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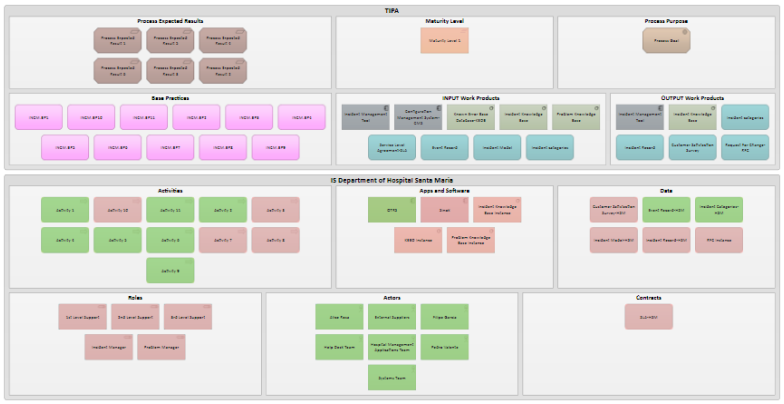

Modeling a Process Assessment Framework in ArchiMate

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Abstract

The Tudor IT Service Management Process Assessment (TIPA) is a process assessment framework that meets two standards: the ISO/IEC 15504 Process Assessment and ITIL. Based on the Process Reference Model (PRM) and the Process Assessment Model (PAM) both described by the ISO/IEC 15504, the main benefits of using this ITIL assessment framework are to provide an IT service management plan and a management framework for process improvement.

However, because of TIPA's textual process descriptions, it does not ensure the alignment between service management and the organization's concepts and artefacts in a standardized way. Even though its ISO/IEC 15504 compliant rigorous structure, TIPA do not possess any direct means of linking its assessments and process improvement roadmaps to EA principles and concepts such as applications, infrastructures or business processes, therefore becoming isolated.

In order to solve this issue, an EA representation for the TIPA framework was proposed by using the EA standard ArchiMate. Moreover, it was also defined a set of viewpoints illustrating the process assessment. This provides TIPA with a standard visual notation and a link between process assessment and EA principles.

Afterwards, the research proposal was demonstrated by applying the TIPA viewpoints to an ITIL process. To demonstrate how this research helps establishing roadmaps for process improvement, a real organization was used as field study and a specific process of theirs chosen.

Finally, the BWW method was used for evaluating the TIPA to ArchiMate mappings, the Moody and Shanks framework for evaluating TIPA viewpoints quality management and interviews with ITSM experts to evaluate the utility of TIPA's ArchiMate notation regarding process improvement roadmaps.

Keywords: IT Service Management, Process Assessment, Process Improvement, ITIL, TIPA, EA, PAM, PRM, ArchiMate, Modeling, Viewpoint, EAMS, Blueprint

Resumo

O Tudor IT Service Management Process Assessment (TIPA) é uma framework de avaliação de processos baseada em dois standards: o ISO/IEC 15504 Process Assessment e o ITIL. Baseado no Process Reference Model (PRM) e no Process Assessment Model (PAM), ambos descritos pelo ISO/IEC 15504, os seus principais benefícios são o de prestar um plano de gestão de serviços das TI e o de ser uma framework de gestão de melhoria de processos ITIL.

Contúdo, devido às descrições textuais presentes no TIPA, este não garante de uma forma *standard*, o alinhamento entre a gestão de serviços e os conceitos e artefactos organizacionais. Apesar da sua estrutura rigorosa e conforme o ISO/IEC 15504, o TIPA não possuí meios directos de ligar as avaliações e planos de melhoria de processos a princípios e conceitos de EA como aplicações, infraestruturas ou processos de negócio, tornando-se assim isolado.

De forma a solucionar este problema, foi proposta uma representação EA para a framework TIPA utilizando o standard de EA ArchiMate. Propôs-se também um conjunto de viewpoints que ilustram a avaliação processual. Com isto o TIPA fica provido de uma notação visual bem como uma ligação entre as avaliações de processos e os princípios de EA.

Demonstrou-se a proposta aplicando os TIPA viewpoints a um processo do ITIL. Para demonstrar a forma como esta pesquisa ajuda no estabelecimento de roadmaps para melhorias de processos, foi utilizado como caso de estudo uma organização real e escolheu-se um processo especifico executado nessa organização para efeitos de demonstração.

Finalmente, utilizou-se o método BWW para avaliar os nossos mapeamentos entre TIPA e ArchiMate, a framework Moody and Shanks para avaliar a qualidade dos TIPA viewpoints e entrevistas com peritos em ITSM para avaliar o valor da notação do TIPA em ArchiMate relativo aos roadmaps de melhoria de processos.

Palavras-chave: Gestão de Serviços das TI, Avaliação de Processos, Melhoria de Processos, ITIL, TIPA, EA, PAM, PRM, ArchiMate, Modelação, Viewpoint, EAMS, Blueprint

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List of Acronyms

IS	Information Systems
IT	Information Technologies
ITIL	IT Infrastructure Library
TIPA	Tudor's ITSM Process Assessment
EA	Enterprise Architecture
EAMS	Enterprise Architecture Management System
PAM	Process Assessment Model
PRM	Process Reference Model
HSM	Hospital Santa Maria

1. Introduction

In the last decades, IT has evolved from its traditional orientation of administrative support to a strategic role, turning business/IT alignment into a major concern. The IT Service Management (ITSM) is an IT Governance approach that evolved naturally as services became underpinned in time by the developing technology. In its early years, IT was mainly focused on application development, but as time went by, new technologies meant concentrating on delivering the created applications as a part of a larger service offering, supporting the business itself (Vicente, Gama & Silva, 2013).

1.1. Motivation

IT Infrastructure Library (ITIL) (Ashley Hanna, John Windebank, Simon Adams & John Sowerby, 2009) is the *de facto* standard for implementing ITSM (Hochstein, Zarnekow, & Brenner, 2005). It is a practical, no-nonsense approach to the identification, planning, delivery and support of IT services to the business (Arraj, 2013). 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 and encompasses various processes which are always described in detail in the book in which they find their key application (Van Bon, 2007).

Enterprise Architecture 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 (Marc Lankhorst, 2013).

TIPA, (Jeb McIntyre, ITIL Expert & Vice President for Third Sky, n.d.) (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) (Barafort B. & Di Renzo B. 2002; Renault & Barafort, 2014) that resulted in a framework to measure maturity levels of organizations based on ITIL. 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 (Jeb McIntyre, ITIL Expert & Vice President for Third Sky, n.d.).

Performing a maturity assessment of processes provides valuable information to understand where the organizations stand and to determine what processes need to be improved. The goal of the TIPA methodology is to prepare the basis for improving the management of the IT services provided by an

organization (Public Research Centre Henri Tudor: Béatrix Barafort, Valérie Betry, Stéphane Cortina, Michel Picard, Marc St-Jean & Alain Renault, 2009) and to provide a measurement framework for continuous improvement.

However, TIPA does not ensure the alignment between service management and the organization's concepts and artefacts in a standardized way. Meaning, 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.

Hence, we define our research problem as the lack of a graphical EA notation for the TIPA framework. The goal of this thesis is therefore to enhance TIPA with an EA-related notation with the purpose of mitigating this problem and to aid discussion and validation by the EA, Process Assessing and even the ITIL community itself. This representations' utility will also be assessed inside real organizations in the scope of process improvement. To achieve this, ArchiMate was used as the standard modelling language.

This research contribution is not just a theoretical concept map between TIPA and the ArchiMate language, but an actual set of TIPA viewpoints in ArchiMate demonstrating the research proposal's value and feasibility and to possibly be applied by TIPA and EA practitioners in the future.

1.2. Research Methodology

The research methodology applied across this research was Design Science Research (DSRM) where a research proposal is developed and validated to solve a problem (Hevner, March, Park, & Ram, 2004). This methodology is an iterative research process with the goal of overcoming standard research methodologies, such as traditional descriptive research and interpretative research, whose research outputs are mostly explanatory and, arguably, not often applicable to the solution of problems encountered in research and practice (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). DSRM accomplishes this by designing and creating an explicitly applicable solution to a problem, being an accepted research paradigm in the area of engineering (Peffers et al., 2007).

Information Systems (IS) is considered an applied research discipline where researchers often apply theory from other disciples, such as economics, computer science, social sciences, among others, in order to solve problems at the intersection of IT and organizations (Peffers et al., 2007). The integration of design as a major component of research has been successfully accomplished by several researchers with the goal of solving relevant organization problems (Peffers et al., 2007).

The DSRM proposes the design and development followed by a demonstration and evaluation of artefacts that may include constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices) and instantiations (implemented and prototype

systems) (Hevner et al., 2004). The main focus of this thesis will be in the creation of a model and an instantiation of that model for a specific ITIL process and also within a real organization.

This methodology proved to be useful throughout this research mainly because it forces us researchers to do research iteratively towards incremental improvement of the research either for the best or the worst of it. The structure of this method helps us see clearly what the weakest link of our research is and on how to improve it towards a better solution for our research problem.

The following chapters follow the methodology's steps: "Background Work" and "Problem" cover 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, "Proposal" presents a proposal as an attempt to solve the previously described problem. Next, the "Demonstration" followed by the "Evaluation" comparing the results with the research questions and to conclude, in "Conclusion" it describes the proposal applicability, scientific contributions, limitations and themes for further work.

2. Literature Review

In this chapter a literature review of the main concepts and areas of research related to this research are presented. It starts by introducing the IT Infrastructure Library (ITIL), a best practice model to IT Service Management. Afterwards, it presents an ITIL Process Assessment Framework based on the ISO/IEC 15504 (Process Assessment Standard) by the Public Research Center Henri Tudor that culminated in the internationally-recognized framework for IT process assessment known as TIPA.

In the third part it describes the Enterprise Architecture, a set of principles, methods and models that are used worldwide in the design and realization of organizations, and also the standard modelling language (ArchiMate) that provides a uniform representation of the organization's EA. Then, it introduces Vicente's research on modelling ITIL in ArchiMate which will help in defining the proposal later on. This chapter concludes with some literature regarding a specific EA tool used to demonstrate the proposal named EAMS.

2.1. ITIL

Enterprises need to manage the delivery of IT services that support users in conducting their activities in the context of business processes (Braun & Winter, 2007). ITIL was created by the Central Computer and Telecommunications Agency (CCTA), an office of the British government and was first released to the public in the late eighties (Sante & Ermers, 2009). ITIL is a common-practice model possessing the character of a branch standard (Gama, Sousa, & Mira da Silva, 2012). 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 (Sante & Ermers, 2009).

In 2007, ITIL V3 introduced the Lifecycle principle, whereby the provisioning of IT services was considered to be a continuous process in which new services are brought into existence whilst others are phased out (Sante & Ermers, 2009). The current version of ITIL covers the major weaknesses identified in the previous versions, namely being too focused on technology (Hochstein et al., 2005). Now, instead of focusing on the service itself, the focus lay on this cycle of life, renewal and decommissioning of services, with a greater business-focused perspective (Sante & Ermers, 2009).

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 various processes which are always described in detail in the book in which they find their key application (Van Bon, 2007).

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 (Béatrix Barafort et al., 2009; McIntyre & Third Sky Inc., n.d.). **Figure 1** illustrates TIPA's Process Assessment Model.

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 (McIntyre & Third Sky Inc., n.d.). When doing a TIPA assessment, a baseline assessment is conducted to get a very clear, objective understanding of where the organization is right now as a basis for sound improvement planning (McIntyre & Third Sky Inc., n.d.).

The process improvement is an approach that is time consuming, mainly because there are many interdependencies between the ITIL processes. For example, change assessment (part of the change management) relies on accurate configuration data, and accurate configuration data is heavily influenced by clearly defined services, etc. So it can be very difficult to increase process maturity in one process if a related process is missing key elements (McIntyre & Third Sky Inc., n.d.).

Another challenge to process improvement is that organizations are often fragmented, with multiple service provider types within the IT organization each with self-contained processes. Viewed independently, there could conceivably be relatively high levels of process capability and maturity. But the business usually views IT as a single entity, which often calls for a standard set of ITSM processes across the organization (McIntyre & Third Sky Inc., n.d.).

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. Realistically, however, this may not always align with business priorities. Improvement might be defined as doing more with less, continuously leading by innovation, or any other definition that best addresses the needs of the enterprise. Business-driven decision-making and strategy definition is the key (McIntyre & Third Sky Inc., n.d.).

Achieving operational excellence and ultimately distinctive performance will require an effective and efficient process across the service Lifecycle. A standards-based approach to assessing process maturity can provide a repeatable, vendor natural, and structured approach to assessment. The results will include return on IT investments, less re-work as a result of improved prioritization of improvement initiatives, and cost reduction as processes mature based on business drivers (McIntyre & Third Sky Inc., n.d.).

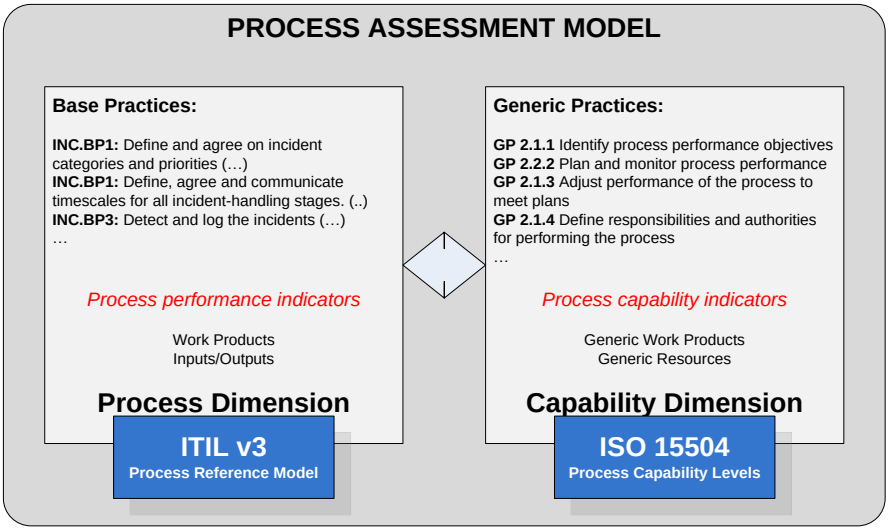


Figure 1: TIPA's Process Assessment Model

2.3. Enterprise Architecture

The Zachman Framework (Zachman, 1987) appeared in the late 1980s with the goal of defining logical constructs (architectures) to represent organizations. It is based on the principle that an organization doesn't have just one architecture, but a set of them, arranged as layers. Each of these layers produce artefacts that answer six organizational questions (What, Where, When, Why, Who, How) (Zachman, 1987).

Today, business performance depends on a balanced and integrated design of the enterprise, involving people, their competencies, organizational structures, business processes, IT, finances, products, and services, as well as its environment (Greefhorst & Proper, 2011).

EA is a coherent set of principles, involving the design and performance of different architectures. It specifies the components and their relationship, which are used to manage and align assets, people, operations and projects to support business goals and strategies (Marc Lankhorst, 2013)(W. Ross, Weill, & C. Robertson, 2006), concerning those properties of an enterprise that are necessary and sufficient to meet its essential requirements (Greefhorst & Proper, 2011).

EA is based on a holistic representation of organizations, on views and the ability to map relationship between artefacts, and on the interdependence and connection between artefacts and architectures, and on the interdependence and connection between layered architectures (Gama et al., 2012) which

usually are (Marc Lankhorst, 2013)(Zachman, 1987): Business, Process, Application, Information, and Technology. The alignment between architectures allows a coherent blueprint of the organization, which is then used for governance of its processes and systems (Pereira & Sousa, 2004).

2.3.1. ArchiMate

The ArchiMate EA modeling language was developed to provide a uniform representation for architecture descriptions (Jonkers, Proper, & Turner, 2009)(The Open Group, 2013). It offers an integrated architecture approach that describes and visualizes the different architecture domains and their underlying relationships and dependencies (Jonkers et al., 2009)(The Open Group, 2013). 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 (Mark Lankhorst, 2004).

In a short time, ArchiMate has become the open standard for architecture modeling in the Netherlands; it is now also becoming well known in the international EA community, being today a TOG standard (Jonkers et al., 2009).

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 (The Open Group, 2013). Besides this, it also distinguishes between active structure (defined as an entity that is capable of performing behavior), behavior (defined as a unit of activity performed by one or more active structure elements) and passive structure elements (defined as objects on which behavior is performed), having also another distinction between internal and external system view.

Furthermore, in order to facilitate tool vendors and methodology experts in providing support for these aspects within the overall ArchiMate language, specific extensions can be added. These modular extensions add new concepts, relationships, or attributes, while complying to the design restriction that ArchiMate is explicitly designed to be as small as possible (The Open Group, 2013). These extensions are thoroughly described in the Proposal chapter.

ArchiMate Metamodels

The ArchiMate framework illustrated in **Figure 2** allows for modelling of the enterprise from different viewpoints, where the position within the cells highlights the concerns of the stakeholder. A stakeholder typically can have concerns that cover multiple cells (The Open Group, 2013).

Each layer corresponds to each of the three levels at which an enterprise can be modelled: business, application, and technology.

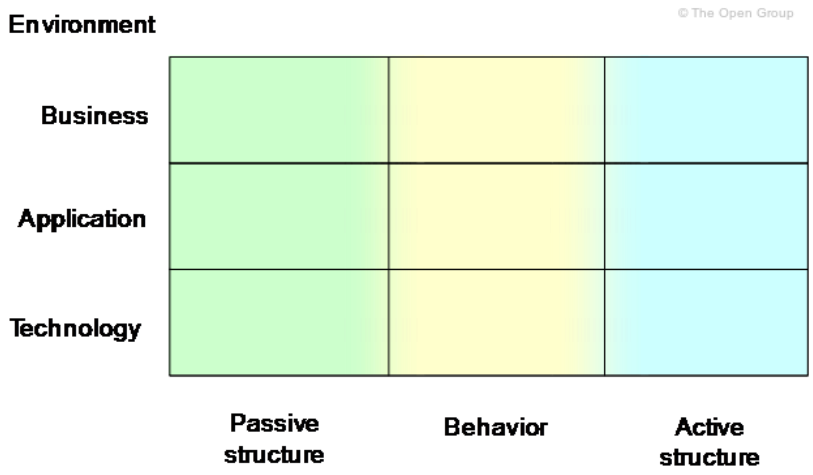


Figure 2: Architectural Framework (from (The Open Group, 2013))

The three aspects that compose ArchiMate's core metamodel (passive structure, behaviour, and active structure) are described in the next section.

Besides the core aspects shown in **Figure 2**, which are mainly operational in nature, the work of an enterprise architect touches upon numerous other aspects, not explicitly covered by the ArchiMate Framework, some of which may cross several (or all) conceptual domains; for example (The Open Group, 2013):

- Goals, principles, and requirements
- Risk and security
- Governance
- Policies and business rules
- Costs
- Performance
- Timing
- Planning and evolution

Not all of these aspects can be completely covered using the standard language extension mechanisms. In order to facilitate tool vendors and methodology experts in providing support for these aspects within the overall ArchiMate language, specific extensions can be added. These modular extensions add new concepts, relationships, or attributes, while complying to the design restriction that ArchiMate is explicitly designed to be as small as possible. The metamodels of the two extensions we will approach in our work are described in the sections below.

Core Metamodel

The ArchiMate's Core Metamodel is presented below in **Figure 3** by a set of concepts and relationships. An explanation of each concept is described below (The Open Group, 2013):

- **Behavior Element:** A behavior element is defined as a unit of activity performed by one or more active structure elements.
- **Passive Structure Element:** A passive structure element is defined as an object on which behavior is performed.
- **Active Structure Element:** An active structure element is defined as an entity that is capable of performing behavior.
- **Service:** A service is defined as a unit of functionality that a system exposes to its environment, while hiding internal operations, which provides a certain value (monetary or otherwise).
- **Interface:** An interface is defined as a point of access where one or more services are made available to the environment.

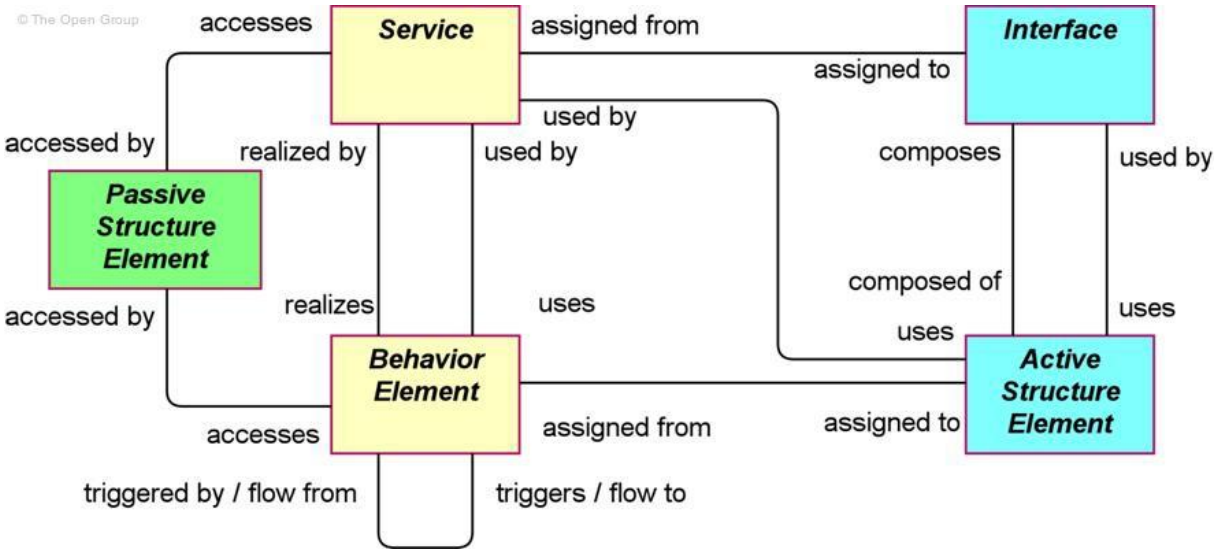


Figure 3: Generic Metamodel: The Core concepts of ArchiMate (from (The Open Group, 2013))

Motivation Extension Metamodel

The Motivation Extension Metamodel is presented below in **Figure 4** by a set of concepts and relationships. An explanation of each concept is described below (The Open Group, 2013):

- **Stakeholder:** A stakeholder is defined as the role of an individual, team, or organization (or classes thereof) that represents their interests in, or concerns relative to, the outcome of the architecture.

- **Driver:** A driver is defined as something that creates, motivates, and fuels the change in an organization.
- **Assessment:** An assessment is defined as the outcome of some analysis of some driver.
- **Goal:** A goal is defined as an end state that a stakeholder intends to achieve.
- **Principle:** A principle is defined as a normative property of all systems in a given context, or the way in which they are realized.
- **Requirement:** A requirement is defined as a statement of need that must be realized by a system.
- **Constraint:** A constraint is defined as a restriction on the way in which a system is realized.

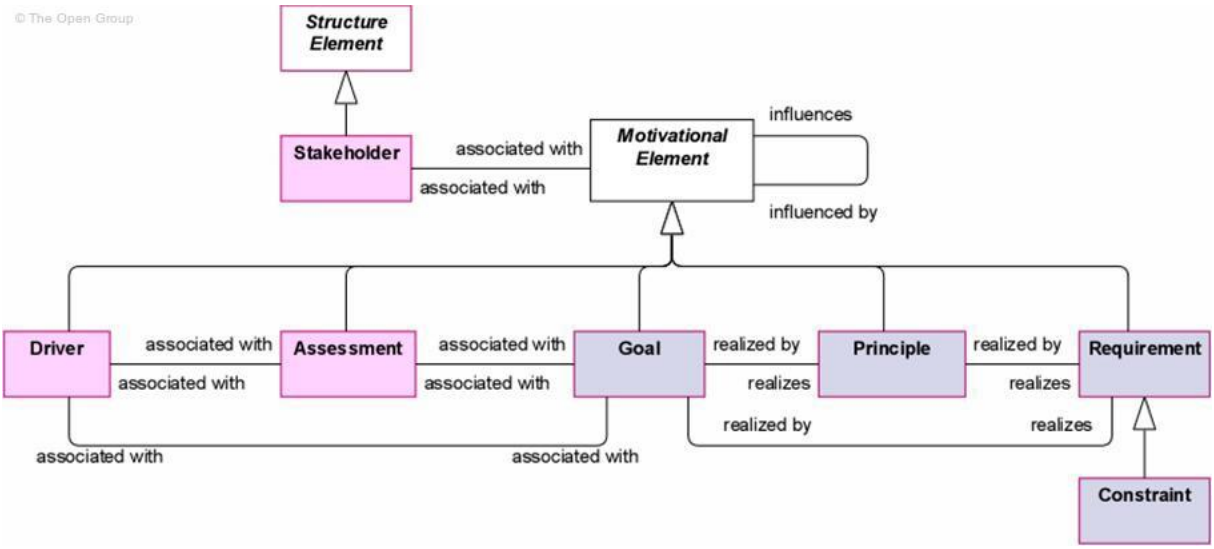


Figure 4: Motivation Extension Metamodel (from (The Open Group, 2013))

Implementation and Migration Extension Metamodel

The Implementation and Migration Extension Metamodel is presented below in **Figure 5** by a set of concepts and relationships. An explanation of each concept is described below (The Open Group, 2013):

- **Work Package:** A work package is defined as a series of actions designed to accomplish a unique goal within a specified time.
- **Deliverable:** A deliverable is defined as a precisely-defined outcome of a work package.
- **Plateau:** A plateau is defined as a relatively stable state of the architecture that exists during a limited period of time.
- **Gap:** A gap is defined as an outcome of a gap analysis between two plateaus.

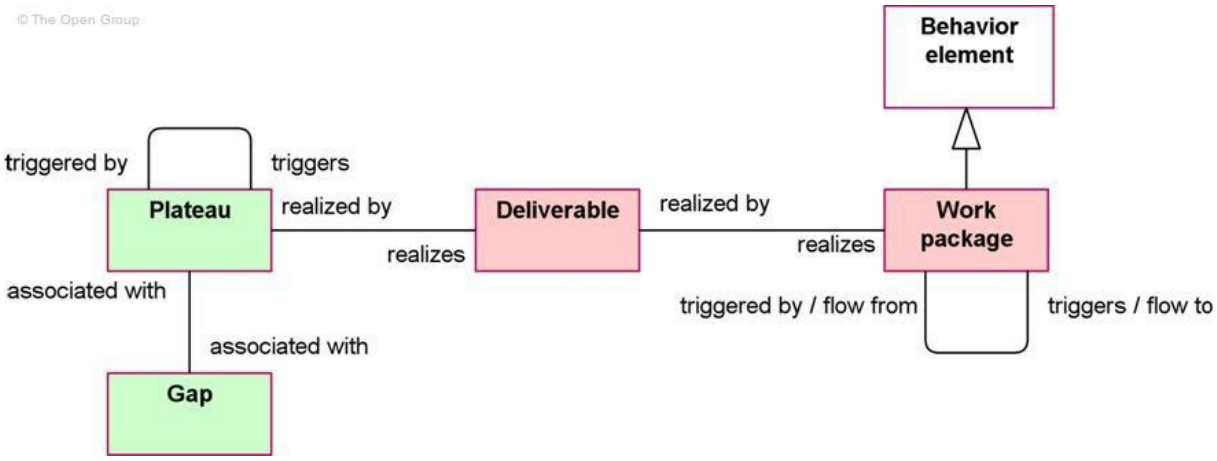


Figure 5: Implementation and Migration Extension Metamodel (from (The Open Group, 2013))

Why ArchiMate

The 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 (Marc Lankhorst, 2013) 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 the fact that 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 integrated architectural approach that describes and visualizes the different architecture domains and their underlying relations and dependencies (The Open Group, 2013). 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 (The Open Group, 2013). Therefore, it seemed to fill all the other languages' gaps and stood out as the best one for modeling TIPA.

2.4. Enterprise Architecture Management System (EAMS)

Enterprise Architecture Management System, better known as EAMS by Link Consulting, is a new kind of EA tool, which collects and manages information from one or various sources and presents it in a comprehensible time based visual formats (Link Consulting, 2014). EAMS is both:

1. An information aggregator with connectors for the main Business and IT applications and catalogs (EA, BI e CMDB…).

2. A powerful visualizer mapping information in relevant contexts establishing cartographical reference of all relevant information and adding a powerful feature for time navigation on the architectural blueprints.

Every EA solution should function as a centralized corporate repository of the information contained in other existing systems. EAMS provides a framework, connectors and integration mechanisms that combine and conciliate the information exchange between the architecture repository and other applications (Link Consulting, 2014).

Unlike most EA tools, EAMS is not oriented towards modeling activities. Every diagram modeled by a user, has to be manually conciliated, maintained and versioned, which leads to a chaotic operational scenario with substantial complexity requiring considerable amounts of efforts, driving the Enterprise Architecture initiative into the ground. Instead, EAMS is based in automation mechanisms that, supported only by repository data, can generate the architectural artefacts necessary to sustain the EA planning, operation and management. Such allows the users to explore and navigate in a seamless manner through architectural views of past, current and target scenarios (Link Consulting, 2014).

All of this converges into an easy to use communication tool that was built not only for technical profiles, but also for all other stakeholders involved in EA initiatives (Link Consulting, 2014).

2.5. ITIL in ArchiMate

Vicente (Marco Vicente et al., 2013) approached the concept of integrating EA and ITIL and successfully defined an EA specification in ArchiMate that uses ITIL principles, methods, processes and concepts to perform IT Service Management, and general EA principles, methods and models to the design and realization of the remaining organizational structure (Marco Vicente et al., 2013).

Vicente had already defined this architecture's motivation model, its drivers, assessments, goals, requirements and principles (M. Vicente, Gama, & Mira da Silva, 2014), and continued his work by representing the architecture, by modeling ITIL components and relationships according to the EA approach and the ITIL principles, and constraining the organization's freedom of design (Marco Vicente et al., 2013).

One of the problems that Vicente noticed was the fact that having two different frameworks to approach governance could lead to several setbacks. In a time when organizations strive to be efficient and effective, it seemed counterintuitive to be wasting resources by having different organizational departments or teams handling both approaches independently. In fact, while enterprise architects are designing organizations based on EA principles and trying to align business and information systems, its IT departments are using ITIL to design and manage IT services. This is being done in closed silos, where the architect knows little about how ITIL is being used on the IT departments, increasing the gap between business and IT, strategy and functional integration (Marco Vicente et al., 2013).

Vicente had also realized that because ITIL content is based on natural language descriptions, it lacks a formal notation and representation, what sometimes led to different interpretations and discussion between practitioners. Therefore, his work also aimed to enhance ITIL with a formal representation of concepts for knowledge sharing, stakeholder communication and to aid discussion and validation by the ITIL community itself (Marco Vicente et al., 2013). This approach, has the goal of giving the architect the elements and models to design specific organizations according to best practices and could also become a tool to check for compliance and maturity levels of processes in particular organizations (Marco Vicente et al., 2013).

As far as this research is concerned, Vicente's work is used to complement TIPA's representation in ArchiMate. **Table 1** presents a map with the summary of ITIL core concepts to ArchiMate proposed by Vicente (Marco Vicente et al., 2013).

Table 1: Mapping ITIL and ArchiMate concepts (adapted from (Marco Vicente et al., 2013))

ITIL Concept	ArchiMate Concept
Department, Business unit	Business Actor
Role, Service Owner	Business Role
Channel, Interface	Business Interface
Collaboration	Business collaboration
Process	Business process
Service	Business service, Application service
Function	Business function
Event	Business event
Information	Business object, Data object, Artefact
Service Level Agreement, Operational Level Agreement, Underpinning Contracts	Contract
Business Service	Product
Value, Key performance indicators, Critical success factors, Metrics	Value
Software system, Information system, Application	Application component
Application assets relationship	Application collaboration, Application interaction
Software function	Application function
Databases (CMDB, KEDB, ...)	System software
Database access	Infrastructure service, Infrastructure interface
Database function	Infrastructure function
Console, server, mainframe	Node, Device
Network	Network, Communication path
Product	N.D.

3. Problem

This chapter describes the “Identify problem and motivate” step of the DSRM process, where awareness and recognition of the problem is taken from the state of the art review, giving us issues that must be addressed.

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 considerable 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 seen in the previous chapter, 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.

However, TIPA does not ensure the alignment between service management and the organization’s concepts and artefacts in a standardized way. Meaning, 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 (http://www.jiscinfonet.ac.uk/infokits/ea/benefits/):

- 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 take advantage of the above mentioned benefits. Furthermore, most organizations cannot obtain the know-how regarding

the changing impact in their processes in order to minimize costs, planning and implementation efforts. **Figure 6** illustrates our research problem.

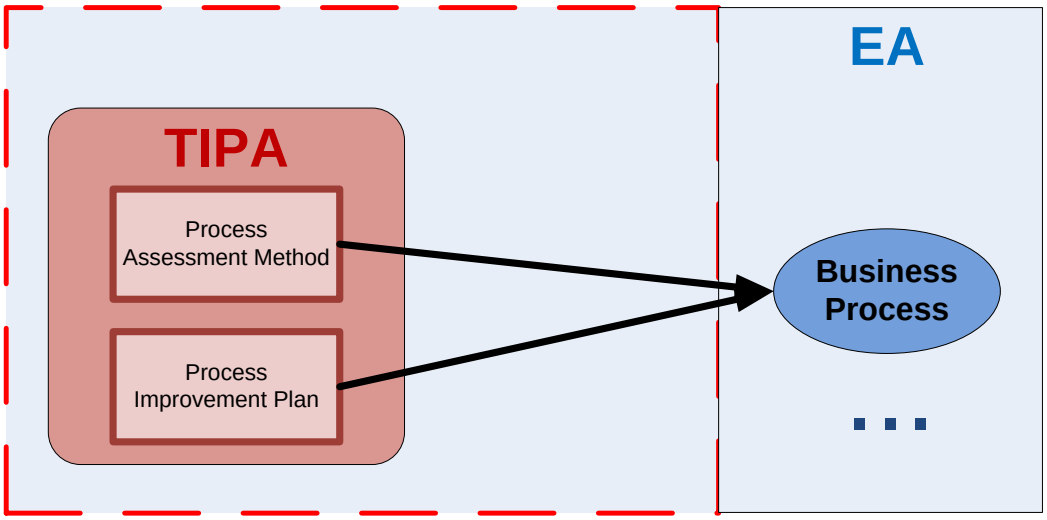


Figure 6: The non-integration issue of TIPA with EA

In **Figure 6** we illustrate two major concepts. The TIPA framework that provides an ISO 15504 based Process Assessment Method and also a Process Improvement Plan for achieve a desired process maturity level and the EA framework, based on a holistic representation of organizations, on views and the ability to map relationship between artefacts, and on the interdependence and connection between artefacts and architectures. The Business Process concept is one of the most important concepts in any Enterprise Architecture. The TIPA's two main procedures referred above, focus on this concept which is why it is important for EA to extend these Process Assessment frameworks in order to represent process assessments in the organizations' EA. Not only that, but also to provide a clearer way of representing TIPA roadmaps towards process improvement and achieving desired process maturity level.

All in all, TIPA lacks the means of properly visualizing and understanding these process assessments and process improvement roadmaps. In short, the research problem can be defined as the **lack of a graphical EA notation for the TIPA framework**.

4. Proposal

To address the research problem, was defined a 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, was proposed a concept and relationship mapping from TIPA to ArchiMate. With that mapping, five viewpoints in ArchiMate were defined that illustrate the main views of the assessment method considering the maturity and the maturity + process dimensions. This chapter corresponds to the "Define objectives of a solution" and to the "Design and Development" steps of the DSRM process (Hevner et al., 2004).

4.1. Objectives of a solution

For the purpose of solving the issues mentioned in the Problem chapter a solution had to be defined focusing on the following objectives:

- Ensuring the alignment between service management assessments and the organization's concepts and artefacts in a standardized way.
- Ensuring a mean of properly visualizing and understanding process assessments and process improvement roadmaps.

A solution that complies with both objectives is a proper solution for solving the research problem.

4.2. TIPA Metamodel

In an attempt to define a TIPA's metamodel was considered a two-way approach. Firstly, all concepts and relationships that define the PAM were considered. Afterwards, those concepts were related with the PRM ones in order to assess whether the process purpose and expected results were properly achieved. On **Figure 7** we represent TIPA's process assessment metamodel from a *maturity dimension* perspective (PAM).

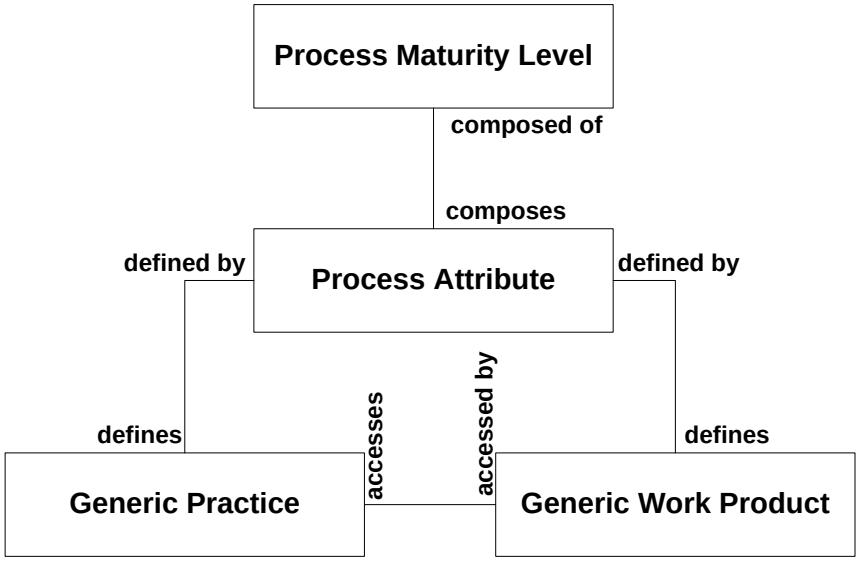


Figure 7: TIPA Process Assessment Metamodel: Maturity Dimension

The Process Assessment Model (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 then defined by Generic Practices and Generic Work Products. These Generic Practices are well-defined and structured activities that together, with the support and existence of specific Generic Work Products, help the organizations achieve the necessary Process Attributes for a desired Process Maturity Level.

Figure 8 illustrates the same metamodel from the process dimension perspective representing the specific aspects of a business process (PRM - maturity level 1 achievement).

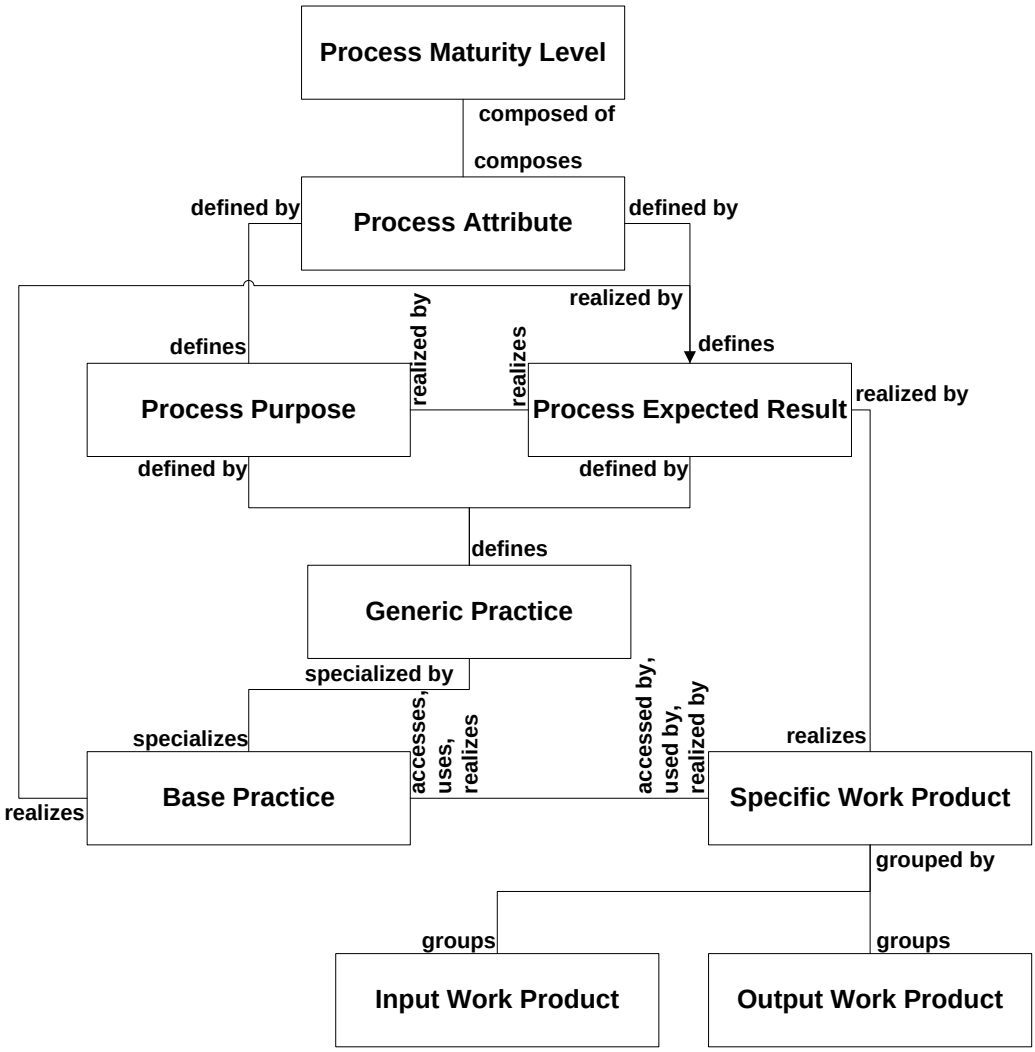


Figure 8: TIPA Process Assessment Metamodel: Maturity + Process Dimension

The Process Reference Model (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 compared to the PAM is that in the Process Reference Model, we evaluate the process from its specific goals and expected 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 each process is evaluated from a horizontal perspective (we approach each process individually).

So for this particular Process Maturity Level, its only attribute is the achievement of the process purpose that is obtained by positively assessing its expected results. The existence of these expected results is presented by the Generic Practice that is specified by a set of Base Practices that correspond to the main activities that define the process. Those activities are then supported by specific work products whose existence supports the correct implementation of those activities. Furthermore, these work products can be used as input for a specific activity or as output from an activity to another.

Both **Figure 7** and **Figure 8** representing TIPA's metamodel are conceptual mappings where each concept is related to another by well-defined relationships.

4.3. Mapping TIPA Process Assessment Scope to ArchiMate

A process assessment evaluates the level of maturity of giving processes which means there is a kind of motivation in performing these process assessment methodologies by the organizations. Therefore, each concept of the PAM and the PRM used by the TIPA framework has a motivational meaning supporting it.

ArchiMate provides an extension named the Motivation Extension which models the motivations, or reasons, that underlie the design or change of some EA. Its concerns are the architecture strategy and tactics as well as the motivation.

Having said this, the mapping approach was to follow a relation between each TIPA concept and elements from the Motivation Extension. On **Table 2** and **Table 3** they illustrate the mapping of the TIPA process assessment core relationships and concepts to ArchiMate respectively.

Table 2: Mapping TIPA relationships to ArchiMate (Process Assessment Scope)

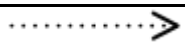
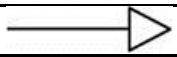
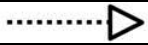
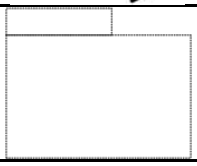
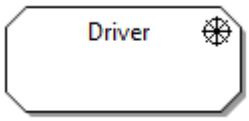
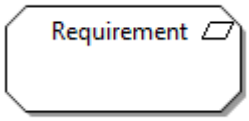
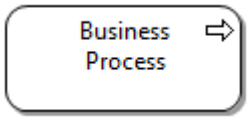
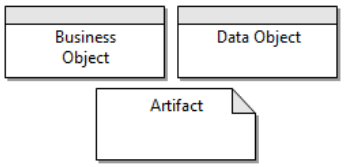
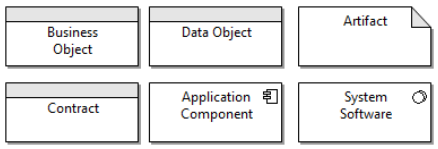
TIPA relationship	ArchiMate	ArchiMate representation
Composed of	Composition	
Defines	Association	
Uses	Used By	
Accesses	Access	
Specializes	Specialization	
Achieve, Implements	Realization	
Groups, Grouped by	Grouping	

Table 3: Mapping TIPA concepts to ArchiMate (Process Assessment Scope)

TIPA Element	ArchiMate Element	ArchiMate representation
Process Maturity Level **Process Attribute**	Driver	
Process Purpose	Goal	
Process Expected Result	Requirement	
Generic Practice **Base Practice**	Business Process	
Generic Work Product	Business object, Data object, Artefact	
Specific Work Product	Business object, Data object, Artefact, Contract, Application Component, System Software	

A TIPA assessment provides a motivational evaluation of the compliance between each organization's processes and respective ITIL process. ArchiMate's Motivation Extension provides the motivational elements to support this approach. The Motivation elements are Stakeholder, Driver, Assessment, Goal, Requirement, Principle and Constraint. However, only some will be considered regarding the mapping.

TIPA's maturity dimension has Process Maturity Levels that define a point on a six-point scale that represents the process maturity. In the TIPA assessment scope, is assumed that each Process Maturity Level represents the level of compliance each process has with the respective ITIL process which means, the strategy behind the achievement of a desired Process Maturity Level is something that motivates, and fuels the change in an organization. That semantic is represented by the **Driver** element in ArchiMate. Furthermore, the name of a driver should preferably be a noun which complies with the respective TIPA concept itself.

Then there is the Process Attribute concept that represents the sub-levels of Process Maturity Levels. They are used to measure the achievement of a particular aspect of a level, focusing on a measurable

characteristic of the overall process maturity. Together, these Process Attributes compose the Process Maturity Level. In ArchiMate it represents that as sub-driver of a major driver 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 TIPA there is the concept of Generic Practice. Generic Practices are activities usually executed for maturity levels upper than level 1. They are activities of a generic type, and they apply to any process, producing the attribute's expected results and supporting the achievement of the attribute. In ArchiMate, a Business Process is defined as a behavior element that groups behavior based on an ordering of activities. Usually, architects use the Business Process element as an abstraction for a set of individual activities (or tasks). Assuming the Business Process as the set of activities to define a Process Attribute, we can then represent a Generic Practice in ArchiMate with the Business Process element.

When performing a maturity level 1 targeted assessment, assessors consider the Base Practices concept that defines the usual activities performed during the process. If considering those 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, these Base Practices can be represented in ArchiMate with the Business Process element also.

TIPA's Generic Work Products are the inputs and outputs of a Process Attribute and so they have a relation to the process Generic Practices. These Work Products are generic to every ITIL process and are represented by the Information element in ITIL. That same element was mapped in ArchiMate by Vicente (Marco Vicente et al., 2013): Information - Business Object.

TIPA's Specific Work Products are the artefacts 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 (Marco Vicente et al., 2013) already mapped those ITIL concepts in ArchiMate: Information (Business Object, Data Object, and Artefact), 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).

Another particularity of the specific work product concept is the fact that each one can be classified as an input work product or output work product. All the input work products have the same characteristic of being consumed by a Base Practice. All the output work products have the same characteristic of being produced by a Base Practice. The way ArchiMate relates a set of elements based on some common characteristic is through the grouping relationship.

4.4. TIPA Viewpoints

The concept of viewpoint is a mean to focus on particular aspects of the architecture. These aspects are determined by the concerns of a stakeholder whit whom communication takes place. Therefore, the content of a specific viewpoint is entirely dependent on the argumentation with respect to a stakeholder's concern (The Open Group, 2013).

The purpose of designing viewpoints is of communicating certain aspects of the architecture. The communication enabled by viewpoints can be strictly informative, but in general is bi-directional. The architect informs stakeholders, and stakeholders give their feedback on the presented aspects. Relevance to a stakeholder's concern *is* the selection criterion that is used to determine which objects and relationships are to appear in the view (The Open Group, 2013).

This section defines five viewpoints that illustrate the relationships amongst the various concepts of the PAM and the PRM used by the TIPA framework that are relevant to the stakeholders of an organization. Together, these viewpoints show us the overall picture of the entire assessment.

The first subsection classifies the different viewpoint according to The Open Group standard, and then the five next subsections explain each proposed TIPA viewpoint along with a formal description and illustration of concepts and relationships that are compliant with the ArchiMate 2.1 viewpoint specification.

4.4.1. Viewpoint Classification

An architect is confronted with many different types of stakeholders and concerns. To help him selecting the right viewpoints for the task at hand, a framework was introduced for the definition and classification of viewpoints and views. This framework is based on two dimensions: *purpose* and *content*. The following three types of architecture support the *purpose* dimension of architecture views (The Open Group, 2013):

- **Designing:** Design viewpoints support architects and designers in the design process from initial sketch to detailed design. Typically, design viewpoints consist of diagrams, like those used in, for example, UML.
- **Deciding:** Decision support viewpoints assist managers in the process of decision-making by offering insight into cross-domain architecture relationships, typically through projections and intersections of underlying models, but also by means of analytical techniques. Typical examples are cross-reference tables, landscape maps, lists, and reports.
- **Informing:** Informing viewpoints help to inform any stakeholder about the enterprise architecture, in order to achieve understanding, obtain commitment, and convince adversaries. Typical examples are illustrations, animations, cartoons, flyers, etc.

The goal of this classification is to assist architects and others find suitable viewpoints given their task at hand; i.e., the purpose that a view must serve and the content it should display. With the help of this framework, it is easier to find typical viewpoints that might be useful in a given situation. This implies that we do not provide an orthogonal categorization of each viewpoint into one of three classes; these categories are not exclusive in the sense that a viewpoint in one category cannot be applied to achieve another type of support. For instance, some decision support viewpoints may be used to communicate to any other stakeholders as well (The Open Group, 2013).

For characterizing the content of a view we define the following abstraction levels (The Open Group, 2013):

- **Details:** Views on the detailed level typically consider one layer and one aspect from the ArchiMate Framework. Typical stakeholders are a software engineer responsible for design and implementation of a software component or a process owner responsible for effective and efficient process execution. Examples of views are a BPMN process diagram and a UML class diagram.

- **Coherence:** At the coherence abstraction level, multiple layers or multiple aspects are spanned. Extending the view to more than one layer or aspect enables the stakeholder to focus on architecture relationships like process-uses-system (multiple layer) or application-uses-object (multiple aspect). Typical stakeholders are operational managers responsible for a collection of IT services or business processes.

- **Overview:** The overview abstraction level addresses both multiple layers and multiple aspects. Typically, such overviews are addressed to enterprise architects and decision-makers, such as CEOs and CIOs.

In **Figure 9**, the dimensions of purpose and abstraction level are visualized in a single picture, together with examples of typical stakeholders that are addressed by these viewpoints. The top half of this figure shows the purpose dimension, while the bottom half shows the level of abstraction (or detail).

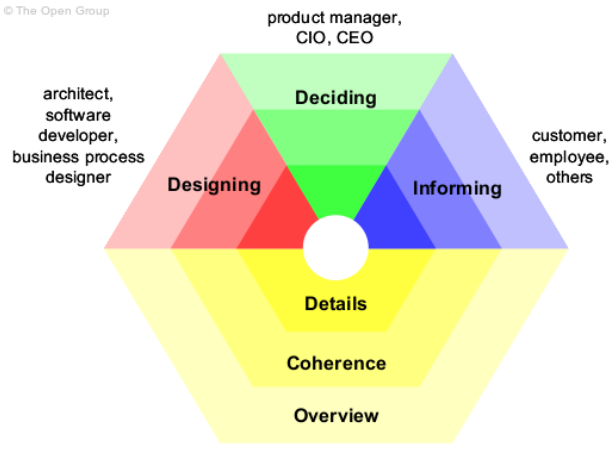
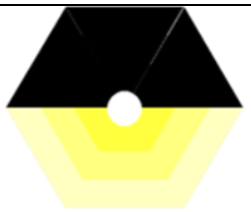


Figure 9: Classification of Enterprise Architecture Viewpoints (from (The Open Group, 2013))

4.4.2. Process Maturity Level Composition Viewpoint

The Process Maturity Level Composition Viewpoint allows a designer to model the refinement of Process Maturity Levels (Drivers) into the respective Process Attributes (Drivers) that compose those Process Maturity Levels. The refinement of Process Maturity Levels into Process Attributes is modelled using the composition relationship. This view is a specialization of ArchiMate's Motivation Viewpoint.

Table 4: Process Maturity Level Composition Viewpoint Description

Process Maturity Level Composition Viewpoint		
Stakeholders	Enterprise and ICT architects, process managers, organization's board of administrators	
Concerns	Architecture strategy and tactics, motivation	
Purpose	Designing, deciding	
Abstraction Level	Details	
Layer	Business, Application, and Technology layers	
Aspects	Motivation	

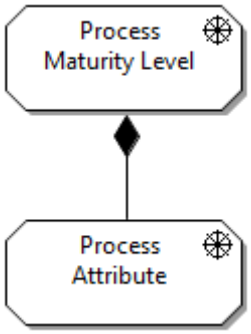
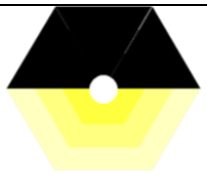


Figure 10: Process Maturity Level Composition Viewpoint

4.4.3. Process Attribute Definition Viewpoint

The Process Attribute Definition Viewpoint allows a designer to model the refinement of a Process Attribute into the Generic Practices and Generic Work Products that define that same Process Attribute. The refinement is modelled using the association relationship. This view is an extension of ArchiMate's Motivation Viewpoint.

Table 5: Process Attribute Definition Viewpoint Description

Process Attribute Definition Viewpoint		
Stakeholders	Enterprise and ICT architects, process managers, organization's board of administrators	
Concerns	Architecture strategy and tactics, motivation	
Purpose	Designing	
Abstraction Level	Details	
Layer	Business, Application, and Technology layers	
Aspects	Motivation	

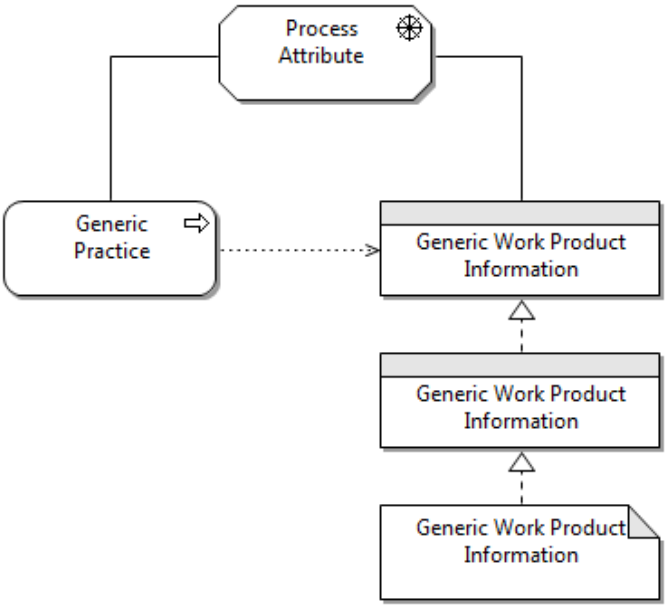


Figure 11: Process Attribute Definition Viewpoint

4.4.4. Generic Practice Viewpoint

The Generic Practice Viewpoint is used to show the high-level structure and composition of a specific process generic practice. Next to the practices themselves, this viewpoint contains other directly related concepts, such as:

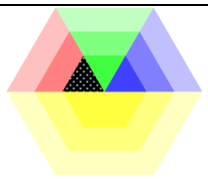
1. The Activities that compose a generic practice and the services that they offer to the outside world, showing how a base practice contributes to the realization of the company's services;

2. The assignment of generic practices to roles, which gives insight into the responsibilities of the associated actors;

3. The information used by the generic practice.

This view is an extension of ArchiMate's Business Process Viewpoint.

Table 6: Generic Practice Viewpoint Description

Generic Practice Viewpoint		
Stakeholders	Process and domain architects, process managers	
Concerns	Structure of generic practices, consistency and completeness, responsibilities	
Purpose	Designing	
Abstraction Level	Detail	
Layer	Business layer	
Aspects	Behavior	

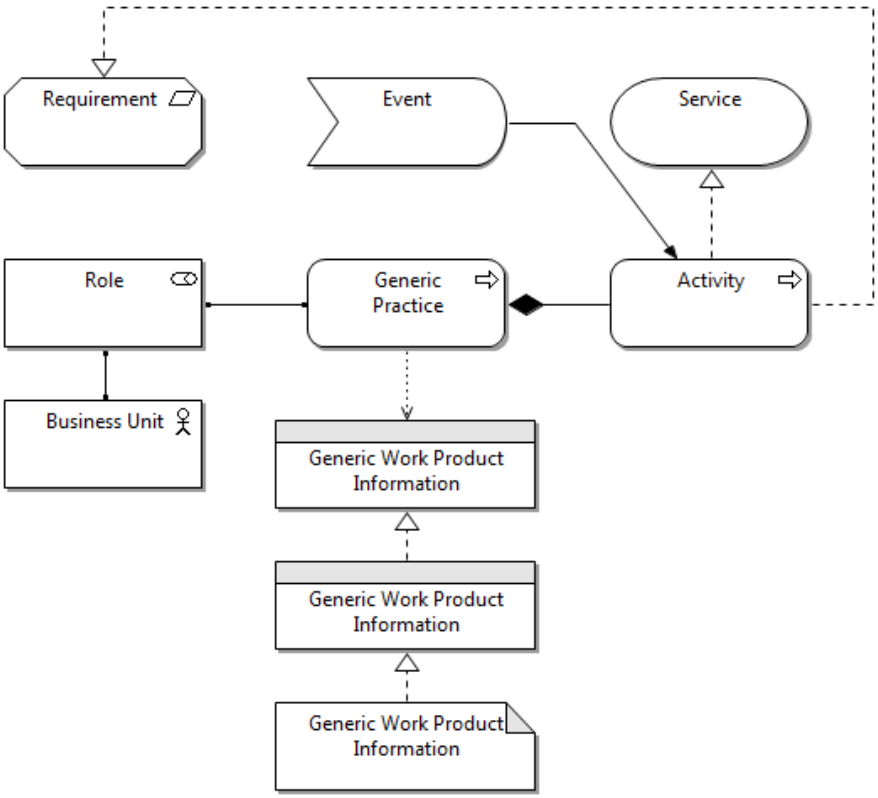


Figure 12: Generic Practice Viewpoint

4.4.5. Process Expected Result Realization Viewpoint

The Process Expected Result Realization Viewpoint requirements allow the designer to model the realization of each Process Expected Result by the ArchiMate's core elements that represent the ITIL

elements of a specific process, such as business actors, business services, business processes, application services, application components, etc. This view is an extension of ArchiMate's Requirements Realization Viewpoint. This viewpoint also relates each Process Expected Result with the respective Process Purpose. The realization relationship is used for connecting all the elements of this viewpoint with the Process Expected Result.

Table 7: Process Expected Result Realization Viewpoint Description

Process Expected Result Realization Viewpoint		
Stakeholders	Enterprise and ICT architects, requirements managers, process managers, organization's board of administrators	
Concerns	Architecture strategy and tactics, motivation	
Purpose	Designing, deciding	
Abstraction Level	Details	
Layer	Business, Application, and Technology layers	
Aspects	Motivation	

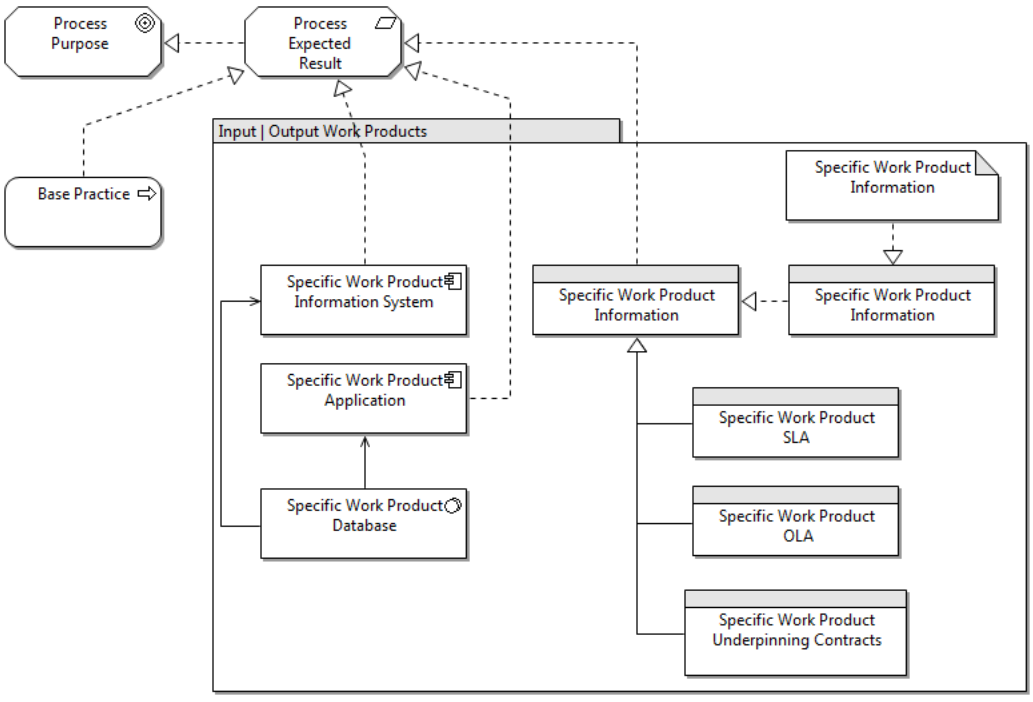


Figure 13: Process Expected Result Realization Viewpoint

4.4.6. Base Practice Viewpoint

The Base Practice Viewpoint is used to show the high-level structure and composition of a specific process base practice. Next to the practices themselves, this viewpoint contains other directly related concepts, such as:

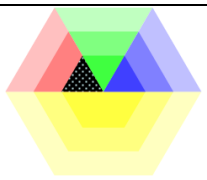
1. The Activities that compose a base practice and the services that they offer to the outside world, showing how a base practice contributes to the realization of the company's services;

2. The assignment of base practices to roles, which gives insight into the responsibilities of the associated actors;

3. The information and applications/Information Systems used by the base practice.

This view is an extension of ArchiMate's Business Process Viewpoint.

Table 8: Base Practice Viewpoint Description

<table>
<tr><td colspan="3">Base Practice Viewpoint</td></tr>
<tr><td>Stakeholders</td><td colspan="2">Process and domain architects, process managers</td></tr>
<tr><td>Concerns</td><td colspan="2">Structure of generic practices, consistency and completeness, responsibilities</td></tr>
<tr><td>Purpose</td><td>Designing</td><td rowspan="2">  </td></tr>
<tr><td>Abstraction Level</td><td>Detail</td></tr>
<tr><td>Layer</td><td colspan="2">Business layer</td></tr>
<tr><td>Aspects</td><td colspan="2">Behavior</td></tr>
</table>

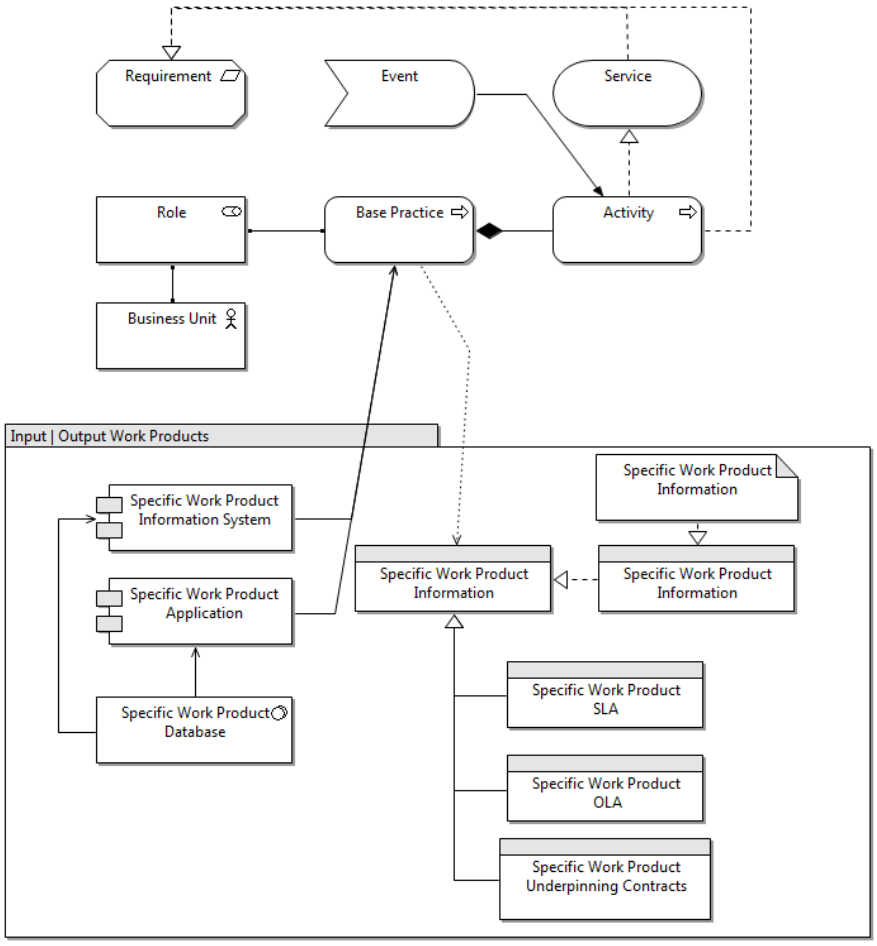


Figure 14: Base Practice Viewpoint

Each of these viewpoints is applicable to every ITIL process in the TIPA framework. The Demonstration chapter demonstrates an application of each of the five viewpoints in the context of a popular and well-known ITIL process.

4.5. Mapping TIPA Process Improvement Scope to ArchiMate

The TIPA framework for process improvement 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 best 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.

Hence, considering the process improvement scope, this mapping scenario follows an approach of relating each TIPA concept with elements from the Implementation and Migration Extension. **Table 9** and **Table 10** illustrate the mapping of the TIPA relationships and concepts to ArchiMate respectively, now considering the Process Improvement scope.

Table 9: Mapping TIPA relationships to ArchiMate (Process Improvement Scope)

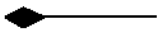
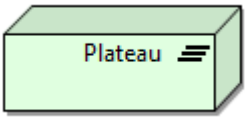
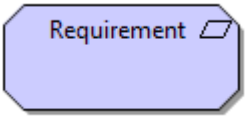
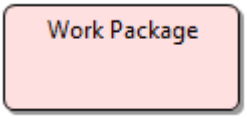
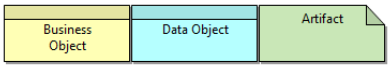
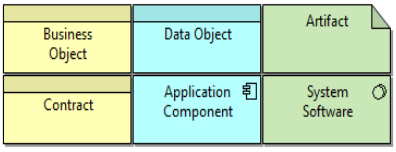
TIPA relationship	ArchiMate	ArchiMate representation
Composed of	Composition	
Defines	Association	
Uses	Used By	
Accesses	Access	
Specializes	Specialization	
Achieve, Implements	Realization	
Groups, Grouped by	Grouping	

Table 10: Mapping TIPA concepts to ArchiMate (Process Improvement Scope)

TIPA Element	ArchiMate Element	ArchiMate representation
Process Maturity Level **Process Attribute**	Plateau	
Process Purpose	Goal	
Process Expected Result	Requirement	
Generic Practice **Base Practice**	Work Package	
Generic Work Product	Business object, Data object, Artefact	
Specific Work Product	Business object, Data object, Artefact, Contract, Application Component, System Software	

The only difference between the first mapping and this one is the meaning behind Process Maturity Level, Process Attribute and the Generic and Base Practices in the scope of process improvement.

Since this mapping approaches a different scope, it is needed to use different ArchiMate concepts that can model these same TIPA concepts concerning process improvement.

The Plateau concept is defined as a relatively stable state of the architecture that exists during a limited period of time. This concept supports the milestones that are defined in each project. In the scope of process improvement, 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.

The Process Purpose and Process Expected Results have the same ArchiMate representation regarding both scopes.

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, assessors 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, the Base Practices are represented through the Work Package concept.

In this chapter was proposed a solution that would take into consideration the two objectives: **Ensuring the alignment between service management and the organization's concepts and artefacts in a standardized way** and **Ensuring a mean of properly visualizing and understanding process assessments and process improvement roadmaps in a clearer, interactive and efficient way**.

Two mapping approaches were used, one from a process assessment perspective and the other from a process improvement perspective both described by the TIPA framework. For each one different ArchiMate extensions were used to suit both TIPA approaches (one focused more on the motivational and strategic part of the business – Motivation Extension and the other focused on the change and implementation of new aspects of a business – Implementation and Migration Extension).

The next chapters demonstrate the research proposal from both perspectives mentioned in the TIPA framework using different target subjects (a theoretical and a practical one – field study). Then, an evaluation of the proposal is made using different scientific evaluation methods and also field experts' feedback through interviews.

5. Demonstration

This chapter describes the "Demonstration" step of the DSRM method (Hevner et al., 2004), where it demonstrates two different applications of the research proposal. First it demonstrates an example of applying the proposed TIPA viewpoints to a specific ITIL process (Incident Management). Finally it demonstrates the practical utility of using the second mapping in helping organizations improve their processes towards ITIL compliance.

5.1. Using TIPA Viewpoints for Modeling the ITIL Incident Management Process in ArchiMate

After mapping TIPA's concepts into ArchiMate and defining our viewpoints, was important to demonstrate how the proposal could be applied in practice and thus add value to the process assessment methodology itself. In order to do that, the TIPA Incident Management process assessment was used as an instantiation of the defined TIPA viewpoints.

It was only considered the modelling of the process assessment regarding the Process Maturity Level 1 since it covers all the concept hierarchy and is defined as the minimum requirement to successfully operate the process inside organizations. This demonstration covers the first mapping, meaning it is aimed for assessing ITIL processes.

The Process Maturity Level Composition Viewpoint, proposed earlier in **Figure 10** is demonstrated below in **Figure 15** with the incident management process.

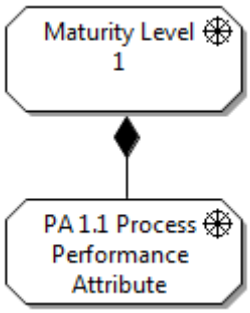


Figure 15: Process Maturity Level Composition Viewpoint: Incident Management

The Process Attribute Definition Viewpoint, proposed earlier in **Figure 11** is demonstrated below in **Figure 16** with the incident management process.

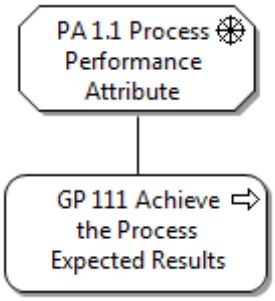


Figure 16: Process Attribute Definition Viewpoint: Incident Management

The Process Expected Result Realization Viewpoint, proposed earlier in **Figure 13** is demonstrated below in **Figure 17** with the incident management process (Expected Result 5 - Incidents are tracked through each stage of their lifecycle).

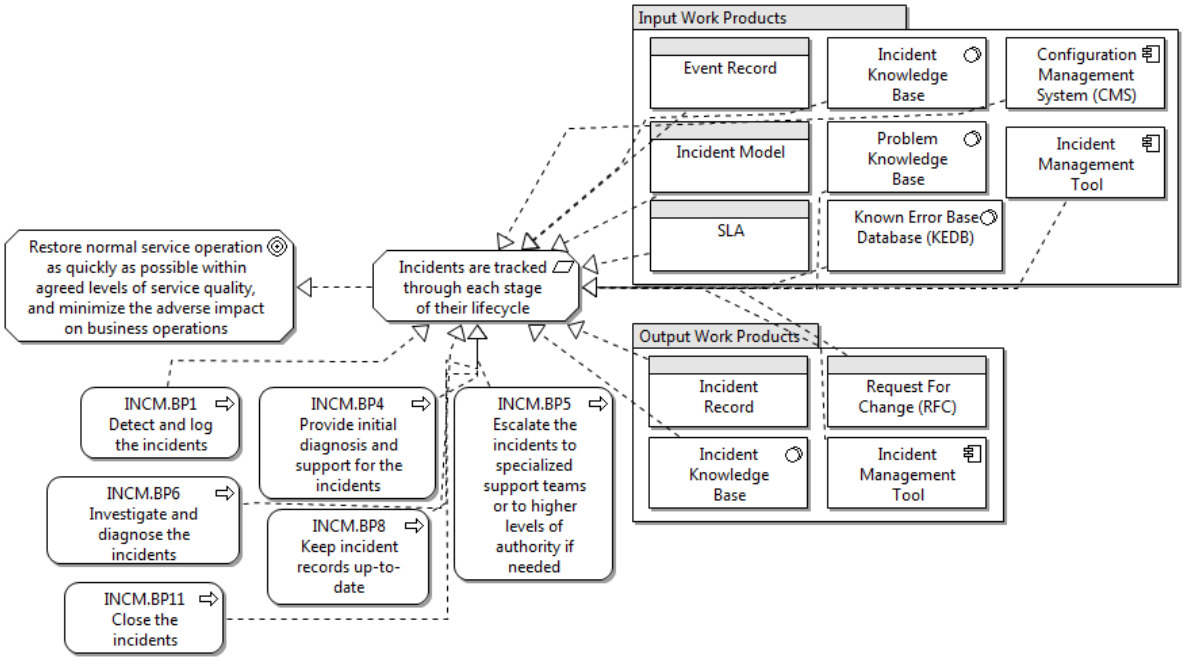


Figure 17: Process Expected Result Realization Viewpoint: Incident Management ER5 - Incidents are tracked through each stage of their life cycle

Finally, the Base Practice Viewpoint, proposed earlier in **Figure 14** is demonstrated below in **Figure 18** with the incident management process (Base Practice 11 – Close the Incidents).

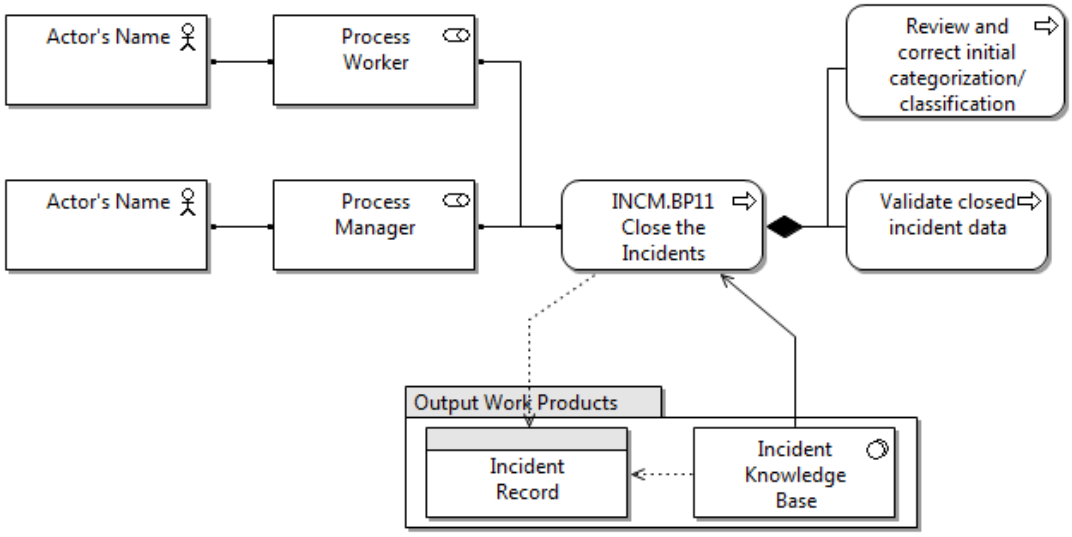


Figure 18: Base Practice Viewpoint: Incident Management BP11 – Close the Incidents

By taking into account all of these viewpoints instantiations, stakeholders can perceive an overview of a TIPA process assessment and which organizational elements directly affect the performance and operability of each process. With these graphical representations, people also obtain utmost precision of the entire process assessment.

5.2. Using TIPA in ArchiMate for Improving the ITIL Incident Management Process in a Hospital

This section, describes the results of applying the second mapping to a real organization by the means of an EA tool (EAMS). It starts by describing the blueprint describing both the TIPA reality and the Hospital's EA and how the EA changes towards ITIL compliance and achieving Maturity Level 1. Finally, it presents some of the tool's useful features such as the relationship between elements and how they interact with each other.

5.2.1. Hospital Architecture Overview

After mapping the TIPA concepts into ArchiMate, was important to demonstrate the practical use of this research. Keeping that in mind, an EA tool was chosen, a solution from Link Consulting, called EAMS. A particular feature of this tool is having the concept of time. By taking advantage of it, it is possible to show how the EA of any organization changes.

For demonstration purposes a real case study was used – the Information Systems department of a local hospital. The ITIL Incident Management process was the process chosen since it is the most important process performed inside the department.

First, a definition of 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 was made. For the sake of simplicity, the EA survey conducted at the IT department that is illustrated on **Figure 19** was based solely on TIPA's assessment elements. The departments' EA elements are grouped according to the TIPA's line of assessment. Afterwards a hypothetical end date for the process improvement project was defined (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 19** illustrates a blueprint of the current EA concerning the IS department.

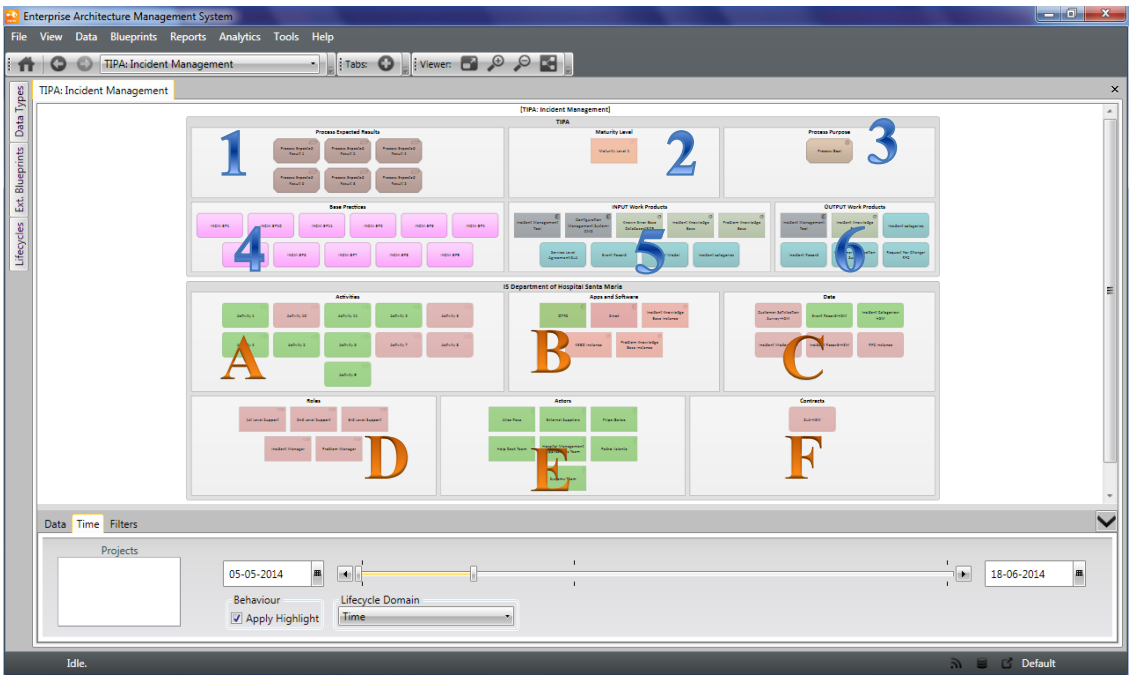


Figure 19: Blueprint of the current IS departments' EA

The upper six containers in Figure 1 show 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 artefacts are the outcome of performing the processes' activities.

The lower six containers represent the departments' EA. The artefacts 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 of 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 20** represents the departments' EA state after the process improvement project completion.

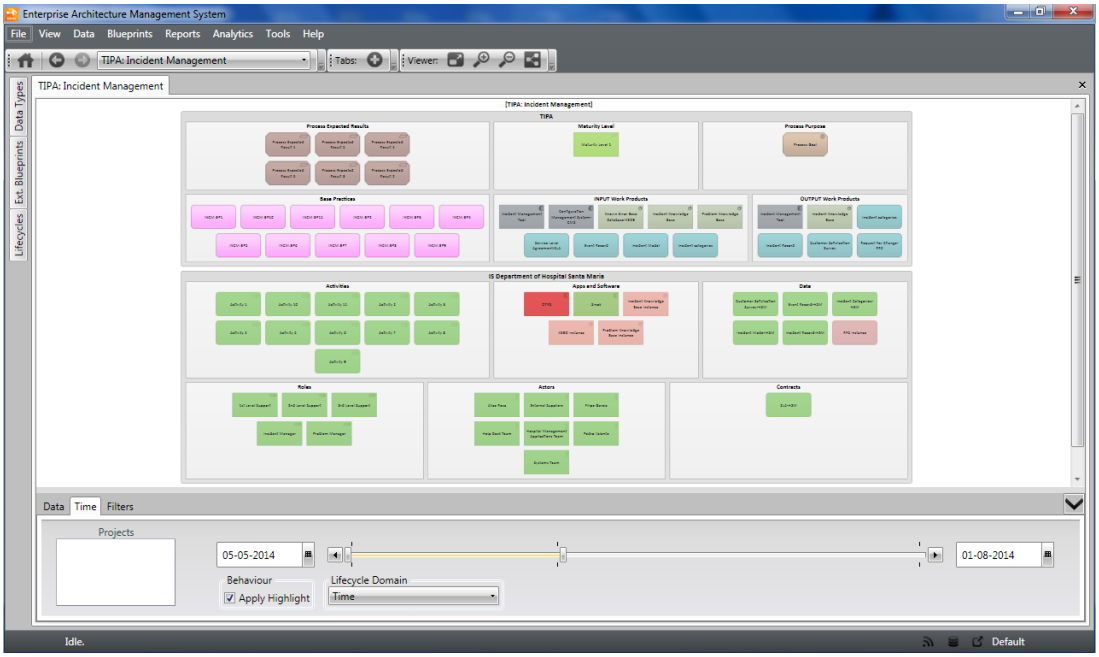


Figure 20: Blueprint of the future IS departments' EA

Once the improvement project is completed all the process activities of the department are implemented and supported by a new application whereas the old one is discontinued. This view represents the achieving of Maturity Level 1 according to TIPA where the Incident Management process purpose and its expected results are met by the Hospital's IT department.

5.2.2. Representing the New Incident Management Software Tool in the Hospital Architecture

One of the main changes in the process architecture is the production of this new software (Sinok) that will substitute the old one (OTRS). Both software perform the role of ITIL Incident Management Tool. However, the old one (OTRS) was somewhat generic and did not support some important aspects of what a proper Incident Management Tool should be.

Furthermore, this new software application (Sinok), besides being better software concerning incident management, it will also provide the features of a Configuration Management System. This will help the department to perform some of the activities that could not be properly done and also improve the performance of the ones that were already implemented, thus helping achieve Maturity Level 1.

Figure 21 illustrates the relationships between the OTRS application and the departments' elements as well as the TIPA elements before being replaced by Sinok.

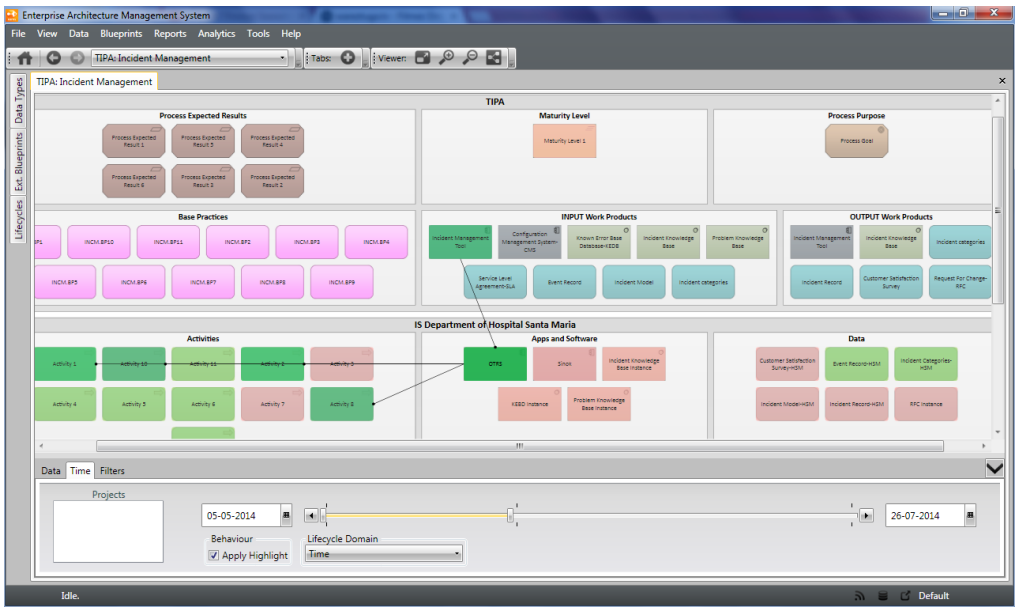


Figure 21: Blueprint of the OTRS software application and the different relationships ("as is")

Another interesting aspect of EAMS is being able to see all the relationships that a specific element has with the other architecture elements. This allows us to better understand the impact of a certain element has on the different elements that compose the process architecture. **Figure 22** illustrates a similar approach but now concerning the Sinok application. The timeline is after the project finishing date and we can see that the OTRS application status is dead. Furthermore, the Sinok application is now related with the Incident Management Tool and the Configuration Management System elements, therefore providing extra features that allow the process to properly execute activity 7, thus becoming more ITIL compliant.

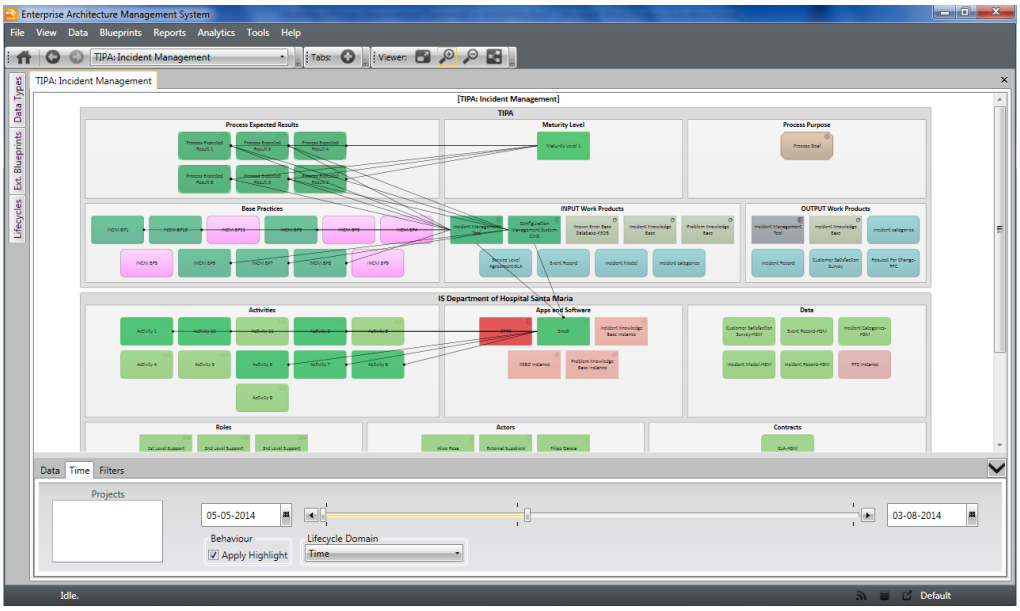


Figure 22: Blueprint of the Sinok software application and the different relationships ("to be")

By using the TIPA metamodel as input for the EAMS application, it is possible to visualize through time how the process EA changes in order to become fully compliant with ITIL. As pointed before, only one process was considered; however, the same can be done with the remaining ones. This demonstration gives an interesting insight of the process and provides helpful roadmaps to help improving processes that are poorly defined and performed compared to ITIL best practices. **Figure 23** and **Figure 24** below illustrate a zoomed view of the blueprint concerning the TIPA instantiation of the process and the departments' EA of the same process respectively.

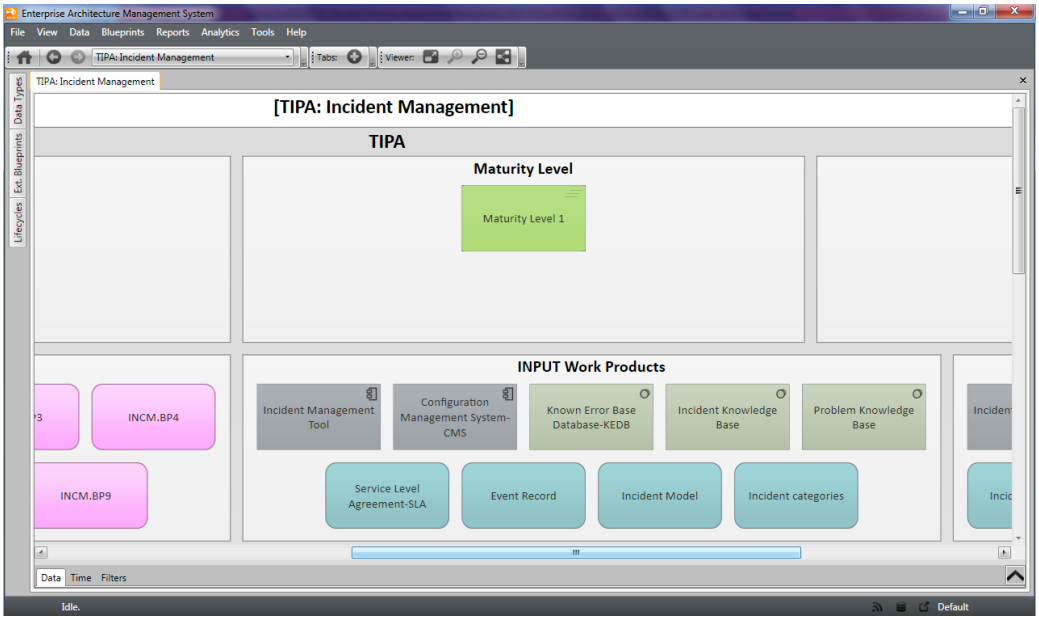


Figure 23: Zoomed view of the Blueprint (TIPA)

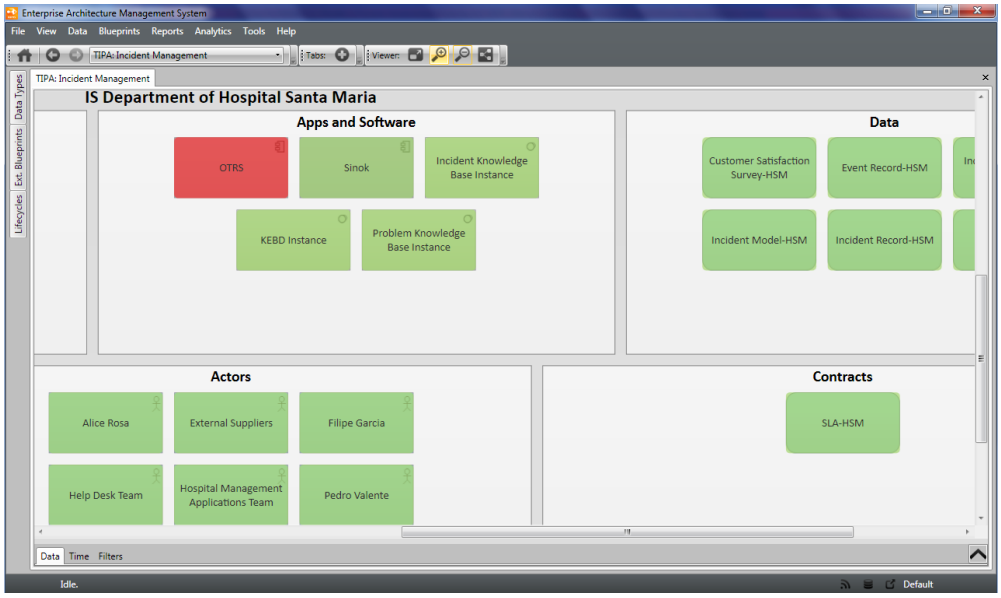


Figure 24: Zoomed view of the Blueprint (IS Department of Hospital Santa Maria)

This chapter described a demonstration of the research proposal using two different approaches. From a modelling perspective, the entire maturity level 1 assessment of the Incident Management Process in ArchiMate using our proposed TIPA viewpoints was modelled. Afterwards, to demonstrate the practical use of the second mapping concerning process improvement an EA tool (EAMS) was used and modelled both TIPA view of a properly performed Incident Management Process and the hospital's IT department view of that process in its AS-IS state. Then, by using EAMS timeline feature was possible to see how the end state of the hospital's EA should be in order to be compliant with ITIL and to acquire TIPA's maturity level 1 (performed).

The next chapter describes an evaluation of the research proposal from different perspectives in order to validate its completeness, correctness and utility.

6. Evaluation

This chapter refers to the “Evaluation” step of the DSRM process (Hevner et al., 2004), where an evaluation of the research proposal is done and confirm the added value it brings to the subject. First it describes the BWW Method used to evaluate the two mappings according to the four ontological deficiencies: incompleteness, redundancy, excess and overload. Then, it describes a framework for evaluating the quality of the proposed TIPA Viewpoints: the Moody and Shanks Framework for model quality management and, in section 6.3, explains the reasons of choosing specific ArchiMate viewpoints in order to define the proposed TIPA viewpoints. Afterwards, it explains the practical use of applying the defined TIPA Viewpoints and it concludes with an evaluation of the field study by interviewing ITSM experts.

6.1. Bunge-Wand-Weber Method

In order to evaluate the two concept mappings from TIPA to ArchiMate, a BWW (Wand & Weber, 1993) analysis was performed according to two criteria: completeness and clarity. The Bunge-Wand-Weber Model provides a method for the ontological evaluation of grammars, where we compare two sets of concepts to identify four ontological deficiencies:

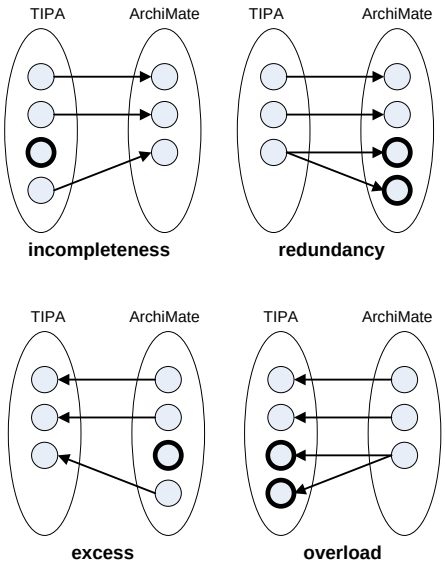


Figure 25: Bunge-Wand-Weber four ontological deficiencies

1. **Incompleteness**: can each element from the first set be mapped to an element from the second? – The mapping is incomplete if it is not total.

2. **Redundancy**: is the first set elements mapped to more than a second set element? – The mapping is redundant if it is ambiguous.

3. **Excess**: is every first set element mapped on a second set one? – The mapping is excessive if there are first set elements without a relationship.

4. **Overload**: is every first set element mapped to exactly one second set element? – The mapping is overloaded if any second set element has more than one mapping to a first set one.

The amount of TIPA concepts that have no representation in ArchiMate defines the lack of completeness. Clarity is a combination of redundancy, overload and excess of concepts. Lack of completeness can be a serious issue while lack of clarity can make the mapping unidirectional and hard to reverse.

The mapping is therefore **complete** since every TIPA concept can be represented in ArchiMate. Furthermore, ArchiMate concepts can be so generic in a way that can accommodate some TIPA concepts. This means the mapping does not exactly reflect the actual meaning of the element, but its generic meaning. This can be seen as an advantage in order to achieve completeness. Since AchiMate possesses extension mechanisms as part of the standard, a process assessment based extension to specialize and accurately represent these concepts would bring more precision to the mapping.

As for **redundancy**, there is sometimes more than one ArchiMate element that represents a TIPA concept. This happens with the Generic Work Product and Specific Work Product. TIPA describes these concepts as a set of artefacts that result from performing each process. These artefacts are the ITIL elements of each process which were already mapped by Vicente and each one represents a different ArchiMate element. The big redundancy problem is that the “correct” ArchiMate concept has to be chosen according to context and experience, and even though this choice is rather easy for human architects, it can become a serious problem for automated model transformations. Therefore it is possible to conclude that the mapping is redundant.

E**xcess** was also found since ArchiMate has concepts that are not defined on TIPA as stakeholder or principle. One could argue that implicitly they actually exist with their ArchiMate definitions, where stakeholder is “the role of an individual, team, or organization (or classes thereof) that represents their interests in, or concerns relative to, the outcome of the architecture” and principle “a normative property of all systems in a given context, or the way in which they are realized” or even gap “an outcome of a gap analysis between two plateaus”, but the concepts themselves are never mentioned in TIPA.

Finally, it was also found **overload**. There are several ITIL concepts that map only on a single ArchiMate one, like Driver, Business Process and Business Object. Because TIPA elements had to be derived from its textual descriptions, it was predictable that at least two TIPA concepts would match an ArchiMate one. This deficiency can lead to problems if someone ever wanted to do the opposite process: to go from an ArchiMate's representation of TIPA back to TIPA again. To avoid this, while modeling, it should include in ArchiMate's object attributes a reference to the original TIPA concept it was mapped from, to allow an eventual reverse mapping.

In fact, although instances of almost every deficiency were found, 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 people annotate the ArchiMate object properties' with the name of the TIPA concept that may arise ambiguity.

6.2. Moody and Shanks Framework

For evaluation of the defined TIPA viewpoints, the Moody and Shanks (Moody & Shanks, 2003) framework was used for model quality management, which proposes the following quality factors:

1. **Completeness** refers to whether the model contains all user requirements;

2. **Integrity** is the definition of business rules or constraints from the user requirements to guarantee model integrity;

3. **Flexibility** is defined as the ease with which the model can reflect changes in requirements without changing the model itself;

4. **Understandability** the ease with which the concepts and structures in the model can be understood;

5. **Correctness** is defined as whether the model is valid (i.e. conforms to the rules of the modeling technique). This includes diagramming conventions, naming rules, definition rules, and rules of composition and normalization;

6. **Simplicity** means that the model contains the minimum possible constructs;

7. **Integration** is related to the consistency of the models within the rest of the organization;

8. **Implementability** is defined as the ease with which the model can be implemented within the project time, budget and technology constraints.

Hence, for **completeness**, the viewpoints contain all user requirements, since they include all the relevant elements and relationships that describe a TIPA assessment. For **integrity** the viewpoints have all the TIPA rules and constraints, namely the ones that address which are the processes expected results in order to achieve the processes purpose, as well as their respective practices and

work products, the later one being translated into the business objects, application and infrastructure dependencies. They also have **flexibility** because parts of the viewpoints can be dropped out according to the organization own ITIL implementation regarding their processes, not affecting the overall outcome.

As far as **understandability** is concerned, the concepts and structures used are TIPA, ITIL, EA and ArchiMate ones, which are easily recognizable for people in these fields. Regarding **correctness**, the TIPA viewpoints were built by a method that mapped every TIPA concept to the correct ArchiMate one, followed by its representation according to every ArchiMate rule and convention.

Simplicity can also be found since our major concern was developing a set of views that focused on representing only the relevant information for their target stakeholders. Concerning **integration**, one of the major goals of representing TIPA on ArchiMate was to allow integrating its viewpoints with the organization EA representation. Finally, for **implementability** these viewpoints can be used as motivation for implementing similar viewpoints using an ArchiMate project implementation approach on a real IT service provider organization. Although this will be demonstrated properly in future work.

6.3. Mapping of TIPA Viewpoints with ArchiMate Viewpoints

In order to define and design the TIPA viewpoints, based on the proposed TIPA metamodel in ArchiMate, the already defined ArchiMate viewpoints from the Motivation Extension and from ArchiMate's core had to be considered, based on the stakeholder's concerns, the purpose and the aspects, to be the ones from which an extension of the proposed TIPA viewpoints would be made. Therefore, **Table 11** and **Table 12**, shows all the ArchiMate's viewpoints from both Motivation Extension and Core respectively and the reasons why these viewpoints were chosen, or not.

Table 11: Mapping of ArchiMate's Viewpoints with TIPA's Viewpoints (Motivation)

ArchiMate (Motivation)	**TIPA**	**Reason**
Stakeholder Viewpoint	N.D.	The Stakeholder Viewpoint illustrates the stakeholders, the internal and external drivers for change and the assessments of these drivers. Although this viewpoint might sound suitable for designing both Process Maturity Level Composition Viewpoint and Process Attribute Definition Viewpoint, the Motivation Viewpoint can also give us a complete or partial motivation aspect based on the stakehodler's concerns and also provide a link between the motivational concepts and ArchiMate's core.
Goal Realization Viewpoint	N.D.	The Goal Realization Viewpoint presents the refinement of high-level goals into more concrete goals. The Process Purpose which is mapped into the Goal concept is already a concrete goal that needs to be achieved in order for the process to be correctly performed. For that reason this viewpoint is irrelevant for designing our TIPA viewpoints.
Goal Contribution Viewpoint	N.D.	The Goal Contribution Viewpoint presents the influence relationships between goals and requirements. In our proposed metamodel there are no influence relations and therefore this viewpoint does not suit any of our proposed viewpoints.
Principles Viewpoint	N.D.	The Principles Viewpoint presents the principles that are relevant to design the problem at hand. This viewpoint does not provide the relevant concepts and views in order to model a TIPA assessment based on our proposed TIPA metamodel.
Requirements Realization Viewpoint	Process Expected Result Realization Viewpoint	The Requirements Realization Viewpoint models the realization of requirements by the ArchiMate's core elements. The Process Expected Result Realization Viewpoint is therefore best described by this viewpoint since we want to describe what concepts realize the Process Expected Results.
Motivation Viewpoint	➢ Process Maturity Level Composition Viewpoint ➢ Process Attribute Definition Viewpoint	The Motivation Viewpoint can present complete or partial views of the motivation aspects that related the stakeholder's concerns, their goals and how they related with ArchiMate's core. Both TIPA viewpoints focus on achieving these purposes.

Table 12: Mapping of ArchiMate's Viewpoints with TIPA's Viewpoints (Core)

ArchiMate (Core)	TIPA	Reason
Introductory Viewpoint	N.D.	The Introductory Viewpoint is a subset of the full ArchiMate language using a simplified notation. It does not possess any useful view in the scope of TIPA.
Organization Viewpoint	N.D.	The Organization viewpoint focuses on the (internal) organization of a company, a department, a network of companies, or of another organizational entity. It is irrelevant for a TIPA assessment.
Actor Co-operation Viewpoint	N.D.	The way each actor cooperates is irrelevant for the Process Dimension assessment. TIPA only considers the existence, or not, of people responsible for performing specific tasks.
Business Function Viewpoint	N.D.	The Business Function viewpoint shows the main business functions of an organization and their relationships in terms of the flows of information, value, or goods between them. These flows are irrelevant for a TIPA process dimension assessment.
Business Process Viewpoint	➢ Generic Practice Viewpoint ➢ Base Practice Viewpoint	The Business Process Viewpoint is used to show the high-level structure and composition of one or more business processes. Since both the Generic Practices and Base Practices concepts are mapped into ArchiMate's Business Process concept, is only reasonable that this viewpoint gathers the required concepts and relationships to properly model both the Generic Practice Viewpoint and the Base Practice Viewpoint.
Business Process Co-operation Viewpoint	N.D.	The Business Process Co-operation viewpoint is used to show the relationships of one or more business processes with each other and/or with their environment. TIPA evaluates each process separately therefore this viewpoint is not suitable for our purposes.
Product Viewpoint	N.D.	The way products are presented is irrelevant for the Process Dimension assessment. TIPA does not consider the existence of specific products in the assessment.
Application Behaviour Viewpoint	N.D.	The way each application behaves is irrelevant for the Process Dimension assessment. TIPA only considers the existence, or not, of specific application concepts.
Application Co-operation Viewpoint	N.D.	The way each application cooperates is irrelevant for the Process Dimension assessment. TIPA only considers the existence, or not, of specific application concepts.
Application Structure Viewpoint	N.D.	The way each application is structured is irrelevant for the Process Dimension assessment. TIPA only considers the existence, or not, of specific application concepts.
Application Usage Viewpoint	N.D.	The way each application is used is irrelevant for the Process Dimension assessment. TIPA only considers the existence, or not, of specific

		application concepts.
Infrastructure Viewpoint	N.D.	The way infrastructure is presented is irrelevant for the Process Dimension assessment. TIPA only considers the existence, or not, of specific infrastructural concepts.
Infrastructure Usage Viewpoint	N.D.	The way Infrastructure is used by applications is irrelevant for the Process Dimension assessment. TIPA only considers the existence, or not, of specific infrastructural concepts.
Implementation and Deployment Viewpoint	N.D.	The Implementation and Deployment viewpoint shows how one or more applications are realized on the infrastructure. This view is of no value corning a TIPA assessment.
Information Structure Viewpoint	N.D.	The Information Structure Viewpoint shows the structure of the information used in the enterprise or in a specific business process or application. This viewpoint does not suit our needs for properly design a TIPA viewpoint.
Service Realization Viewpoint	N.D.	The Service Realization viewpoint is used to show how one or more business services are realized by the underlying processes. The details provided by this viewpoint are irrelevant to a TIPA assessment.
Layered Viewpoint	N.D.	The Layered viewpoint pictures several layers and aspects of enterprise architecture in one diagram. These layered views are not suitable to properly define a TIPA viewpoint.
Landscape Map Viewpoint	N.D.	A landscape map is a matrix that represents a three-dimensional co-ordinate system that represents architectural relationships. This viewpoint is irrelevant concerning a TIPA assessment.

Considering the reasons presented in the previous tables and our mappings, it was possible to define complete and interesting viewpoints that can correctly illustrate specific parts of a process assessment. Within these viewpoints, specific stakeholders can understand which specific parts of the process architecture are being assessed and know how to improve them to achieve a desired process maturity level.

6.4. Applicability of TIPA Viewpoints

This section describes the applicability of the proposed TIPA viewpoints, meaning it evaluates to what extent the defined TIPA viewpoints (defined in section 4.4 and demonstrated in section 5.1) are applicable during process assessments.

The design of the five viewpoints (Process Maturity Level Composition, Process Attribute Definition, Generic Practice, Process Expected Result Realization and Base Practice), each one illustrating a part of the overall assessment, proved that it is possible to model a TIPA assessment in ArchiMate. This means that stakeholders can use these models and import them into EA software applications,

such as EAMS, in order to efficiently and properly manage the implementations of ITIL processes throughout specific time frames and with the purpose of successfully achieving their business goals. A simple demonstration was made on how that can be achieved using a specific ITIL process (Incident Management) and for a specific level of maturity (Process Maturity Level 1) within the Santa Maria Hospital IT Department. For organizations whose business goals require higher Maturity Levels a similar approach can be done in order to achieve those process maturity levels.

Therefore, it proved the feasibility of associating the process assessment methodology with an EA standard and from there, use the EA benefits to turn TIPA into a more powerful and useful framework. In order to thoroughly evaluate the applicability and usefulness of the proposed viewpoints, each of the remaining twenty five ITIL process for each of the five levels of maturity and the remaining four maturity levels for the Incident Management process had to be demonstrated. That however, would extrapolate this research to two or three times its established period therefore, the complete demonstration and evaluation could be considered as future work.

The next section evaluates to what extent is useful to integrate the research proposal with EA software in order to apply process assessment/process improvement roadmaps in a more interactive and efficient way. Then, from conclusions in the next section it is possible to expect, with some error rate, the same outcome for the remaining ITIL processes and Maturity Levels although, as mentioned before, that would be future work.

6.5. Architecture Demonstration

To assert the process improvement models' (defined in section 4.5 and demonstrated in section 5.2) real utility and correction a suitable data generation method was taken into consideration. It would bring great value to meet ITIL professionals and the IS department team leaders and present them this research, 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 pre-defined questionnaire responses (Oates, 2006).

However, some quantitative data analysis would also be useful, so, at the end of the interviews, each guest filled out a small survey regarding our EAMS blueprint. Therefore, 10 specialists were interviewed, from different areas and nationalities but all with a strong ITIL and Process Assessment background. The 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, useful feedback regarding the utility of our research was obtained. People found the 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 this research connection with the EA tool.

The remainder of the interviews served to present the inherent motivation, explain how the blueprint works, the 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 most interesting STOP, KEEP, START answers were: STOP – Simplify the blueprint providing only vital information, KEEP – Clarity, I find it easy to view objects and dependencies, START – Add relations between processes, START – Add efficiency indicators, START – Prioritize the components, START – Provide reports about the assessments (EA elements).

The multiple answers had 4 levels and ranged from Poor/Useless/No (1) to Very good/Very useful/Always (4). On **Figure 26** we present for each question its average rating.

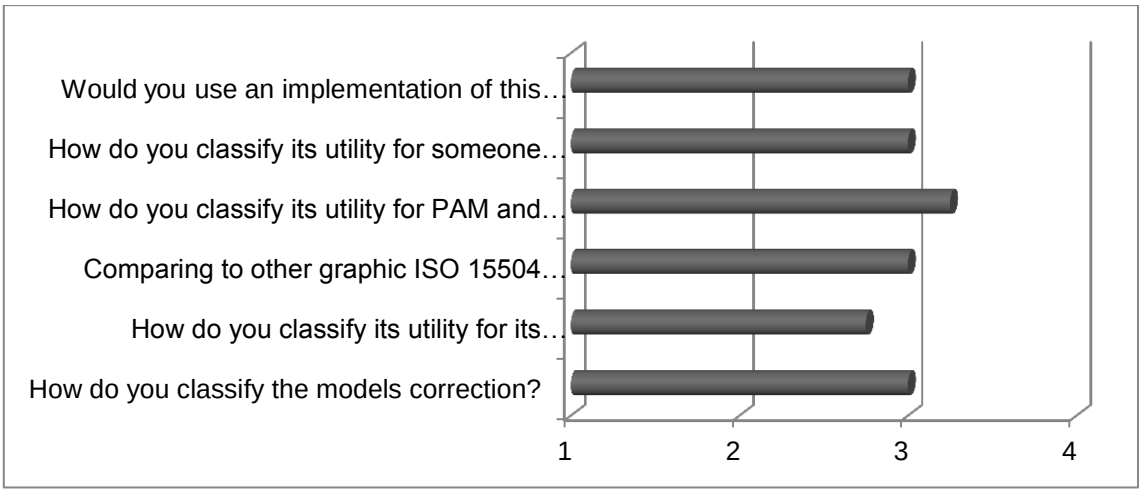


Figure 26: Form answers

From the questionnaire results several things could be concluded. That the models' utility for the different stakeholders is not the most interesting factor of this 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 this research was its utility regarding ITIL assessment. Most of the interviewed experts recognized that the 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 thesis, a graphical notation of the TIPA for ITIL Process Assessment Framework was proposed using the ArchiMate modelling language in order to address the following issue: lack of a EA graphical standard notation for these process assessment frameworks. In order to do so, a mapping of TIPA's PAM and PRM core concepts and relationships into ArchiMate ones was made and also a definition of a set of viewpoints to illustrate, in a clearer way, the process assessment method.

Then the proposal was demonstrated using the viewpoints to model ITIL's Incident Management process. Here each concept was instantiated to the scope of the Incident Management process to show how to represent a specific assessment in a uniform and precise way while showing also the connection between the process assessment method and the EA notation. Afterwards, the second mapping (in scope of process improvement) was demonstrated by applying it to a real case study – an IS department of a local hospital. An EA tool (EAMS) was used for that purpose that can be configured using various metamodels. The metamodel used was the ArchiMate metamodel. After including the departments' Incident Management process EA and the TIPA model a blueprint was created containing both instances that simulates the entire process improvement project period along with the necessary architectural changes to achieve Maturity Level 1.

The evaluation of this research is an analysis of the proposed mappings using the Bunge-Wand-Weber method. For validating the quality of our viewpoints it was used the Moody and Shanks framework. Then, our field study demonstration was evaluated by doing a set of interviews with ITIL experts with the purpose of assessing our proposals' utility and correctness to the organizational world. The next sections enumerate the contributions and limitations of this work. It concludes with the future work.

7.1. Contributions

With this research the following contributions were made: (1) the establishment of a bridge between both areas; (2) Process Assessment and EA discussion in their own communities; and (3) to help specific stakeholders realize what architectural elements play an important part in achieving process purpose, expected results, efficiency and therefore a higher process maturity level. For establishing the link between the ISO 15504 and EA two mappings were proposed: one considering the process assessment methodology and the other concerning the process improvement plan described by TIPA.

Then the practical use and value of these mappings was demonstrated by creating a set of viewpoints that describe the different views of a TIPA assessment and by applying the second mapping inside a real organization using an EA software tool. All the mappings and demonstrations were then properly evaluated using different evaluation methods.

7.2. Limitations

Concerning the limitations of this research the following were found:

1. Due to the graphical nature of ArchiMate, this research proposal disregards specific details of the assessment itself, namely the TIPA base/generic practices assessment questions made by the assessor with the purpose of assessing the existence of work products and proper practice performance.

2. This research proposal cannot evaluate a process maturity based on the N/P/L/F scale. This scale assumes an achievement percentage range of practices and work products that cannot be modeled in ArchiMate.

3. This approach makes an implicit assessment based solely on the existence, or not, of the process generic/specific work products and generic/base practices for a specific maturity level.

4. This research proposal only models the assessment of a single process and not between two or more processes that are connected.

5. This proposal might not provide a clear visual understanding of the assessment itself and of the assessing process when scaled to bigger enterprises with complex EAs.

7.3. Future work

For future work several things can be done regarding this research. An interesting one would be applying the same research but to other ISO 15504 based frameworks like the PAM for COBIT (TIPA equivalent but using the COBIT framework as input); then observe and compare the major differences, advantages and disadvantages between those frameworks and TIPA and taking relevant conclusions. Another interesting approach would be to find effective and efficient ways of mitigating some of the above mentioned limitations with the purpose of strengthening and enriching this work. Also as was mentioned in the Evaluation chapter, an interesting thing to be done regarding this work would be to demonstrate and evaluate the research proposal for the remaining ITIL processes and considering each maturity level assessment.

In short, process assessment frameworks have the goal of assessing the maturity level of processes that support the business of organizations as well as providing a process improvement plan to help

organizations achieve higher process maturity levels. TIPA in particular, addresses those processes but from an IT Service Management perspective using ITIL. The connection between these process assessment frameworks and standard enterprise approaches such as EA is therefore imperative and has a positive impact in understanding the assessment method and how it relates to the various architectural elements that compose a specific process of an organization.

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