their processes and how compliant they are with ITSM best practices. These organizations (public hospitals, the naval service, amongst others) make great efforts in modeling not only their architectures but also implementing the ITIL framework. They spend great amounts of money on ITIL software like EasyVista and on EA modeling tools in order to achieve a specific process maturity for their enterprise goals.

TIPA, as we have seen in the previous section, is a process assessment framework that focuses on two major aspects: assessing the maturity of specific IT processes based on the ITIL framework and on providing roadmaps for process improvement.

Unfortunately, TIPA does not ensure the alignment between service management and the organization’s concepts and artifacts in a standardized way. TIPA do not possess any direct means (except the fact they follow a process approach) of linking its assessments and process improvement roadmaps to EA principles and concepts such as applications, infrastructures or business processes, therefore becoming isolated and, eventually, turning obsolete.

EA has several benefits for the success of a business. Some of those benefits are [12]: allows the re-design of business processes to be better, faster and cheaper; cuts costs and future proofs organizations infrastructure by adopting open and/or industry standards; reduces data duplication and redundancy; plans technology replacement/updating effectively; avoids costs by taking better decisions; delivers organizational change more quickly and cheaply.

Therefore, by not possessing any integration mechanisms with EA, TIPA cannot properly provide useful roadmaps towards process improvement and making these organizations more ITIL compliant since most of the above benefits might not be achieved. Furthermore, most organizations cannot obtain the know-how regarding the changing impact in their processes in order to minimize costs, planning and implementation efforts.

All in all, TIPA lacks the means of properly visualizing and understanding these process assessments and process improvement roadmaps. Therefore, we define our problem as the lack of a graphical EA notation for the TIPA framework.

4. RESEARCH

To address our problem, we first modeled TIPA’s metamodel consisting of the main concepts composing the Process Assessment Model (PAM) and Process Reference Model (PRM) and respective relationships amongst them. Afterwards, we proposed a concept and relationship mapping from TIPA to ArchiMate.

4.1 TIPA Metamodel

Figure 1 and 2 show the TIPA metamodel from the maturity dimension (PAM) and from the process dimension (PRM).
PAM is used to assess a specific Process Maturity Level and TIPA represents it by its Maturity Dimension. In order to achieve a desired Process Maturity Level, each organization must understand and know the respective Process Attributes (used to measure the achievement of a particular aspect of a maturity level, focusing on a measurable characteristic of the overall process maturity) for each Maturity Level. Each of these attributes is defined by Generic Practices and Generic Work Products. These practices are well-defined and structured activities that together, with the support and existence of specific work products, help the organizations achieve the Process Attributes for a desired Process Maturity Level.

PRM is used to assess the first level of Process Maturity (where the process is correctly performed) and is represented by TIPA’s Process Maturity and Process Dimension. The difference of the PRM and PAM is that in the Process Reference Model, we evaluate the process from its specific goals and expect results regarding the specific process, whereas in the PAM we do a more transversal assessment (where we evaluate the managing, specification, continual improvement of the process), in the PRM we evaluate each process from a horizontal perspective (we approach each process individually). The following mapping takes into account the TIPA metamodel and the ArchiMate metamodels regarding the Motivation Extension and the Implementation and Migration Extension, both provided by The Open Group [11].

### 4.2 Mapping TIPA to ArchiMate

The TIPA framework considers a process improvement plan as the foundation for a process improvement project with the purpose of achieving a desired Process Maturity Level. ArchiMate’s Implementation and Migration Extension defines a set of concepts that describe the phases of migration planning and implementation governance described in TOGAF’s ADM.

Therefore it provides the ArchiMate concepts that best represent this approach.

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**Table 1. Mapping TIPA elements to ArchiMate (Process Improvement)**

<table>
<thead>
<tr>
<th>TIPA Element</th>
<th>ArchiMate Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Maturity Level</td>
<td>Plateau</td>
</tr>
<tr>
<td>Process Attribute</td>
<td></td>
</tr>
<tr>
<td>Process Purpose</td>
<td>Goal</td>
</tr>
<tr>
<td>Process Expected Result</td>
<td>Requirement</td>
</tr>
<tr>
<td>Generic Practice</td>
<td>Work Package</td>
</tr>
<tr>
<td>Base Practice</td>
<td></td>
</tr>
<tr>
<td>Specific Work Product</td>
<td>Business object,</td>
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<tr>
<td></td>
<td>Data object,</td>
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<tr>
<td></td>
<td>Artifact</td>
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<tr>
<td></td>
<td>Business object,</td>
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<tr>
<td></td>
<td>Data object,</td>
</tr>
<tr>
<td></td>
<td>Artifact, Contract,</td>
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<tr>
<td></td>
<td>Application Component,</td>
</tr>
<tr>
<td></td>
<td>System Software</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>TIPA Relationship</th>
<th>ArchiMate Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composed of</td>
<td>Composition</td>
</tr>
<tr>
<td>Defines</td>
<td>Association</td>
</tr>
<tr>
<td>Achieve, Implements</td>
<td>Realization</td>
</tr>
<tr>
<td>Specializes</td>
<td>Specialization</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Groups, Grouped by</td>
<td>Grouping</td>
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The **Plateau** concept is defined as a relatively stable state of the architecture that exists during a limited period of time. This concept supports each project’s milestones. In TIPA’s process improvement plan, each Process Maturity Level represents a stage...
in time of the processes maturity. This semantic complies with the meaning of Plateau. Each Process Maturity Level is composed of Process Attributes. In ArchiMate, Process Attributes are sub-plateaus of a major plateau that is the Process Maturity Level.

When assessing maturity level 1, the Process Attribute can be defined by the Process Purpose and Process Expected Result concepts. Both these concepts describe respectively the end state and the observable properties that must be realized when performing a specific process. Both concepts are represented by the Goal and Requirement elements respectively.

In ArchiMate, a Work Package is defined as a series of actions designed to accomplish a unique goal within a specified time. The Work Package concept is therefore the concept that best describes TIPA’s Generic Practices in this scope. When performing a maturity level 1 assessment, we consider the Base Practice concept that defines a usual activity performed during the process. Considering these as being a specialization of the Generic Practices in order to achieve the Process Purpose and implement the Process Expected Results that compose the Process Attribute, we represent Base Practices through the Work Package concept.

TIPA’s Specific Work Products are the artifacts associated with the execution of a process and therefore exist only in the scope of the maturity level 1 assessment. They are the ITIL elements that relate to a specific ITIL process. Vicente [13] already mapped these ITIL concepts in ArchiMate: Information (Business Object, Data Object, Artifact), Service Level Agreement (Contract), Operational Level Agreement (Contract), Underpinning Contracts (Contract), Software System (Application Component), Information System (Application Component), Application (Application Component) and Databases (System Software).

Regarding the relationships, these are straightforward and do not need any particular explanation since their semantics concerning both universes (TIPA and ArchiMate) are similar.

5. DEMONSTRATION
Here we demonstrate the practical utility of our mapping in helping a real organization improve a specific process towards ITIL compliance. In this section, we will demonstrate the results of applying our mapping to a real organization – Hospital Santa Maria - using an EA tool (EAMS).

After we mapped TIPA into ArchiMate we needed to demonstrate the practical use of our research. Keeping that in mind we chose to use an EA tool, a solution from Link Consulting, called EAMS. A particular feature of this tool is having the concept of time. By taking advantage of it, we can show how the EA of any organization changes through time.

For demonstration purposes we used a real case study – the Information Systems department of one of the biggest hospitals in Portugal (Hospital Santa Maria). We considered the ITIL Incident Management process since it is the most important process performed inside the department.

We started by defining a blueprint that would illustrate an overview of both the EA of the hospitals’ IS department and the TIPA’s EA representation of the Incident Management level 1 process assessment. Afterwards we defined a hypothetical end date for the process improvement project (31/07/2014). The departments’ reality is represented before that date. After the end date, the departments’ EA regarding the process becomes compliant with ITIL and TIPA. Figure 3 illustrates a blueprint of the current EA concerning the IS department.

Figure 3. Blueprint of the current IS departments’ EA

The upper six containers in Figure 1 possess instantiations of the TIPA framework regarding the process. The Process Expected Results container (1) contains the six expected results of successfully performing the process according to TIPA. The Maturity Level container (2) contains the instantiation of the level of maturity, in this case is Maturity Level 1. The Process Purpose (3) contains an instantiation of the process goal. The Base Practices container (4) has the eleven main activities that compose the process. The INPUT Work Products container (5) contains all the information, software, contracts, etc. that the processes’ practices need as input to operate correctly. The same goes for the OUTPUT Work Products container (6) although in this case these artifacts are the outcome of performing the processes’ activities.

The lower six containers represent the departments’ EA. The artifacts that are illustrated with a green color are the ones already implemented by the department. On the other hand, the red ones are the EA elements yet to be implemented in order for the departments’ process to be fully compliant with the process description according to ITIL. The Activities container (A) contains all the process activities performed by the department staff. The Apps and Software containers (B) has all the software related with the process. The Data container (C) contains all the information, whether digital or physical, related with the process. The Roles container (D) presents all the roles of the different people working in the process. The Actors container (E) has the different teams and respective leaders that perform the process. Finally the Contracts container (F) contains all the contracts related with the process. Figure 4 represents the departments’ EA state after the process improvement project completion.
We then found redundancy. Therefore we conclude our mapping to be redundant.

become a serious problem for automated model transformations. Although we have found instances of almost every deficiency, they seldom occur and their effects can be effectively minimized while modeling. On redundancy, the only problem would be not being able to automate the ArchiMate generation for a small set of TIPA concepts; excess does not possess any real problem; and as for overload, the mapping can be always reversed if we annotate the ArchiMate object properties’ with the name of the TIPA concept that may arise ambiguity.

6.2 Interviews with ITSM experts

To assert the process improvement models’ real utility and correction we looked for a suitable data generation method. We wanted to meet ITIL professionals and the IS department team leaders and present them our work, while asking questions and gathering feedback according to their field of expertise. Interviews seemed the right choice since it allows asking questions that are open-ended and explore emotions, experiences or feelings that cannot easily be observed or described via predefined questionnaire responses [15].

However, we also wanted to have some quantitative data analysis, so, at the end of the interviews, we also asked our guests to fill out a small survey regarding our EAMS blueprint. Therefore, we interviewed 10 specialists, from different areas and nationalities but all with a strong ITIL and Process Assessment background. Our interview subjects were professionals with different ITIL skills and with distinct occupations, including a PhD student, managers, consultants and process owners at distinct, different sized organizations.

Along the interviews, we obtained useful feedback regarding the utility of our research. People found our work innovative and of great utility if perfected in the right way to meet the major stakeholders’ needs. Some suggestions such as “provide reports about the assessment based on the EA elements”, “find a way of scaling the model to different size enterprises”, “extend the model to observe relations between processes”, “add efficiency indicators”, “provide a relationship between the blueprint and the expected practical results from the IT clients’ point of view”. amongst others of more graphical context were given with the purpose of improving our research connection with the EA tool.

The remainder of the interviews served to present our motivation, explain how our blueprint works, our mapping method, the reasoning process behind it and gather ideas and suggestions for further work. At the end of the interviews we asked the subjects to fill out a nine question survey of six multiple choice and three open answer questions about our work. The questions were: 1 - How do you classify the models’ correction?, 2 - How do you classify its utility for its different stakeholders?, 3 - Comparing to other graphic ISO 15504 models you know (if any), how do you rate this one?, 4 – How do you classify its utility for PAM and ITIL validation?, 5 - How do you classify its utility for someone
who is assessing and improving the ITIL implementation on an organization? 6 – Would you use an implementation of this model in any EA tool in order to improve your organizations’ processes? 7 – STOP: What would you remove from the blueprint/model? 8 – KEEP: What would you maintain in the blueprint/model? And 9 – START: What else would you include in the blueprint/model?

The multiple answers had 4 levels and ranged from Poor/Useless/No (1) to Very good/Very useful/Always (4). On Figure 5 we present for each question its average rating.

![Figure 5. Form Answers](image)

From the questionnaire results we concluded that the models’ utility for the different stakeholders is not the most interesting factor of our proposal. However, and depending on the stakeholder, it might prove to be a useful tool to use when improving processes towards the ITIL best practices. The greatest added value of our research was its utility regarding ITIL assessment. Most of the experts we interviewed recognized that our research provided a good way of connecting the assessment methodology with the organizations’ elements that are connected to a specific process and that are illustrated through EA standards. They noticed how clearer it was to understand what aspects of the process had to be improved in order to achieve a greater maturity level and becoming more ITIL compliant and most of them said they would probably use this approach.

7. CONCLUSION
In this paper, we propose a graphical notation of the TIPA Framework using the ArchiMate modeling language in order to address the following issue: lack of a link between this methodology and Enterprise Architecture approaches. In order to do so, we mapped TIPA’s PAM and PRM core concepts and relationships into ArchiMate’s ones.

We then demonstrated our proposal by applying it to a real case study. For that purpose we used an EA tool (EAMS) where we created a blueprint including the departments’ Incident Management process EA and the TIPA model regarding Incident Management. Then we simulated the entire process improvement project in order to achieve Maturity Level 1.

Our evaluation is an analysis of our proposed mappings using the Bunge-Wand-Weber method. We then evaluated our field study demonstration by doing a set of interviews with ITIL experts with the purpose of assessing our proposals’ utility and correctness to the organizational world.

For future work several things can be done regarding our research. An interesting one would be applying the same research to other process assessment frameworks like the PAM for COBIT; then observe and compare the major differences, advantages and disadvantages between those frameworks and TIPA and taking relevant conclusions.

8. REFERENCES