Enterprise Architecture and ITIL

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This idea that there is generality in the specific is of far-reaching importance

Douglas R. Hofstadter, *GEB*

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Resumo

O alinhamento entre o negócio e as tecnologias de informação (TI) é hoje em dia uma das maiores preocupações nas organizações. As Arquitecturas Empresariais (AE) e o Information Technology Infrastructure Library (ITIL) são duas abordagens distintas e de perspectivas diferentes de governação, que se tornaram recentemente dominantes. No entanto, projectos paralelos de AE e ITIL podem resultar num desperdício de recursos e numa duplicação de custos e esforços. Para integrá-las propomos a definição de uma Arquitectura Empresarial específica para organizações que precisam de gerir serviços de TI. O nosso objectivo é usar a abordagem das AEs para definir uma arquitectura com as motivações, princípios, conceitos e métodos do ITIL para realizar a gestão de serviços de TI, usando o ArchiMate como linguagem de modelação. Demonstramos a nossa proposta através de um conjunto de modelos ITIL, aplicados a organizações, e construídos de acordo com as vistas que propomos. Como avaliação usamos entrevistas, a framework de Moody e Shanks, e o método ontológico de Wand e Weber.

Palavras-chave: Arquitectura Empresarial, ITIL, gestão de serviços de tecnologias da informação, alinhamento negócio/IT, TOGAF, ArchiMate

Abstract

Business/IT alignment has become one of the most relevant concerns on organizations. Enterprise Architecture (EA) and the Information Technology Infrastructure Library (ITIL) are two distinct governance approaches with different perspectives, that have become recently dominant between practitioners. However, parallel EA and ITIL projects can lead to wasted resources and a duplication of costs and efforts. To integrate both we propose a specific EA definition for organizations that need to manage IT services. Our goal is to use the EA approach to design an architecture with the ITIL motivations, principles, concepts and methods to perform IT service management, using ArchiMate as the architecture's modeling language. We demonstrate our proposal through a set of ITIL models, applied to organizations, and built according to our ITIL viewpoints. For evaluation we shall use interviews, the Moody and Shanks framework, and the Wand and Weber ontological method.

Keywords: Enterprise Architecture, ITIL, IT Service Management, business/IT alignment, TOGAF, ArchiMate

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List of Acronyms

BMM	Business Motivation Model.
BPMN	Business Process Model and Notation.
BRG	Business Rules Group.
CMDB	Configuration Management Database.
CMS	Configuration Management System.
CSF	Critical Success Factor.
DSRM	Design Science Research Methodology.
EA	Enterprise Architecture.
ITIL	IT Infrastructure Library.
ITSM	IT Service Management.
KEDB	Known Error Database.
KPI	Key Performance Indicator.
OMG	Object Management Group.
RACI	Responsible, Accountable, Consulted, Informed.
SKMS	Service Knowledge Management System.
SMART	Specific, Measurable, Achievable, Relevant, Time framed.
SWOT	Strenghts, Weaknesses, Opportunities, Threats.
TOGAF ADM	TOGAF Architecture Development Method.
TOGAF	The Open Group Architecture Framework.
TOG	The Open Group.
UML	Unified Modeling Language.

Chapter 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. In the early 1990s, Henderson and Venkatraman (1993) proposed a strategic alignment model based on two building blocks: strategic fit and functional integration, using business strategy as the driver and IT as the enabler. This model presented several perspectives on how to integrate business and IT domains, using concepts like information systems service organizations and IT governance.

1.1 Motivation and Objectives

Recently, the growing demand on IT lead to the improvement of the key concepts related to IT Governance, namely the ones connected to IT alignment with strategic objectives and cost reduction initiatives (Gama et al., 2012). From these Governance initiatives, two main approaches have had major relevance: Enterprise Architecture (EA) and IT Service Management (ITSM).

EA is a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems, and infrastructure (Lankhorst et al., 2009). Therefore, according to EA approaches, organizations usually share several architectures: business, processes, information, application and technology infrastructure (Lankhorst et al., 2009; The Open Group, 2011; Zachman, 1987).

ITSM 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 (The Stationery Office, 2007). ITIL (Hanna et al., 2008) is the *de facto* standard for implementing ITSM (Hochstein et al., 2005). It is a practical, no-nonsense approach to the identification, planning, delivery and support of IT services to the business (Arraj, 2010).

However, having two different frameworks to approach governance can lead to several setbacks. In a time when organizations strive to be efficient and effective, it seems counterintuitive to be wasting resources by having different organizational departments handling both approaches independently.

Additionally, instead of solving the main business/IT alignment issue, this is actually worsening it. 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, between strategy and functional integration.

We understand they have different perspectives, but we also believe both teams should work together and aligned where the approaches intersect. It should be clear how they integrate and which responsibilities each one has.

Thereby, our proposal is to join both approaches by establishing a specific enterprise architecture for organizations that need to manage IT services. Enterprise Architecture does not focus on specific organization types because its goal is to be able to represent every organization. On the contrary, our goal is to narrow it down, and restrict the architecture to organizations that have the management of IT services as an architectural driver.

Thus, in this thesis we propose an EA specialization that uses ITIL motivations, 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. This will allow to see how ITIL fits on EA models and concepts, and how architects and ITIL practitioners can collaborate to achieve business/IT strategic alignment.

To achieve this, we will begin to define how ITIL relates to EA. Then, we will build a concept mapping from ITIL to EA. We shall also define the principles, overall motivations and methods of this architecture. ArchiMate will be the modeling language, and a set of new viewpoints will be proposed in order to best model and represent this EA to several stakeholders.

To demonstrate our proposal we will (1) build the core and motivation models for all the ITIL processes; (2) extend an ArchiMate case study to exemplify our EA method; (3) model a real organization that uses ITIL; and (4) show how our architecture's valuation concepts can be used to perform architecture-based valuation. Evaluation will be done through interviews, with the Moody and Shanks framework for model evaluation and with the Wand and Weber ontological method for identifying ontological deficiencies.

Therefore, our goal is twofold: on one hand to contribute with a formal definition of ITIL for knowledge sharing, stakeholder communication and to help and promote ITIL discussion and validation by the ITIL community itself; and, on the other, to give to architects a set of principles and models, aligned with the EA approach, to restrict and guide the design of organizations according to best practices in ITSM.

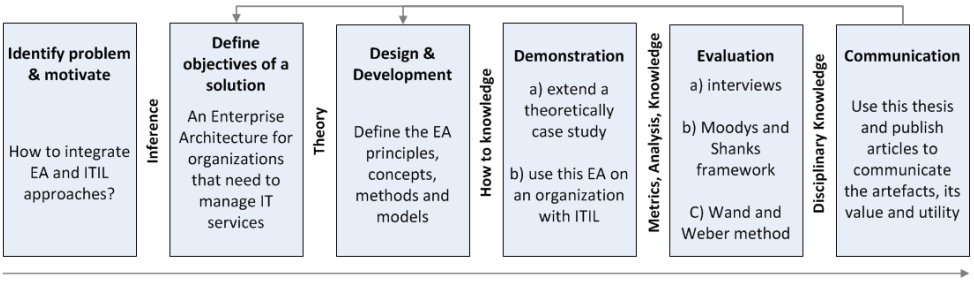


Figure 1.1: The DSRM process (adapted from Peffers et al. (2007))

1.2 Research Methodology

The methodology applied across this thesis is Design Science Research (DSRM), where we develop and validate a proposal to solve our problem (Hevner et al., 2004). It is a system of principles, practices and procedures required to carry out a study. It aims at overcoming research paradigms, such as the traditional descriptive research and interpretative research, in which the outputs are mostly explanatory and, one could argue, are often not applicable in practice (Peffers et al., 2007).

Information systems can draw advantage from DSRM since they are characterized by often using theories from diverse disciplines, such as social science, engineering, computer science, economics, and philosophy, among others, to address problems at the intersection of information technology and organizations (Hevner et al., 2004). Several researchers have succeeded in integrating design as a major component of research in order to solve relevant organizational problems (Peffers et al., 2007).

To overcome these organizational problems, DSRM proposes the creation and evaluation of artifacts 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). In this thesis we will mainly focus on models and methods. Models use constructs to represent real world situations, the design problem and the solution space whereas methods provide guidance on how to solve problems. The application of strict practices is required in both the construction and evaluation of the designed artifacts. In Figure 1.1 we map the DSRM steps to our work.

The following chapters follow the methodology's steps: "Related 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, we present a "Demonstration" followed by the "Evaluation" comparing the results with the research questions and to conclude we show our proposal applicability and themes for further work.

Chapter 2

Related Work

In this chapter we present a literature review of the topics related to this project. We start by Enterprise Architecture, followed by TOGAF - an EA framework, and the Business Motivation Model. Next, we address ArchiMate - an EA modeling language and its motivation and valuation extensions. Then, we present ITIL, a best practice model to perform IT service management. Finally, we show how ITIL representations usually only include business and informational concepts, not covering other domains.

2.1 Enterprise Architecture

The Zachman (1987) Framework 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 does not have just one architecture, but a set of them, arranged as layers. Each of these layers produce artifacts that answer six organizational questions (What, Where, When, Why, Who and How).

Today, business performance depends on a balanced design of the enterprise, involving people, competences, organizational structures, business processes, IT, finances, products and services, as well as its environment (Greefhorst and Proper, 2011). EA is a coherent set of principles, involving the design and performance of different architectures. It specifies the components and its relationships, which are used to manage and align assets, people, operations and projects to support business goals and strategies (Lankhorst et al., 2009; Ross et al., 2006) concerning those properties of an enterprise that are necessary and sufficient to meet its essential requirements (Greefhorst and Proper, 2011).

EA is based on a holistic representation of organizations, on views and relationships between artifacts and architectures, and on the independence and connection between layered architectures (Gama et al., 2012) which usually are (Lankhorst et al., 2009; The Open Group, 2011; Zachman, 1987): Business, Process, Application, Information, and Technology, which allows a coherent blueprint of the organization, which is then used for governance of its processes and systems (Pereira and Sousa, 2004).

2.2 TOGAF

The Open Group Architecture Framework (TOGAF) is a framework for developing an EA (The Open Group, 2011). It was developed and is currently maintained as a standard by The Open Group (TOG). The first version of TOGAF, in 1995, was based on the US Department of Defense's Technical Architecture Framework for Information Management (TAFIM) (The Open Group, 2011; Sante and Ermersj, 2009). Each version of the standard is developed collaboratively by the members of the TOG Architecture Forum (The Open Group, 2011; Sante and Ermersj, 2009).

The first seven versions of TOGAF addressed technology architecture based on its adoption in businesses. In 2002, Version 8 was published, which expanded the scope of TOGAF from a purely technology architecture to an EA, by including business and information systems architecture in the new version (Sante and Ermersj, 2009). In 2009, TOGAF 9 was released with new features as a modular structure, a content framework specification, extended guidance and additional detail.

TOGAF provides the methods and tools for assisting in the acceptance, production, use, and maintenance of an EA (The Open Group, 2011). It is one of the leading architecture frameworks worldwide, and in its latest version there is increasing reflection on the use of the architecture and its governance (Sante and Ermersj, 2009), being based on an iterative process model supported by best practices and a reusable set of existing architecture assets (The Open Group, 2011). The TOGAF document focus on EA key concepts and TOGAF Architecture Development Method (ADM), a step by step approach to develop an EA (Jonkers et al., 2009).

The TOGAF ADM is the result of continuous contributions from a large number of architecture practitioners. It describes a method for developing and managing the lifecycle of an EA, and forms the core of TOGAF by integrating several architectural assets, to meet the business and IT needs of an organization. While using the ADM, the architect is developing a snapshot of the enterprise's decisions and their implications at particular points in time. Each iteration of the ADM will populate an organization-specific landscape with all the architecture assets identified and leveraged through the process, including the final organization-specific architecture delivered (The Open Group, 2011).

The main phases of the TOGAF ADM are *A. Architecture Vision*, *B. Business Architecture*, *C. Information Systems Architecture*, *D. Techonology Architecture*, *E. Opportunities and Solutions*, *F. Migration Planning*, *G. Implementation Governance* and *H. Architecture Change Management*. In phases B, C, D a baseline and a target architecture are defined in each EA layer, and a gap analysis is performed to assert how to reach the intended architecture.

2.3 Business Motivation Model

In the view of TOGAF, EA is divided into four architecture domains: business, data, application and technology. These domains describe the architecture of systems that support the enterprise and correspond to the “How, What, Who, Where and When” columns of the Zachman (1987) framework. In turn, they do not cover the elements which motivate its design and operation which corresponds to Zachman’s “Why” column (The Open Group, 2012).

In fact, these elements belong to what is called the Business Motivation Model (BMM) defined by the Object Management Group (OMG) as a “scheme and structure for developing, communicating, and managing business plans in an organized manner” (Object Management Group, 2010).

The Business Rules Group (BRG) developed the Business Motivation Model which was later accepted as an OMG specification. BMM identifies factors that motivate the establishing of business plans, identifies and defines its elements and indicates how all these factors and elements inter-relate. In fact, there are two major areas of the BMM.

First we have Ends and Means, where Ends are things that the enterprise wishes to achieve (as goals and objectives) and Means things that will be used to achieve these Ends (as strategies, tactics, business policies and business rules). The second is the Influencers that shape the elements of the business plans, and the Assessments made about the impacts of those Influencers on Ends and Means (eg strengths, weaknesses, opportunities and threats).

The model was initially created to provide the motivations behind business rules, but can also be used to find the motivation for architecture principles (Greefhorst and Proper, 2011). Accordingly, TOGAF 9 also includes a BMM that is simpler than the OMG one and is based on the concepts of drivers, goals, objectives, and measures. It has concepts as Driver (factors generally motivating or constraining an organization), Goal (strategic purpose and mission), Objective (near to mid-term achievements that an organization would like to attain) and Measure (performance criteria).

TOGAF recommends to use this extension when the architecture needs to understand the motivation of organizations in more detail than the standard business or engagement principles and objectives that are informally modeled within the core content metamodel (The Open Group, 2011). Likewise, ArchiMate 2.0 has a motivation extension which is closely linked to the developments of TOGAF, as ArchiMate does not provide its own set of defined terms, but rather follows those provided by the TOGAF standard (The Open Group, 2012).

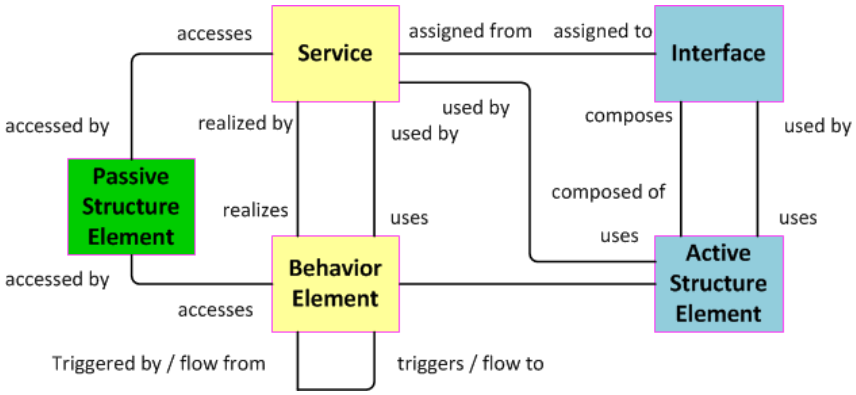


Figure 2.1: Generic Metamodel: The Core Concepts of ArchiMate (adapted from The Open Group (2012))

2.4 ArchiMate

The ArchiMate EA modeling language was developed to provide a uniform representation for architecture descriptions (Jonkers et al., 2009; The Open Group, 2012). It offers an integrated architectural approach that describes and visualizes the different architecture domains and their underlying relationships and dependencies (Jonkers et al., 2009; The Open Group, 2012).

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 (Lankhorst and the ArchiMate team, 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, 2012). Besides this, it also distinguishes between active structure, behavior and passive structure elements, having also another distinction between internal and external system view. The service is the externally visible behavior of the providing system, from the perspective of systems that use that service; the environment consists of everything outside this providing system.

The value provides the motivation for the service's existence. For the external users, only this exposed functionality and value, together with non-functional aspects such as the quality of service, costs, etc., are relevant. These can be specified in a contract or Service Level Agreement (SLA). Services are accessible through interfaces, which constitute the external view on the active structural aspect (The Open Group, 2012). On Figure 2.1 we present ArchiMate's generic metamodel.

The ArchiMate language defines three main layers: business, application and technology, based on specializations of its core concepts. The general structure of models within the different layers is similar.

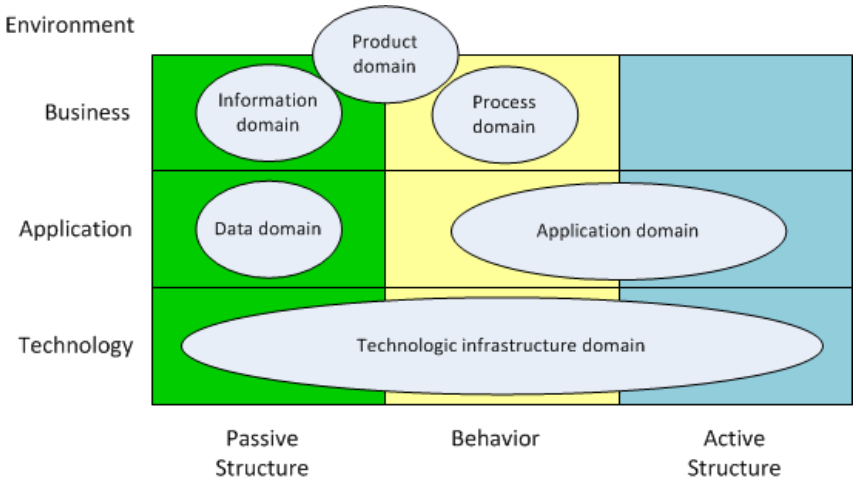


Figure 2.2: Framework ArchiMate (adapted from The Open Group (2012))

The same types of concepts and relationships are used, although their exact nature and granularity differ. In line with service orientation, the most important relationship between layers is formed by “used by” relationships, which show how the higher layers make use of the services of lower layers. A second type of link is formed by realization relationships: elements in lower layers may realize comparable elements in higher layers. These aspects and layers can be organized as a framework of nine “cells”, as illustrated in Figure 2.2.

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, 2012).

2.4.1 Motivation Extension

The core concepts of ArchiMate focus on describing the architecture of systems that support the enterprise, not covering are the elements which, in different ways, motivate its design and operation. These motivational aspects correspond to the “Why” column of the Zachman (1987) framework, which was intentionally left out of scope in the design of ArchiMate 1.0.

ArchiMate also has a Motivation extension that adds the motivational concepts used to model the motivations, or reasons, that underlie the design or change of some EA. These motivations influence, guide, and constrain the design. It adds concepts such as goal, principle, and requirement and addresses the way the EA is aligned to its context, as described by motivational elements (The Open Group, 2012).

This extension recognizes the concepts of stakeholders, drivers, and assessments. Stakeholders are persons or organizations that influence, guide, or constrain the enterprise. Drivers are internal or external factors which influence the plans and aims of an enterprise. Understanding strengths, weaknesses, opportunities, and threats in relation to these drivers will help the formation of plans and aims to address these issues (The Open Group, 2012). In Figure 2.3 we show this extension’s metamodel.

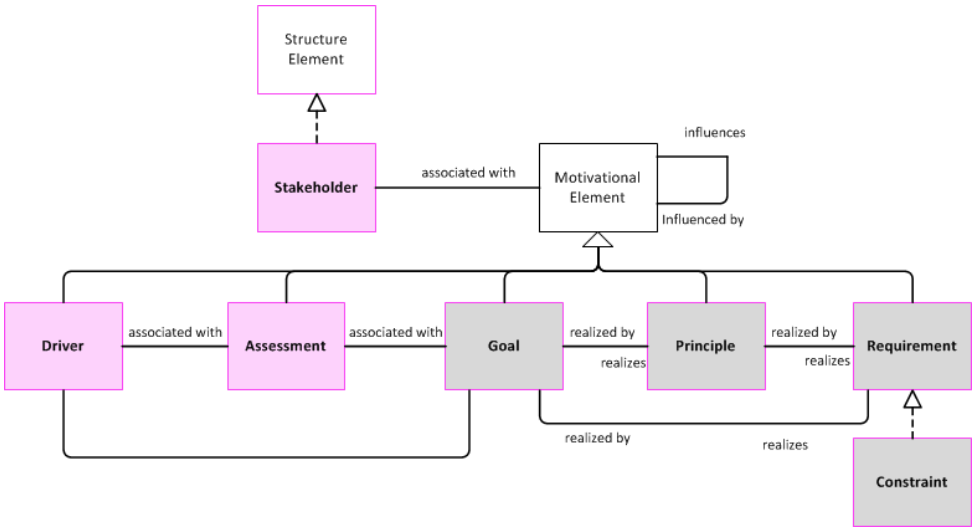


Figure 2.3: ArchiMate Motivation Metamodel (adapted from The Open Group (2012))

2.4.2 Architecture-based IT Portfolio Valuation

There have been some efforts to model business strategy concepts and to use architecture-based approaches to IT portfolio valuation. In fact, Lankhorst et al. (2010); Quartel et al. (2010) describes an integrated IT valuation method that uses architectural models as its backbone. It starts by investigating the business requirements that result from the organization's mission and vision and from its high-level strategy, such as its value center approach and operating model.

These strategic choices determine the aspects that need to be taken into account when assessing the value of the IT portfolio. Then, the resulting business requirements can be modeled in conjunction with the enterprise architecture of the organization. This helps in realizing traceability between business requirements and IT artifacts, which is needed to perform a well-founded portfolio assessment, and it provides concrete insights in the contribution of these elements to the business. KPIs are then associated with business requirements on the one hand and architecture elements on the other hand, and measurement of these KPIs determines the operational performance of the organization and its IT (Lankhorst et al., 2010).

Business requirements and enterprise architecture are the main inputs to calculate the "value" of IT systems and projects. The importance of different criteria to assess this value depends on the strategic direction of the organization. Strategic choices are linked to one or more business goals from which valuation criteria and performance indicators are derived. Depending on these criteria, different valuation techniques may be selected to analyze IT with respect to these criteria. Separate IT budgets may be allocated to limit the IT investments for each value center (Lankhorst et al., 2010).

Later on, he also uses the Bedell's method (Schuurman et al., 2008) to compute an IT portfolio's value based on business contributions. This method answers three questions: (1) Should the organization invest in information systems?; (2) On which business processes should investments focus?; and (3) For

which activities within these processes should IT support (e.g., applications) be developed or improved?

The underlying idea of the method is that a balance is needed between the level of effectiveness of the information systems and their level of strategic importance.

Overall, it is an approach for IT portfolio valuation that uses enterprise architecture extended with business requirements modeling as a basis. The approach borrows ideas from Bedell, i.e., the decomposition of the value of IT into the importance and the effectiveness it provides to the business, and from Venkatraman, i.e., the use of a valuation profile to distinguish different sources of value (value centers) and associated business goals (Quartel et al., 2010).

2.4.3 Valuation Extension

Similarly, Iacob et al. (2012) investigated the suitability of the ArchiMate language to support the modeling of business strategy concepts and architecture-based approaches to IT portfolio valuation. In her work, she gives an overview of existing strategy and valuation concepts and methods in the literature and motivates the need for enterprise architecture and business requirements modeling to capture these aspects, proposing to add to ArchiMate concepts as value, risks, resources, capabilities, competencies and constraints.

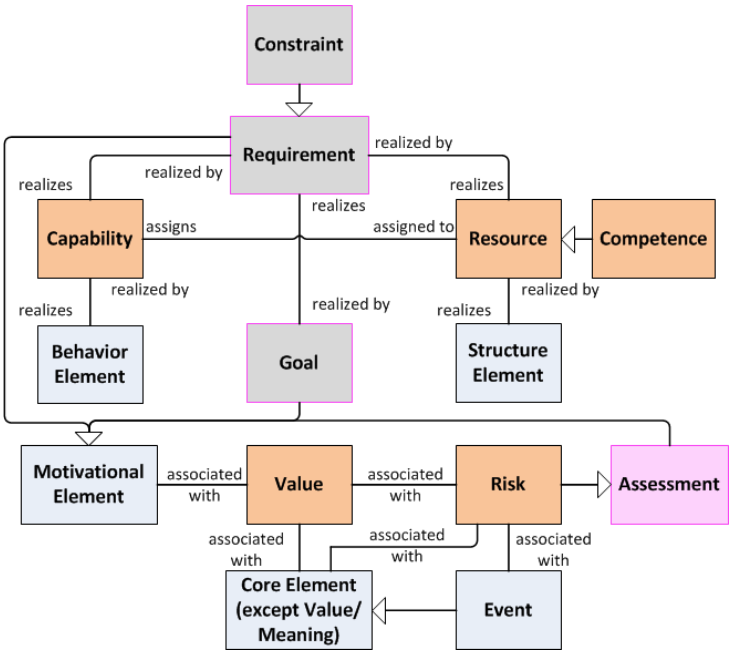


Figure 2.4: Valuation Extension Metamodel (adapted from Iacob et al. (2012))

The proposed language extension is formalized in terms of a metamodel fragment (Figure 2.4), which is aligned with the ArchiMate metamodel. The approach is also illustrated by means of an application portfolio consolidation case study in which is demonstrated how a constrained optimization valuation method can be applied to architecture models enhanced with the new concepts (Iacob et al., 2012).

On a similar note, Kinderen et al. (2012) also proposed a step-wise, intuitive, mapping approach for integrating the value modeling technique *e3value* into the EA framework ArchiMate, showing the integration is useful and that *e3value* is complementary to ArchiMate in terms of profitability calculations while, on the other hand, ArchiMate is complementary to *e3value* in terms of operationalization of a proposed business collaboration.

2.5 ITIL

Enterprises need to manage the delivery of services that support users in conducting their activities in the context of business processes (Braun and 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 and Ermersj, 2009). ITIL is a common-practice model possessing the character of a branch standard (Hochstein et al., 2005). 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 and Ermersj, 2009).

In 2007, ITIL v3 introduced the lifecycle principle, whereby the provisioning of services became a continuous process in which new services are brought into existence whilst others are phased out (Sante and Ermersj, 2009). The current version of ITIL covers the major weaknesses identified in the previous versions, namely being too focused on technology (Gama et al., 2012).

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 and Ermersj, 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 from the Service Lifecycle with various processes which are always described in detail in the book in which they find their key application (van Bon et al., 2007).

2.5.1 ITIL Graphical Representations

ITIL is a collection of five books with the best practices related to the effective and efficient management of IT (Gama et al., 2012). It is an English language set of documents consisting of several volumes of IT management concepts, processes and methods (Hochstein et al., 2005). The modeling object is IT service management and the language of description is a natural language (Hochstein et al., 2005), while its processes are usually depicted as well defined sequences of activities by flow charts.

There is an effort on these books to illustrate concepts, its relationships, framework lifecycle, processes, information management, information systems and databases through visual representations. However, it is mainly in process modeling (by flow charts or using the Business Process Model and Notation

(BPMN) (Object Management Group, 2011)) that we see a formal representation, with a known symbolic and semantic model. The other representations to describe the remaining ITIL domains seem to lack a common, clear and formal notation and semantic.

Besides these official books, we searched for other ITIL graphical representations. We found several ad-hoc diagrams from distinct organizations with different notations. These were mainly in-house sketches, diagrams and flowcharts expressing the ITIL views of its authors. Because they are so many and so distinct, its description would be lengthy and hardly noteworthy. Additionally, we have also come across with some commercial solutions. Thus, we have chosen three of the most popular ones to include here as an example on how ITIL is usually represented [1].

ITIL Process Maps (2012) from IT Process Maps, is announced as "a complete reference process model, designed to serve as a guideline and starting point for your ITIL and ISO 20000 initiatives". The product is a set of process models mapped in BPMN, with processes, artifacts and events. The diagrams have drill-down capabilities and it also has a responsibility assignment matrix (RACI) to illustrate the participation of the ITIL roles in the various ITIL processes. It is available for several platforms, as Microsoft Visio, IDS Scheer's ARIS, and iGrafx Flowcharter/Process.

foxPRISM (2012) from foxIT is a tool that consists of "a fully interactive web based process knowledge base that assists in the design and management of Service Management processes and the implementation of Service Management tools (...) provides a customizable framework onto which organizations can map and build their own process models". This web tool uses flowcharts in swimlane format and text to describe ITIL processes. The elements are processes, activities, roles and events. It also uses a RACI matrix to map roles to processes.

Casewise Online Visual Process Model for ITIL (2012) is a web tool described as "the world's first diagram-only view of all guidance for each of the five new ITIL v3 books providing organizations with the insight to simplify the alignment of business processes ensuring all ITIL standards are met by using simple frameworks and mapping tools". It has all the ITIL processes mapped in BPMN, with processes, activities and events. Also has drill-down capabilities and in each process it is possible to check each process according to Critical Success Factors (CSFs), Key Performance Indicators (KPIs), Best Practice Tips and Hints, Risks and Controls.

It is noticeable from these representations that ITIL is often depicted as just a process architecture, hence the use of flowcharts or BPMN. The BPMN standard is restricted to process modeling, not covering application, infrastructure or motivation issues. Its main purpose is to provide a uniform notation in terms of activities and their relationships (Lankhorst et al., 2009). We acknowledge the added value of these tools and models and are not claiming they are incorrect, but pointing out instead they lack completeness, because they limit themselves to the representation of business and informational concepts, not considering other domains.

[1] IT Process Maps, ITIL Process Map, Microsoft, Microsoft Visio, IDS Scheer's ARIS, iGrafx Flowcharter/Process, foxIT, foxPRISM and Casewise are all registered trademarks

2.6 Enterprise Architecture and ITIL

There have also been some attempts to relate and integrate EA and ITIL. In fact, Braun and Winter (2007) proposed an EA expansion to integrate ITIL v2 and Service Oriented Architectures (SOA), having EA as a pivotal concept with ITIL regarded for IT operations. EA provided an overview of the IT architecture to support IT services, while ITIL was assigned to the IT architecture as an essential part of management processes to services delivery (Gama et al., 2012).

Nabiollahi et al. (2010) provides a service based framework for EA to meet the ITSM requirements of ITIL v3, suggesting an EA extension to involve service architecture layer from ITIL Service Design (Taylor et al., 2007a). The development of an architecture model for IT services is proposed, making it a service layer for EA. However, it does not clarify how to do it or the relationships between architectures (Gama et al., 2012).

Gama et al. (2012) recently proposed to merge both ITIL and EA initiatives in a single body restricting resources and efforts. The solution encompasses the EA principles with referred architectures and the relationship between them, following ITIL service management processes. The common concepts and interfaces between EA and ITIL were identified having services as the integration key point.

Thorn (2007) addresses the relation between ITIL and TOGAF, regarding EA as a fundamental concept for organizational engineering, in which ITIL is included as a framework to an operation model for IT delivered services. He argues that both frameworks can be used together by mapping them, TOGAF covers the development of EA, and is involved in the product's conception lifecycle whereas ITIL ensures the delivery and management of IT services to users (Gama et al., 2012; Thorn, 2007).

In the same note, Sante and Ermersj (2009) address the fact that the recent versions of ITIL and TOGAF keep converging to integration. In fact, in ITIL v3 references are made to architectural concepts, hitherto only found in publications on architecture. The same, although to a much lesser extent, applies to TOGAF 8: where references are made to IT management (Sante and Ermersj, 2009).

The author relates the five ITIL books to TOGAFs ADM cycle, showing that there are several similarities, but two main differences: a) developing business architecture is part of TOGAF while the scope of ITIL is limited to developing an effective and efficient IT department, whilst developing business architecture is out of scope in ITIL; and b) running IT operations and delivering actual IT services are within the scope of ITIL, while TOGAF does not cover the development and maintenance of a run time environment, neither the way how services are actually produced and delivered (Sante and Ermersj, 2009).

Chapter 3

Problem

This chapter describes the “Identify problem & motivate” step of the DSRM process, where we become aware and recognize a problem from a state of the art review, giving us the issues that must be addressed.

Today, there is no fully complete framework to be used as a comprehensive off-the-shelf solution to ensure the alignment between service management and the organization’s concepts and artifacts. In fact, different frameworks are often used as complementary. Beyond the difficulties associated with the governance of both initiatives, this implies some problems (Gama et al., 2012). Parallel EA and ITIL projects imply a duplication of investments and costs, and even with shared infrastructures we cannot avoid a duplication of data repositories, procedures and human resources, being hard to define a way for teams not to compete together or maintain different efforts aligned (Gama et al., 2012).

Although EA and ITIL describe areas of common interest, they do it from different perspectives. ITIL was developed to support Service Management and EA to support an holistic organization view. However, since services have become part of fast-changing organizations, the prediction of what will be needed tomorrow is of growing interest to the people that deliver them. Conversely, architecture has changed from a rather static design discipline to an organization-encompassing one, and is only useful if the rest of the organization is using it to enable all developments to be aligned (Sante and Ermersj, 2009).

There are several common benefits and components which raise the issues of relationship and integration of EA and ITIL although they have different concerns on IT service provision (Nabiollahi et al., 2010). EA is regarded as a pivotal concept for organizational engineering and ITSM is regarded as the dominant operations model for IT (Braun and Winter, 2007). EA guarantees consistency in building new products or services and addresses business requirements, while ITSM, on the other hand, guarantees the consistency of services, through the use of standard processes (Correia and Abreu, 2009).

In fact, EA principles remain the best way to represent organizations as a system, relating multiple

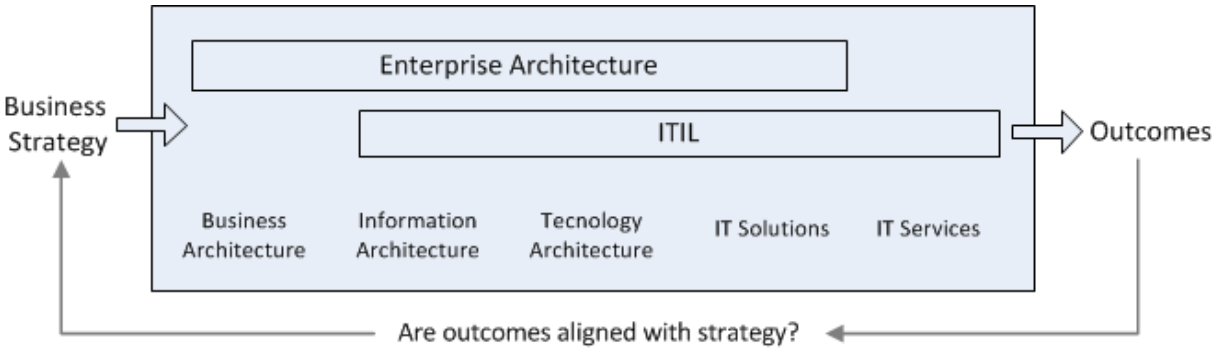


Figure 3.1: Strategic alignment with EA and ITIL (adapted from Sante and Ermersj (2009))

architectures to their artifacts and components. The widespread scope of ITIL involves all organizational architectures, but it does not describe how to design and realize the whole organization (Gama et al., 2012). Figure 3.1 shows EA and ITIL scopes and how to use both to achieve strategic alignment.

On the other hand, although ITIL shares the same domains as EA, they are indeed different and complementary, mainly because EA may change business processes according to business requirements and strategy, while ITIL has standard well defined processes. In fact, ITIL processes never change and the requirements from business strategy are used not to change its own processes, but to create, change or evolve the services it offers. That said, each framework has a different coverage and distinct responsibilities.

Accordingly, Radhakrishnan (2008) also identifies several benefits of EA and ITSM collaboration, like organizational learning, avoiding duplication of effort, re-use of documentation and outputs, cross training, and planning and implementing the target EA and ITSM architectures with a coordinated and integrated method.

The integration attempts that we have described earlier (Section 2.6) tried to answer a real problem that should not be taken lightly. However, while all the approaches seemed so close to integration, they did not propose a definitive and holistic solution. In fact, Braun and Winter (2007) and Thorn (2007) work is limited to ITIL v2, what makes it outdated, Nabiollahi et al. (2010) proposes a service architecture as a new architecture layer, but does not clarify the architectures relationships. As for Sante and Ermersj (2009) work, although we agree upon the approach and conclusions reached, the result is not a unique body of knowledge with EA and ITIL, but two different frameworks linked by a mapping.

Moreover, none of these approaches provide models or a formal representation for the proposed solutions. In fact, what we are looking for is a holistic solution, following the EA approach but using ITIL best practices to perform IT service management. A body based on a set of principles, methods and formal models to underlie the design and change of these organizations.

In short, we define our problem as **the lack of a definitive solution to integrate the EA and ITIL approaches in order to solve the business/IT misalignment they introduced.**

Chapter 4

Proposal

This chapter corresponds to the "Define objectives of a solution" and to the "Design and Development" steps of the DSRM process, where we explain our approach and propose a solution to integrate Enterprise Architecture and ITIL.

Based on the problem we described and on the lack of suitable solutions, we propose **an EA/ITIL integration through the definition of an Enterprise Architecture, with principles, concepts, methods and models, for organizations that need to manage IT services. This architecture should use the EA approach for organizational engineering and strategic alignment, along with the ITIL framework for IT service management**. In Figure 4.1 we show our proposed EA structure.

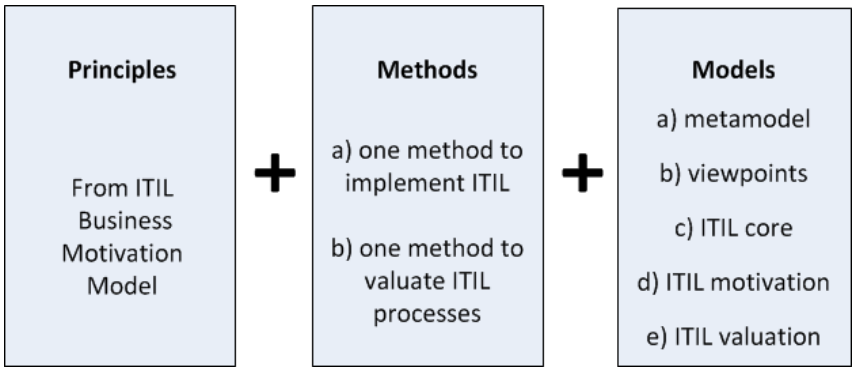


Figure 4.1: Proposed Enterprise Architecture

In this chapter we will start to show that ITIL is part (or a subset) of EA, and why we chose ArchiMate as the modeling language. Then we will anallyze and identify the architecture principles that restrict its design and change. Later on, we will show how ITIL concepts relate to ArchiMate ones. Afterwards, we will identify and represent the ITIL Business Motivation Model, followed by a proposal to model ITIL valuation concepts and use them to perform achitecture-based valuation. Next, we will propose a set of ArchiMate viewpoints to enable stakeholders to focus on particular aspects of the architecture, and finally, we will use TOGAF's ADM to implement ITIL as an architecture change.

4.1 EA and ITIL Relationship

We soon realized that it would be harder to integrate two approaches if they did not speak exactly the same language, so we needed a uniform representation, a common frame of reference. Our goal was to find graphical languages that best described each one and map them according to similar concepts.

For EA, Lankhorst et al. (2009) enumerates several languages. There is IDEF, BPMN, ARIS and finally UML. 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, 2012), so ArchiMate stood out as the language we were after for modeling EA. As for ITIL, on the *Related Work* section we had already become aware that it was often depicted as just a process and information architecture, usually by flowcharts or BPMN, lacking a formal representation on other domains.

Although we realize that most of ITIL contents are about describing best practice processes (and the information they use), we believe that limiting ITIL to these only two domains is one of the factors that turns its integration with EA so difficult. Actually, both approaches are more alike than one could initially think. In fact, as Sante and Ermersj (2009) point out, the earliest versions of ITIL hardly contained any references to architecture as a concept, method or framework.

However, in ITIL v3 references are made to architectural concepts, while showing that the main structural differences between ITIL v3 and TOGAF 9 is that ITIL does not change the organization's own business processes while, on the other hand, it runs IT operations and delivers IT services. This difference is still an heritage from both frameworks early versions, where ITIL was just about service delivery and support, and TOGAF just about EA.

Additionally, Gama et al. (2012) also related the core EA artifacts and the EA five architecture layers (business, processes, information, application and technology infrastructure) to ITIL artifacts and management processes, showing that there is in fact a link between ITIL and EA in all these domains and not only on the business and information ones.

Thus, in this thesis we propose that like EA, we can also look at ITIL as a composition of other architectures, namely business, information, application and infrastructure. Hence, on business we have actors, roles, ITIL processes and functions, events; on application the major information systems, like the Configuration Management System (CMS), the Service Knowledge Management System (SKMS) or the Availability Management Information System (AMIS); on infrastructure we have the databases like

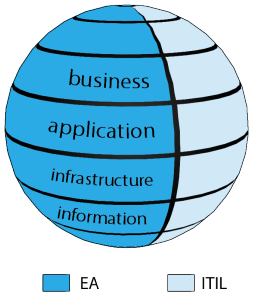


Figure 4.2: EA and ITIL relationship

the Configuration Management Databases (CMDBs) or the Known Error Database (KEDB); and finally on the information we have business objects, data objects and database artifacts.

All these linked by a service oriented approach, where functionality is available to the next layer in the form of services. Thus, if one looks at ITIL from this point of view, we begin to realize that by representing and splitting it across EA domains, we can actually integrate them by integrating each of its layers. Figure 4.2 shows this proposed vision of ITIL components as a subset of EA ones.

Hence, we propose that **if an organization can be represented by an enterprise architecture, with all its layers, components and relationships, and if that organization has implemented ITIL, then ITIL components and relationships will be a subset (in every layer) of the EA ones**.

Therefore, if ITIL can be regarded as part of EA, sharing the same domains, components and relationships, and in the absence of a formal ITIL graphical language we can then model the ITIL metamodel with EA elements, using the language we had already chosen for EA: ArchiMate.

4.2 Architecture Principles

In this section we identify and discuss ITIL principles, which will be our architecture's principles. In fact, architecture principles provide a means to direct transformations of enterprises, forming the cornerstones of any architecture and bridging the gap between high-level strategic intents and concrete designs (Greefhorst and Proper, 2011).

Dietz (2006) also points out that "The notion of architecture I have in mind is one of normalized restriction of design freedom. Operationally, it is a set of design principles, concerning both the function and the construction of systems" . Also, according to The Open Group (2011) "Principles are general rules and guidelines, intended to be enduring and seldom amended, that inform and support the way in which an organization sets about fulfilling its mission".

On the other hand, as part of the specification process, architecture principles may be prioritized to determine the guiding (key) ones. These are the most fundamental ones. Those that truly make a

difference are the hardest to change and are closest to the drivers. Determining the guiding architecture principles is important since top-level architectures should only contain a limited number of them.

A rule of thumb is to have no more than 10 guiding architecture principles. More than that decreases the accessibility of the architecture, and obfuscates the importance of the most important architecture principles. Other architecture principles can be documented in downstream architectures (segment architectures, reference architectures and solution architectures) (Greefhorst and Proper, 2011).

Accordingly, in ITIL we also find this principles' hierarchy, layered according to the scope we choose to address. In fact, the main ITIL principle is "all services must provide measurable value to business objectives and outcomes", followed by three other fundamental ones (van Bon et al., 2007):

- *Specialization & co-ordination principle*: The goal of service management is to make capabilities and resources available through services that are useful and acceptable to the customer with regard to quality, costs and risks. The service provider takes the weight of responsibility and resource management off the customer's shoulders so that they can focus on the business' core competence. Service management co-ordinates the business of service management responsibility with regard to certain resources. Utility and warranty act as a guide.

- *Agency principle*: Service management always involves an agent and a principal that seconds this agent to fulfill activities on their behalf. Agents may be consultants, advisors or service providers. Service agents act as intermediary between service providers and customers in conjunction with users. Usually, these agents are the service provider's staff, but they can also be self-service systems and processes for users. Value for the customer is created through agreements between principals and agents.

- *Encapsulation principle*: The customer's interest focuses on the value of use; he prefers to be spared from any technical details and structure complexity. The 'encapsulation principle' is focused on hiding what the customer does not need and showing what is valuable and useful to the customer. Three principles are closely linked to this: separation of concerns; modularity: a clear, modular structure; and loose coupling: reciprocal independence of resources and users.

However, since ITIL is a five-book framework, it is possible to enumerate principles for each of the books, that guide and restrict the freedom of design on the topics they cover. They are aimed to enable service providers to plan and implement these best practices. Taylor et al. (2007b) also states that "principles are the same irrespective of the organization: however, the approach may need to be tailored to circumstances", what comes aligned to what Greefhorst and Proper (2011) also argued: "Depending on the specific situation, different drivers will lead to the formulation of design principles, and architecture principles in particular". As an example, in Table 4.1 we present the Service Transition principles.

Then again, ITIL also defines sub principles for each of the above. We present on Table 4.2 the key principles for "Define and implement a formal policy for Service Transition".

Table 4.1: Service Transition principles

Define and implement a formal policy for Service Transition
Implement all changes to services through Service Transition
Adopt a common framework and standards
Maximize re-use of established processes and systems
Align Service Transition plans with the business needs
Establish and maintain relationships with stakeholders
Establish effective controls and disciplines
Provide systems for knowledge transfer and decision support
Plan release and deployment packages
Anticipate and manage course corrections
Proactively manage resources across Service Transitions
Ensure early involvement in the service lifecycle
Assure the quality of the new or changed service
Proactively improve quality during Service Transition

Table 4.2: Sub principles of the “Define and implement a formal policy for Service Transition” principle

Policies should clearly state the objectives and any non-compliance with the policy shall be remedied
Align the policies with the overall governance framework, organization and Service Management policies
Sponsors and decision makers involved in developing the policy must demonstrate their commitment to adapting and implementing the policy
This includes the commitment to deliver predicted outcomes from any change in the Services
Use processes that integrate teams; blend competencies while maintaining clear lines of accountability and responsibility
Deliver changes in releases
Address deployment early in the release design and release planning stages.

We have presented these principles as they are stated on ITIL. However, according to Greefhorst and Proper (2011) architecture principles should adhere to a number of quality criteria; they should be specific, measurable, achievable, relevant and time framed (SMART).

Therefore, we also wanted to evaluate ITIL principles according to the SMART approach. Thus, we find them quite specific according to its depth level; on the other hand, they are definitely achievable; and, as for measurably, ITIL provides several key performance indicators (KPI) to measure these principles. There is however an obvious deficiency in the time-framed attribute, but then again we are talking about a set of best practices to apply on different organizations, so we would advise to use these principles and add time-frame properties according to the specific organization where ITIL is being applied upon.

4.3 ITIL Metamodel using ArchiMate Concepts

Before starting to model we needed to map ITIL concepts in the modeling language's metamodel. ArchiMate's generic metamodel has five core concepts: passive structure, behavior, active structure, service and interface. Those are then instantiated on several other concepts on each of the three layers (business, application and infrastructure). It is these latter ArchiMate's concepts that we will bridge with the ITIL ones to show how closely they relate.

It should be again noted that the core concepts of ArchiMate describe the architecture of systems that support the enterprise. They do not cover the elements which motivate its design and operation (The Open Group, 2012). These aspects correspond to the "Why" column of the Zachman (1987) framework, while the core concepts correspond to the "How, What, Who, Where and When". As we have seen, ArchiMate also has a Motivation extension which adds concepts such as goal, principle, and requirement (The Open Group, 2012) and there is also a yet to be released Valuation extension with concepts such as value, risk, constraint and resource (Iacob et al., 2012).

In fact, we shall map the motivation and valuation concepts later on this thesis as extensions, following ArchiMate's approach. Therefore, we only show ITIL main concepts and relationships mapped to their Archimate counterparts. Using this mapping we present on Figure 4.3 the relation between the ITIL metamodel and the ArchiMate one. The dark elements show ITIL concepts and the light ones show the existent ArchiMate ones. The relationship between concepts is based on ITIL and ArchiMate's own definitions, and while it is often quite straightforward as both frameworks share many concepts and semantics, there are some exceptions which we will address now.

First, ArchiMate distinguishes between a business object as a business concept; a data object as its logical representation and an artifact as a physical piece of data. ITIL sees it all as information, no matter what is its form. Second, we mapped KPIs, CSFs and metrics as value, following Iacob et al. (2012) proposal.

Finally we have the Product concept, which in ArchiMate is seen as a collection of services with a contract, while in ITIL it often refers to something tangible. In fact, the ArchiMate Product concept is more closely related to ITIL's Business Service one. As for the ITIL Product, ArchiMate does not provide a match, because the framework is information-centric and is not designed for physical products or logistics.

Moreover, we also want to distinguish two kinds of mappings: clear specializations (eg SLA for Contract; Database access for Infrastructure service) and synonyms/equivalent (Process for Business Process; Role for Business Role; Function for Business Function). This also demonstrates our ITIL positioning with EA: while the latter show equivalent concepts, the former show that EA concepts are indeed generalizations of ITIL ones.

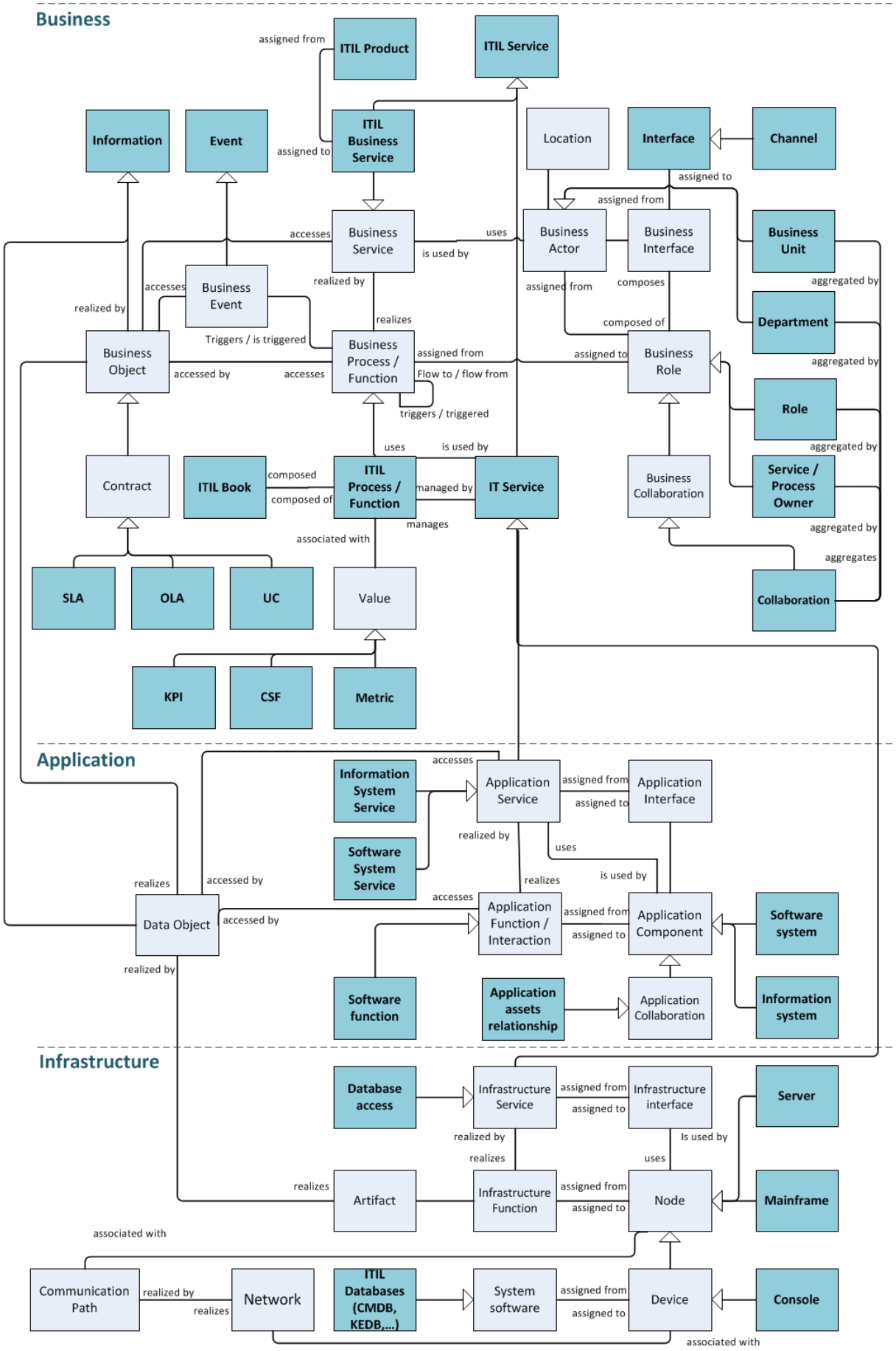


Figure 4.3: Relation between the ITIL metamodel and the ArchiMate one

Table 4.3: Mapping core concepts

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, Artifact
	Meaning
	Representation
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	Infrastucture service Infrastucture interface
Database function	Infrastucture function
Console, server, mainframe	Node, Device
Network	Network Communication path
Product	

Table 4.3 shows the concept mapping while Table 4.4 shows the relationship mapping. Later on, in the demonstration (Section 5.1, page 47) we will use this mapping to build the models for ITIL's 26 processes and 4 functions. These will stand as a formal representation of ITIL and as a tool for architects to use ITIL components and relationships to design ITSM organizations and also to check for best practices' compliance and maturity, by building *as-is* models with the current organization's ITIL processes and *to-be* models representing the ITIL maturity level where the organization plans to stand in the near future. This will allow to use EA methods (like the TOGAF ADM) to perform ITIL implementations like any other architecture change.

Table 4.4: Mapping core relationships

ITIL relationship	ArchiMate relationship
Has, uses, creates, writes, reads and updates information	Association Accesses
Used by	Used by
Makes possible Implements	Realization
Process/function ownership	Assignmen
Flow	Flow
Triggering	Triggering
Element grouping (eg CMS and SKMS)	Grouping
Process decision	Junction
Tool specialization	Specialization

4.4 ITIL Motivation using ArchiMate Concepts

After the work described on the last section, looking at our models, although we had answered most of Zachman Framework's questions, we still lacked the "Why". To answer this last one, we used ArchiMate's Motivation Extension. Hence, ArchiMate's Motivation metamodel has motivational elements that are realized by *requirements* which in turn are realized by core concepts. *Stakeholders* are structure elements assigned from *Business Actors*. The Motivation elements are *driver*, *assessment*, *goal*, *principle* and *constraint*.

In ITIL there are roles, departments, business units and service owners that have interests and concerns in the outcome of the architecture. These are ArchiMate's *stakeholders*. Then, factors that influence the motivational elements are usually presented in the process introduction or definition, sometimes in the scope or otherwise referred as drivers or stakeholders concerns. These elements represent the ArchiMate concept *driver*. Later on, it is common for enterprises to take *assessments* of these drivers. In ITIL these are represented as a SWOT or driver analysis that is used to identify benefits, problems, mistakes, risks and opportunities.

The desired results that a stakeholder wants to achieve are referred in ITIL as the organization mission, goal or objectives. This matches ArchiMate's *goal* concept. Next we have desired properties of solutions – or means – to realize the goals. In ITIL we have requirements, policies, implementation and guidelines that correspond to ArchiMate's *requirement*. Likewise, we have in ITIL principles and implementation guidelines that map to *principle* and finally there is *constraint* that maps to its ArchiMate homonym counterpart.

On Table 4.5 we present a map with the summary of ITIL motivational concepts and relationships to ArchiMate's Motivation extension.

Table 4.5: Mapping motivation concepts and relationships

ITIL concept	**ArchiMate**
Role, Department, Business unit, Service Owner, Responsibility	Stakeholder
Concern, driver, scope, process introduction, process definition	Driver
Benefit, problem, mistake, risk, opportunity, SWOT analysis	Assessment
Mission, goal, objective	Goal
Requirement, policy	Requirement
Principle, implementation guideline	Principle
Constraint	Constraint
ITIL relationship	**ArchiMate**
Is related to, assessment resulted in, stakeholder is concerned with	Association
Makes possible, implements	Realization
Benefits, prejudices	Influence

This mapping will allow us to define for each ITIL process what are its motivations (Section 5.2, page 49), and, by using this approach we will be able to design better organizations according to ITSM best practices, by identifying in our models what are the most relevant concerns and drivers for each organization, and trace them down through goals, principles and requirements to the specific ITIL book, process and activity that realizes them. This way we can achieve business/IT alignment by ensuring that the ITIL processes that will be implemented have a direct match to the organization's concerns and strategy.

4.5 Architecture-based ITIL Valuation

IT is usually seen by the business as a cost center, mostly because there are nowadays too many obsolete systems, with high maintenance costs that are not aligned with the organization's strategy.

On the contrary, by focusing on the value of IT instead of considering costs only, organizations can decide which IT really contributes to their business goals and make a well balanced division into budgets for maintenance, exploration, realization and phasing out. Traditionally, IT has often been regarded only as a cost center in business case calculations. Its less tangible benefits have often been more or less neglected in portfolio management decisions. Furthermore, in the past information systems tended to be relatively stand-alone, supporting a single business silo. This made it easier to attribute their costs and benefits (Lankhorst et al., 2010).

Nowadays, IT services and applications are more and more interwoven with the business and may support many different business activities, which may again contribute to several business goals in various degrees. The value of some IT artifact is determined by how well it contributes to certain business goals.

Therefore, a portfolio valuation approach needs a clear insight into the relationships between business goals and IT artifacts (Quartel et al., 2010). With the growth of the IT portfolio on organizations, there was a need to turn it effective and efficient, so managing IT services became a major concern. And, as we have seen, ITIL is the *de facto* standard for implementing ITSM.

However, although there are no lack of success cases on organizations that adopt the ITIL best practices, it is still hard to predict how much value will each ITIL process actually bring to the organization beforehand. Organizations usually choose ITIL processes according to their goals and business requirements, but what if they do not have enough resources to implement all the ITIL processes that realize their goals, how to choose between them?

In fact, we believe that this is a choice quite similar to choosing between a set of any other IT projects, and the answer should be to choose the ones that better align with the organization motivation (drivers, concerns, assessments, goals, principles and business requirements) but also those that maximize the value that is added by its implementation.

This alignment issue is clearly architectural, so the problem is how to identify and model ITIL value using an EA perspective and valuation concepts, and to show how these models can be useful to perform architecture-based IT service management valuation.

As we have seen with the ITIL business motivation model, we may be able to tell which are the processes that best align with the organization strategy, but we still do not know anything about how much value will they add or how to differentiate them. In fact, when an organization has several ITIL processes that can realize its business strategy and does not have enough resources to implement them all, it is faced with a choice that is quite similar to the one of selecting which IT projects to implement. Therefore, we propose to look at ITIL from a business strategy and IT portfolio valuation point of view and, since we are already using an EA approach, we will start by modeling ITIL using these concepts.

Iacob et al. (2012) examined the business strategy and portfolio management literature to identify the concepts that capture business strategy and value. The result was a set of modeling concepts that are needed for the alignment of three disciplines: business strategy, EA and portfolio management. These new concepts are: value, risk, resource, competence, capability and constraint. The value and constraint concepts already existed on ArchiMate but its definition was extended, so we will include them here too.

Thus, following the same methodology of the previous sections, we searched in ITIL for these concepts. We needed to find them and measure the semantic distance between ITIL and Iacob's definitions. We present our results on Table 4.6.

We can see that the semantic distance is very short, being the ITIL's concepts specializations or subsets of Iacob's (except for the risk). In fact, in ITIL, value is achieved by services while in the Valuation extension, value can come from other sources, like product, process, application component, etc. As for resource while the Valuation extension considers any asset "owned and controlled by the organization"

Table 4.6: The definition of valuation concepts according to the Valuation Extension and ITIL

Concept	**ITIL** (van Bon et al., 2007)	**Valuation Extension** (Iacob et al., 2012)
Value	Value is the core of the service concept. From the customer's perspective value consists of two core components: utility and warranty. Utility is what the customer receives, and warranty is how it is provided. A service is a means of delivering value to customers by facilitating outcomes the customers want to achieve without the ownership of specific costs or risks.	The relative worth, utility, or importance of a core architectural element (e.g., service, product, process, application component, etc.), or of a project
Risk	An uncertain outcome, or in other words, a positive opportunity or a negative threat	The frequency and magnitude of loss that arises from a threat (whether human, animal, or natural event)
Resource	Resources are types of assets. Organizations use them to create value in the form of goods and services. Resources comprise the direct input for production. Resources are often based on experiences; they are knowledge-intensive, based on information, and deeply embedded in the people, systems, processes and technologies of an organization.	An asset owned or controlled by an individual or organization
Competence	–	Core competence is a particular strength of an organization and a specialization of resource (intangible or personnel-based)
Capability	Management, organization, people and knowledge convert resources into value. Capabilities represent the capacity of an organization to co-ordinate, manage and apply resources in order to produce value.	The ability (of a static structure element, e.g., actor, application component, etc.) to employ (configure, integrate, etc.) resources to achieve some goal
Constraint	the limiting factors for the customer in achieving results	a restriction on the way capabilities and systems are realized and resources are employed

(Iacob et al., 2012), ITIL's concept of resource is directed to "experiences, knowledge-intensive, based on information" (van Bon et al., 2007). This is actually closer to the semantic concept of competence in the Valuation extension as "resource intangible or personnel-based" (Iacob et al., 2012).

Since ITIL does not define competence by itself, and also because the Valuation extension considers competence as a specialization of resource, we believe that ITIL resources (because of their intrinsic nature) are largely closer to the competence concept than the resource one.

As for capability, the Valuation extension talks about "the ability of an actor, application component, etc to employ resources to achieve a goal" (Iacob et al., 2012) while ITIL defines "management, organization, people, knowledge convert resources into value" (van Bon et al., 2007). If we believe that goals are set to add value to the organization, then the two concepts are very close. Only for risk, it is ITIL that broadens

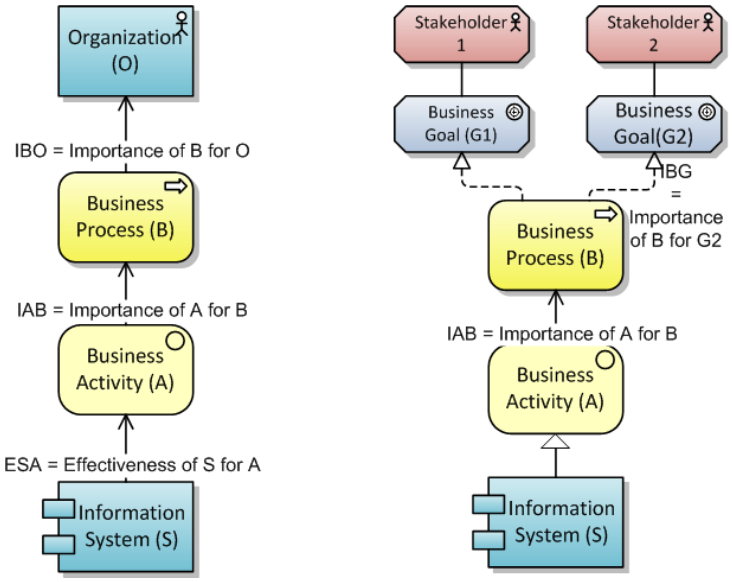


Figure 4.4: Relation between Bedell and enterprise architecture (left) and Bedell extended with business goals (right) (adapted from Quartel et al. (2010))

the concept, while the Valuation extension only considers negative outcomes (using the risk definition from The Open Group (2009)), ITIL also includes the positive opportunities and wides the concept to an uncertain outcome.

However, we also want to discuss the use of architecture to assess the value of ITIL processes, so we refer again to Quartel et al. (2010) that uses Bedell's method (Schuurman et al., 2008) to compute an IT portfolio's value based on business contributions. The underlying idea of the method is that a balance is needed between the level of effectiveness of the information systems and their level of strategic importance.

To calculate these we need to determine: (1) the importance of each business process to the organization (IBO); (2) the importance of each business activity to the business processes (IAB); and (3) the effectiveness of an information system in supporting business activities (ESA).

Figure 4.4 (left) relates this information to EA, where for convenience the 'used by' relation is used to relate the architecture elements. Based on the values for the variables IBO, IAB and ESA three portfolios can be calculated: one to address each of the aforementioned questions (Quartel et al., 2010).

However, Lankhorst goes further and proposes that the contribution of a business process for an organization can be decomposed to the contribution of the process to each business goals (Figure 4.4 right). This helps to decompose the 'problem' of assessing the importance of a business process.

Lankhorst also adds that "Values for IBG may have to be provided at multiple goal levels, but their assessment becomes easier because the 'distance' between the levels is smaller" (Quartel et al., 2010).

Thus, following this line of reasoning we also propose to adapt the method, by including resources and capabilities in it. In fact, instead of just calculating the effectiveness of IT, we propose to decompose

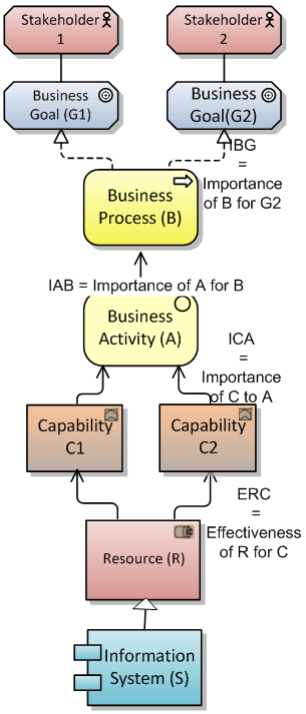


Figure 4.5: Bedell extended with business goals and capabilities

the application (a resource) in its capabilities. Hence, first we generalize the concept of application to resource, and then we argue that this resource has an effectiveness in delivering some capability (ERC) while each capability has an importance for a business activity (ICA). Figure 4.5 shows this adaptation of the Bedell's method.

Therefore, considering we have established a mapping between the Valuation extension and ITIL, and adapted Lankhorst proposal to include these same concepts, we propose to use the Valuation extension to model the value in ITIL processes and to use an architecture-based valuation approach to calculate their value to organizations.

4.6 Architecture Viewpoints

Views give information about architecture areas. In fact, a view is defined as a part of an architecture description that addresses a set of related concerns and is addressed to a set of stakeholders. A view is specified by means of a viewpoint, which prescribes the concepts, models, analysis techniques, and visualizations that are provided by the view. In other words, a view is what you see and a viewpoint is where you are looking from (The Open Group, 2012).

Viewpoints are a means to focus on particular aspects of the architecture and are designed for the purpose of communicating certain aspects of it. What is shown in a view depends on the scope of the viewpoint and on what is relevant to the concerns of the stakeholder (The Open Group, 2012).

ArchiMate has a framework for the definition and classification of viewpoints and views. It is based on two dimensions: purpose and content. Purpose may be of type Designing, Deciding or Informing, while content may have the abstraction level of Details, Coherence or Overview. In Figure 4.6, we present the dimensions of purpose and abstraction level, 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 (The Open Group, 2012).

Figure 4.6: Classification of Enterprise Architecture Viewpoints. Adapted from The Open Group (2012).

In the same way, we also need to focus and communicate particular aspects of our architecture, so, in this section we shall propose a set of viewpoints to represent ITIL and organizations that use ITIL, according to our architecture elements, concepts and concerns.

We divide our views in two sets: in the first we have the views that show how ITIL concepts are modeled according to an Enterprise Architecture approach. In these views we have the *ITIL Book Overview Viewpoint*, the *ITIL Process Viewpoint*, *ITIL Process Detail Viewpoint*, *ITIL Motivation Viewpoint*, *ITIL Requirements Realization Viewpoint* and *ITIL Value Viewpoint*. The main purpose of these views is to model, describe and communicate to the organization stakeholders, the ITIL elements and relationships, according to how they are advised on ITIL best practices. Full models shall represent the whole ITIL processes while partial ones represent the parts of ITIL that each organization has implemented.

On the other hand, we also have the viewpoints that assign these ITIL concepts to its instances on the organization. These views are the *ITIL Service Catalog Viewpoint*, the *ITIL Service Provider Viewpoint* and the *ITIL Compliance Viewpoint*. The latter one, in particular, can be a specialization of any of the first type viewpoints, assigning to each ITIL concept the correspondent instance on the organization.

Across the viewpoints we shall use the color notation that we have introduced in the metamodel: dark elements represent ITIL elements while light ones represent the ArchiMate ones. This will allow to better understand how the ITIL elements relate to those from ArchiMate. However, later on, when building models using these viewpoints, we suggest to use ArchiMate's usual color scheme (green for passive structure, yellow for behavior and blue for active structure) when the models use only elements from ITIL. Otherwise, when models use elements from both ITIL and ArchiMate, we strongly suggest to represent the ITIL ones on dark blue, where the others may follow or not the ArchiMate convention.

4.6.1 ITIL Book Overview Viewpoint

We will start with the *ITIL Book Overview Viewpoint*. This viewpoint focuses on representing each ITIL book (remember we define an ITIL book has a set of ITIL processes) as a black box system that provides business services for the stakeholders outside of the organization, while using specific IT services to support those processes.

This viewpoint has the main purpose to communicate ITIL and help architects and business process designers to understand the operation and dependencies of ITIL books and processes, by providing an ITIL overview over all the organization layers.

Table 4.7: ITIL Book Overview Viewpoint

ITIL Book Overview Viewpoint	
Stakeholders	Architect, business process designer, employee
Concerns	Understand the operation and dependencies of ITIL processes
Purpose	Designing, informing
Abstraction Level	Coherence
Layer	Business, Application, and Technology layers
Aspects	Structure, Behaviour

Concepts and Relationships

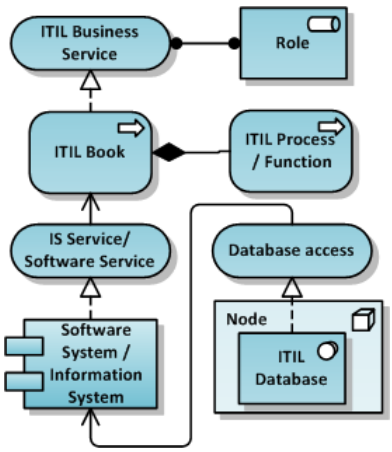


Figure 4.7: Concepts and Relationships of the ITIL Book Overview Viewpoint

Example

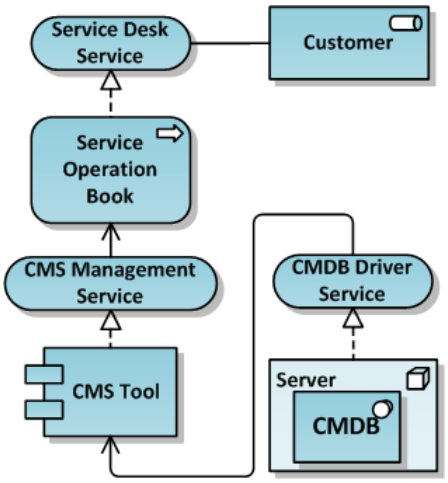


Figure 4.8: Example of the ITIL Book Overview Viewpoint

4.6.2 ITIL Process Viewpoint

The *ITIL Process Viewpoint* focuses on the relationships between an ITIL process, the business services it provides, the roles associated to it, the informational elements it accesses, the events that it triggers or it is triggered by and the supporting IT elements for its operation. Like the *ITIL Book Overview Viewpoint* it also focus on providing a vision of ITIL accross the several organization's layers, but now on a process scope.

Its purpose is mainly to understand each ITIL process through an holistic vision of how it functions and how it relates to its environment.

Table 4.8: ITIL Process Viewpoint

ITIL Process Viewpoint	
Stakeholders	Architect, business process designer, employee
Concerns	Understand the operation and dependencies of ITIL processes
Purpose	Designing, informing
Abstraction Level	Coherence
Layer	Business, Application, and Technology layers
Aspects	Structure, Behaviour

Concepts and Relationships

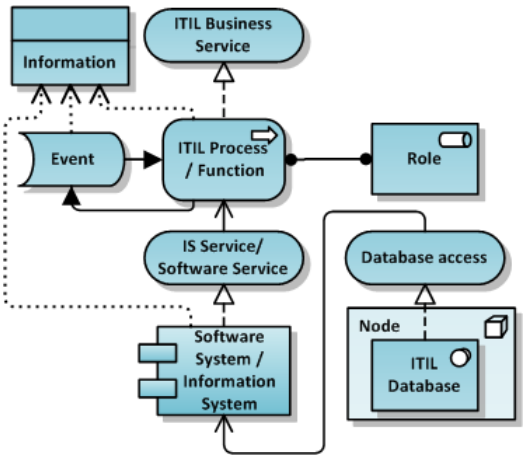


Figure 4.9: Concepts and Relationships of the ITIL Process Viewpoint

Example

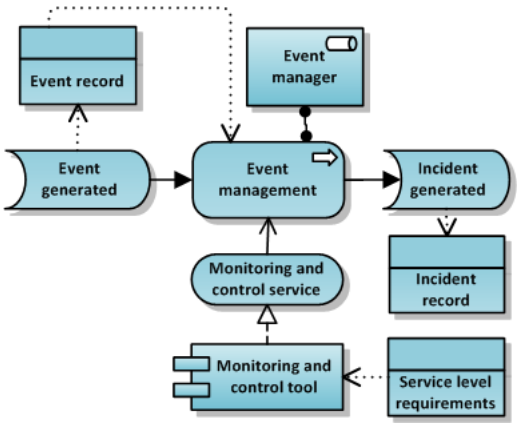


Figure 4.10: Example of the ITIL Process Viewpoint

4.6.3 ITIL Process Detail Viewpoint

The *ITIL Process Detail Viewpoint* focus on the individual activities of each ITIL process and how they cooperate and use the ITIL elements outside the process. Contrary to the *ITIL Process Viewpoint* which was a black box process model, in this one it is possible to see how the process internally operates to achieve its purposes. It provides enough detail to help process owners and architects to design the organization processes according to ITIL.

Table 4.9: ITIL Process Detail Viewpoint

ITIL Process Detail Viewpoint	
Stakeholders	Process and domain architects, operational managers, process owners
Concerns	Structure of ITIL processes, consistency and completeness, responsibilities
Purpose	Designing
Abstraction Level	Detail
Layer	Business and Application layers
Aspects	Behaviour

Concepts and Relationships

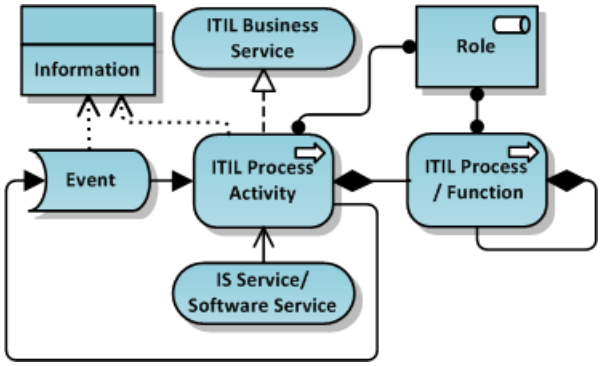


Figure 4.11: Concepts and Relationships of the ITIL Process Detail Viewpoint

Example

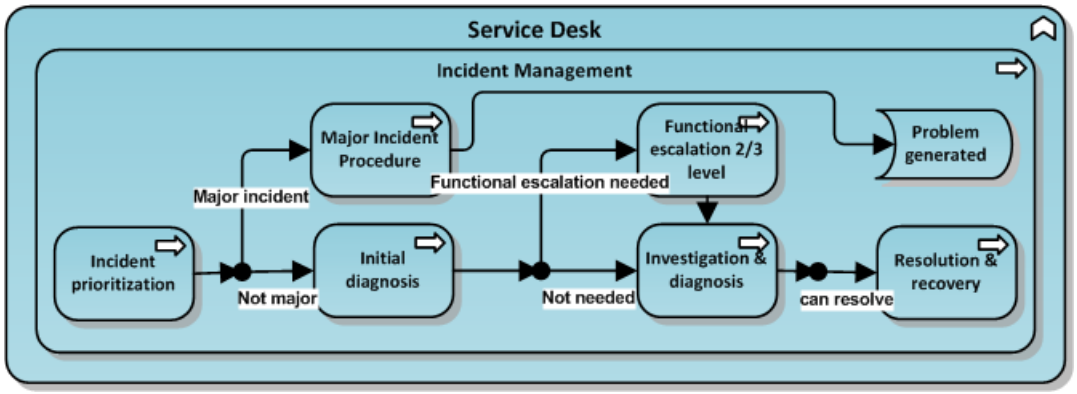


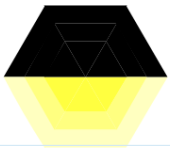
Figure 4.12: Example of the ITIL Process Detail Viewpoint

4.6.4 ITIL Motivation Viewpoint

The *ITIL Motivation Viewpoint* focus on the business motivation model of each ITIL process or book. It provides the reasons and motivations that lie behind the processes' architecture, explaining its importance for the organization. Its purpose is to help organization's stakeholders to understand the *why* of each process and to help to choose those that best match the organization's concerns, problems or goals.

Table 4.10: ITIL Motivation Viewpoint

ITIL Motivation Viewpoint	
Stakeholders	Enterprise and ICT architects, business analysts, requirements managers
Concerns	Architecture strategy and tactics, motivation of each ITIL process or book
Purpose	Designing, deciding, informing
Abstraction Level	Overview, Coherence, Details
Layer	Business, Application, and Technology layers
Aspects	Motivation



Concepts and Relationships

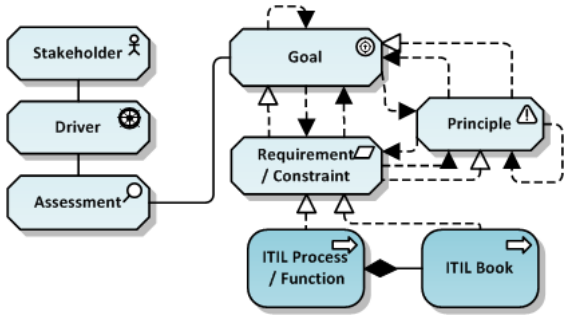


Figure 4.13: Concepts and Relationships of the ITIL Motivation Viewpoint

Example

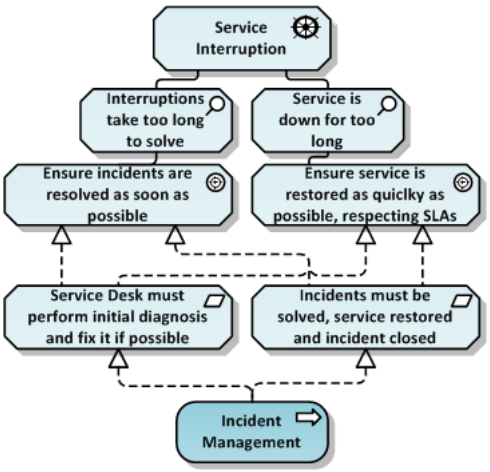


Figure 4.14: Example of the ITIL Motivation Viewpoint

4.6.5 ITIL Requirements Realization Viewpoint

The *ITIL Requirements Realization Viewpoint* focus on the individual elements that realize each ITIL requirement from its business motivation model. Using this viewpoint it is possible to trace all the path from an organization concern to the actual architectural element that realizes it, traversing through assessments, goals, requirements or principles. Its utility is to help architects, designers and requirement managers to acquire the architectural elements that realize their own organization's requirements.

Table 4.11: ITIL Requirements Realization Viewpoint

ITIL Requirements Realization Viewpoint	
Stakeholders	Enterprise and ICT architects, business analysts, requirement managers
Concerns	Architecture strategy and tactics, motivation of each ITIL element in a process
Purpose	Designing, deciding, informing
Abstraction Level	Coherence, Details
Layer	Business, Application, and Technology layers
Aspects	Motivation

Concepts and Relationships

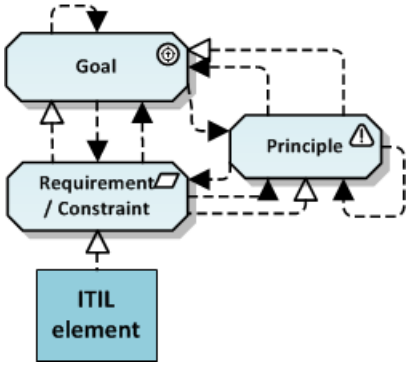


Figure 4.15: Concepts and Relationships of the ITIL Requirements Realization Viewpoint

Example

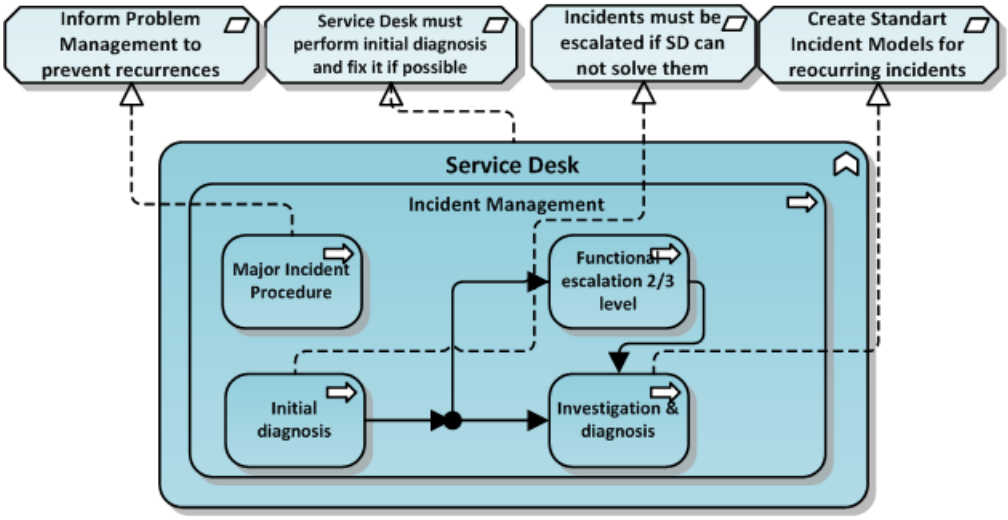


Figure 4.16: Example of the ITIL Requirements Realization Viewpoint

4.6.6 ITIL Value Viewpoint

The *ITIL Value Viewpoint* focuses on the valuation concepts associated with each ITIL process. It represents its value, risks, resources, competences, capabilities and metrics (KPIs and CSFs). The purpose is to provide an overview of the value, resources and metrics that each process brings to the organization, helping on board decisions and being an instrument for communication accross the organization. It is also useful to assert which of the resources or capabilities the organization already possesses or has to acquire.

Table 4.12: ITIL Value Viewpoint

ITIL Value Viewpoint	
Stakeholders	Managers, CEO, CIO, Process owner, employee, customer
Concerns	ITIL process metrics, its value, resources and capabilities
Purpose	Deciding, Informing
Abstraction Level	Coherence
Layer	Business, Application, and Technology layers
Aspects	Value

Concepts and Relationships

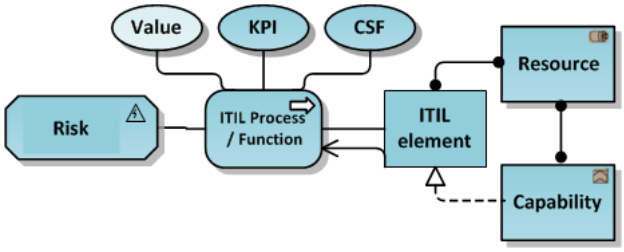


Figure 4.17: Concepts and Relationships of the ITIL Value Viewpoint

Example

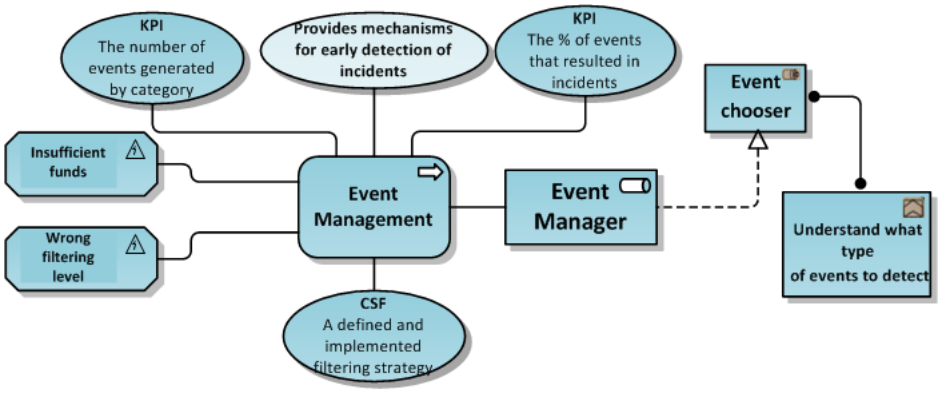


Figure 4.18: Example of the ITIL Value Viewpoint

4.6.7 ITIL Service Catalog Viewpoint

The *ITIL Service Catalog Viewpoint* focus on an overview of all the IT services that an organization provides: its Service Catalog. It also shows the IT elements that support (or expose) those services. It is useful to communicate the organization IT service architecture and to help service providers to model

several of its client organizations, representing which are the services of each client, the Service Level Agreements and the IT applications and infrastructure that support those services.

Table 4.13: ITIL Service Catalog Viewpoint

ITIL Service Catalog Viewpoint	
Stakeholders	Architect, business process designer, process owner, employee, customer
Concerns	SLA terms, IT services, applications and infrastructure that supports them
Purpose	Deciding, Informing
Abstraction Level	Coherence
Layer	Business, Application, and Technology layers
Aspects	Structure, behaviour, information

Concepts and Relationships

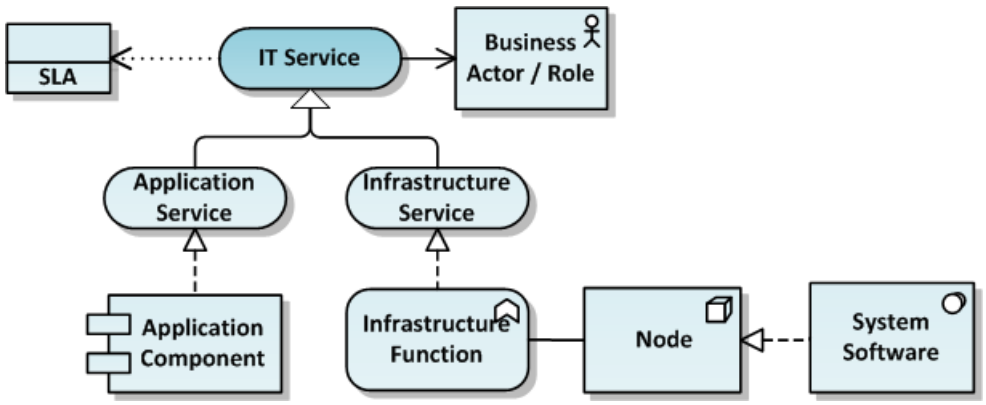


Figure 4.19: Concepts and Relationships of the ITIL Service Catalog Viewpoint

Example

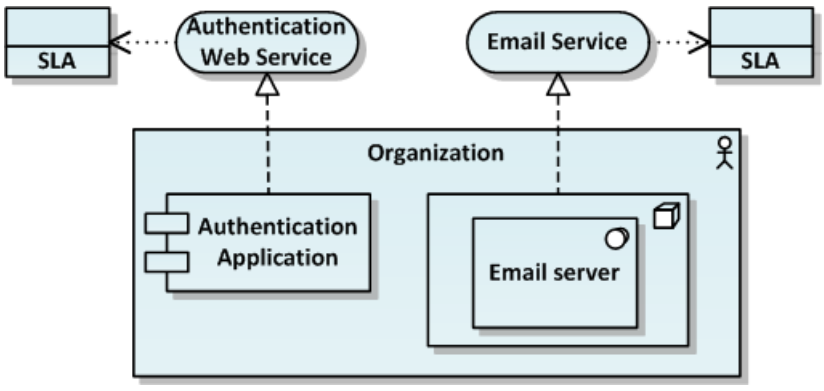


Figure 4.20: Example of the ITIL Service Catalog Viewpoint

4.6.8 ITIL Compliance Viewpoint

The *ITIL Compliance Viewpoint* focus on assigning the ITIL concepts and relationships to the actual architectural elements that represent them. An ITIL Compliance Viewpoint can be an instance of any of the other ITIL views, where we add the actual IT applications, business roles, and infrastructure elements that the organization uses to adhere to ITIL best practices. This view is mainly used to check for compliance, to see how an organization's IT service architecture is compliant with the ITIL best practices framework.

Table 4.14: ITIL Compliance Viewpoint

ITIL Value Viewpoint	
Stakeholders	Architect, software developer, process designer, process owner, employee
Concerns	Compliance and assignment of the organization EA with ITIL
Purpose	Deciding, Informing
Abstraction Level	Details, Coherence
Layer	Business, Application, and Technology layers
Aspects	Structure, Behaviour

Concepts and Relationships

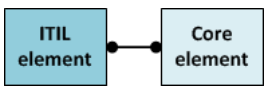


Figure 4.21: Concepts and Relationships of the ITIL Compliance Viewpoint

Example

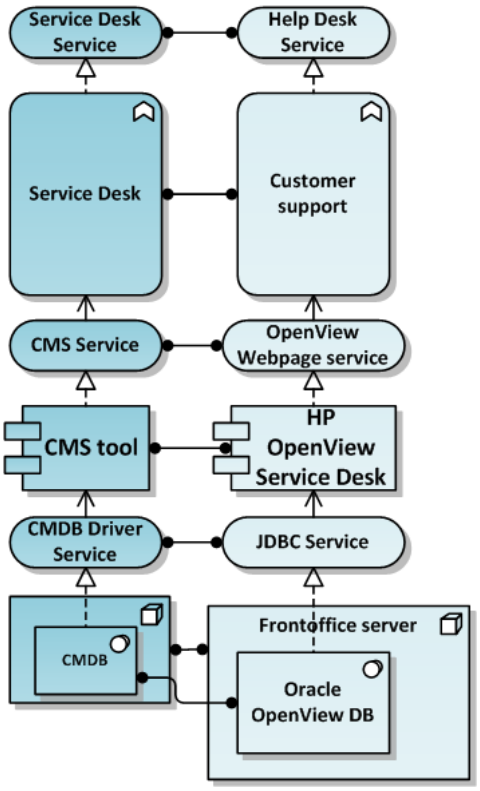


Figure 4.22: Example of the ITIL Compliance Viewpoint

4.6.9 ITIL Service Provider Viewpoint

The *ITIL Service Provider Viewpoint* focus on modeling and representing an IT Service Provider. A Service Provider has usually several customers to whom he provides different services and at different levels. This viewpoint allows to model the services provided according to the service provider architecture and also the customer own architecture, making clear the locations where the IT elements are deployed and how both the organizations communicate.

Table 4.15: ITIL Service Provider Viewpoint

ITIL Service Provider Viewpoint	
Stakeholders	Architect, process designer, process owner, manager, CIO, CEO
Concerns	Architecture of a Service Provider and its customers
Purpose	Deciding, Informing
Abstraction Level	Details, Coherence
Layer	Business, Application, and Technology layers
Aspects	Structure, Behaviour, Information

Concepts and Relationships

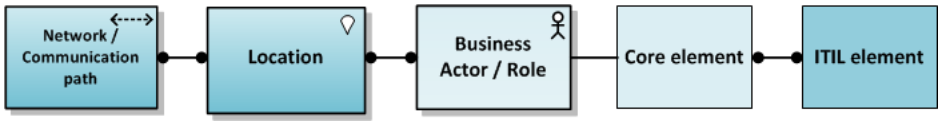


Figure 4.23: Concepts and Relationships of the ITIL Service Provider Viewpoint

Example

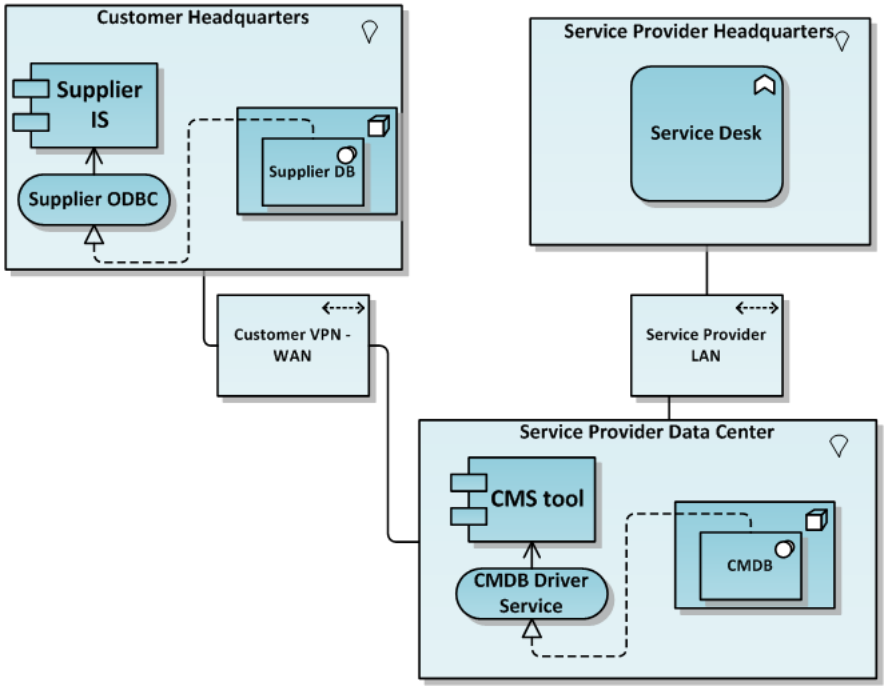


Figure 4.24: Example of the ITIL Service Provider Viewpoint

4.7 Implementing ITIL as an Architecture Change

Until now we have been defining principles, viewpoints and models for our future Enterprise Architecture, but an architecture model is not just useful to provide insight into the current or future situation; it can also be used to evaluate the transition from “as is” to “to be” (Lankhorst et al., 2009), and there is a strong relationship between developing EA and developing an ITIL-based ITSM program. Similarly, there is a strong relationship between implementing a target EA and an ITSM program. These relationships are manifested in terms of People, Process, Business, and Information (Radhakrishnan, 2008).

Thus, based on our proposal that ITIL is part of EA, in the sense that there are ITIL elements in every EA layer, we also propose that: **implementing ITIL on a organization represented by an EA is the same as implementing any other architectural change, so an EA method for the transition from a baseline to a target architecture could be used to implement ITIL**.

Therefore, the method we will propose to implement ITIL as a simple architecture change is based on TOGAF's ADM. In fact, according to TOGAF, "the ADM is a generic method for architecture development, which is designed to deal with most system and organizational requirements. However, it will often be necessary to modify or extend the ADM to suit specific needs. One of the tasks before applying the ADM is to review its components for applicability, and then tailor them as appropriate to the circumstances of the individual enterprise. This activity may well produce an 'enterprise-specific' ADM" (The Open Group, 2011).

Hence, we shall perform the ADM steps with the difference that, when building plateau models for performing gap-analysis, we shall use ITIL process models (that will be defined in Section 5.1, page 47) and bridge them with the baseline architecture to get the target one. Furthermore, the motivations for the architecture change will also be a subset from our ITIL motivation models (Section 5.2, page 49). The method runs as following:

1. For the *Preliminary* phase, first understand and explain to stakeholders our EA, its principles, methods and models

2. Use our ITIL motivation models to identify the specific organization's drivers or concerns;

3. Use our ITIL motivation models to identify the assessments that match the problems the organization has and wants to solve;

4. Follow the realization relationships in our ITIL motivation models. From the assessments we will have the goals, from the goals the requirements, and from the requirements we will get the ITIL processes that the organization needs to implement;

5. Start *Phase A: Architecture Vision* by using the ITIL motivation elements identified in the last steps. Build the architecture vision model;

6. Build a Goal Refinement viewpoint, with the refinement of goals into more concrete ones. Use also our motivation models to do it;

7. Go to *Phase B - Target Business Architecture and Gap Analysis*. First use our models to build a Requirements Realization diagram, where core elements realize the key business requirements. Then, perform a gap-analysis: build a baseline model of the organization business architecture AS-IS using ArchiMate elements, and a TO-BE architecture that includes ITIL elements from our ITIL core models. The gap-analysis will then compare what will have to change in the organization business layer to achieve the required target architecture;

8. Next we reach *Phase C: Target Application Architecture*. Here we will perform the same gap-analysis but for the application architecture. We will model the organization application landscape and the target architecture with all the ITIL applications needed to support the chosen ITIL processes;

9. *Phase D: Target Technology* will perform the gap-analysis on the infrastructure layer, and we will be able to see which are the infrastructure elements that must be present to support the ITIL application layer;

10. Finally, for Implementation and Migration planning and governance, there are *Phases E, F and G* where we will have transition architectures which are intermediate points between baseline and target architectures. These transition architectures will enable phased ITIL implementations, based on the best project management practices. Use any element or relationship from our models to build these plateau architectures descriptions.

The outcome of this approach is that once we start thinking about implementing ITIL as an architecture change, we can use architecture tools and methods to perform it. An organization can use our ITIL models like templates, hand-picking from our sets their own specific motivations, their own specific ITIL processes to implement. They can model their current baseline architecture and then the target one with our ITIL components. Then, through gap analysis on each EA layer, they will be able to see which people, information, processes, tools or infrastructure they will need to buy, keep, develop or change in order to reach the intended ITIL target.

Moreover, they can use several plateau architectures, to achieve a phased, iterative implementation, using project management techniques and relating work packages with EA/ITIL functions, services, processes, applications, data, and technology that will be added, removed, or impacted by the project. All this contributes to implement ITIL according to the best architecture practices, and enforcing that EA and ITIL teams join efforts to achieve this architecture change.

In Figure 4.25 we show how we adapted the TOGAF ADM to include inputs from our architecture.

Nevertheless, we also want to make clear that the above method is just for implementing the ITIL processes themselves, not for implementing IT services. In fact, we are using a TOGAF ADM adapted method to implement ITIL, but for IT services implementation, we should use a method that also includes ITIL Service Design and Service Transition methods.

In fact the main Service Design objective is “The design of new or modified services for introduction into a production environment” (van Bon et al., 2007) while Service Transition’s is “A Service Transition includes the management and co-ordination of the processes, systems and functions required for the building, testing and deployment of a ’release’ into production, and establish the service specified in the customer and stakeholder requirements” (van Bon et al., 2007).

Hence, we must not confuse ITIL implementation with IT services implementation, because although both are architecture changes, they happen at different scopes. In effect, ITIL says nothing about methods for implementing itself. Therefore, we can not use ITIL methods for implementing it (they are not metamethods), but EA ones. However, for IT services design and implementation, we have ITIL methods for it, so we will use them as they are the best practices for IT service design, testing and deployment.

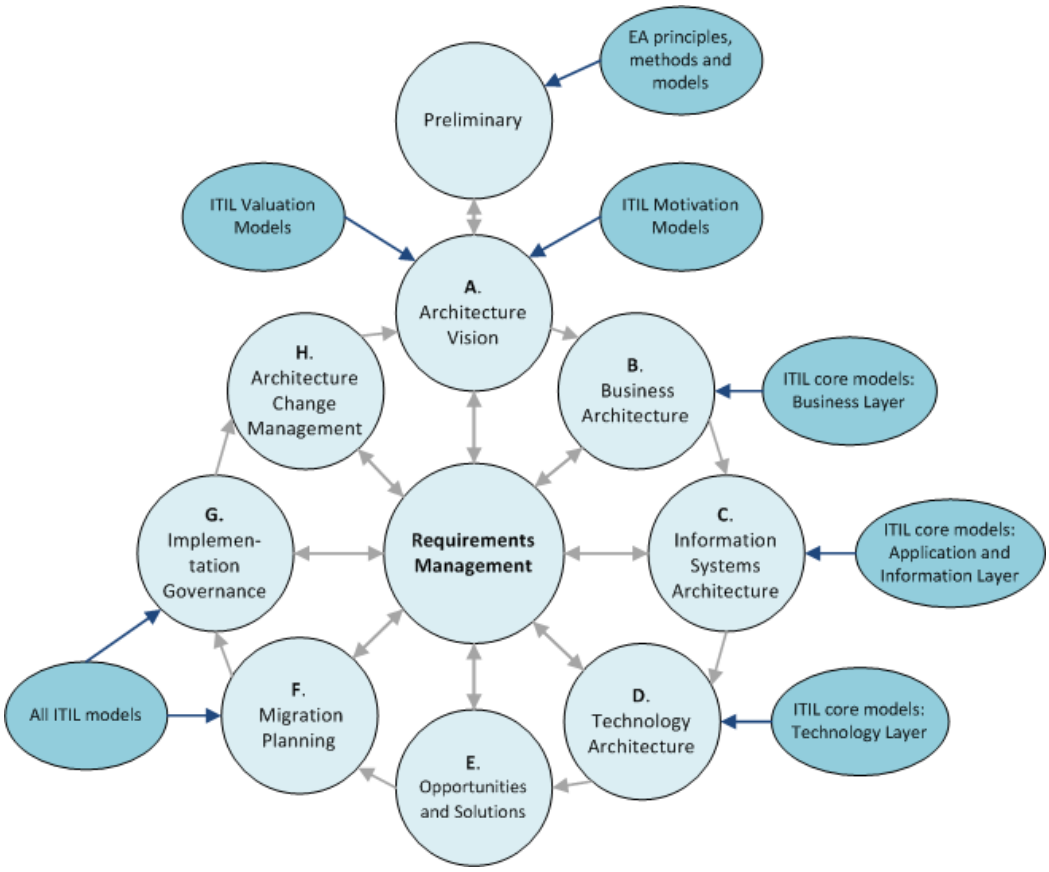


Figure 4.25: TOGAF ADM with ITIL models as inputs (based on The Open Group (2011))

Therefore, we leave for future work the definition of a method to implement IT services, which will join elements from the TOGAF ADM approach with ITIL methods and principles from Service Design and Service Transition. A joint method will again involve both EA and ITIL professionals by using EA gap analysis on each layer, to see which people, information, processes, tools or infrastructure will be needed to buy, keep, develop or change in order to implement these services with the ITIL best practices of Service Design and Service Transition.

Chapter 5

Demonstration

This chapter is the "Demonstration" step of the DSRM method. Peffers et al. (2007) argues that this step should demonstrate that the artifact solves one or more instances of the problem. Therefore, we shall use several approaches: first, we will use our viewpoints to model ITIL processes and their motivation. Then, we will use them to model a real IT service provider organization architecture.

Afterwards, we will use an ArchiMate case study to implement ITIL as an architecture change, and to perform architecture-based ITIL valuation. These demonstrations are also consistent with Hevner et al. (2004) observational, experimental (simulation) and descriptive (scenarios) design evaluation models.

5.1 Process Models

Some of our proposed viewpoints use only ITIL elements and their purpose is to represent ITIL processes as they are described in the ITIL books. Therefore, these are the models that will be useful to organizations for guidance and reference. They will also be needed to build instances of the Compliance Viewpoint, since it uses ITIL processes' elements and relationships.

Therefore, in this section we shall present several models based on these particular viewpoints. For these models we will use the ArchiMate notation for concepts and the color scheme (for aspects) that we introduced in Section 2.4 (page 8). As an example, we usually introduce this part of our work as a 3-model scheme. First we used the *ITIL Book Overview Viewpoint* to model an ITIL overview with all its five books (on Figure 5.1 we present a detail of this model, showing only the Service Strategy book).

Its utility is to understand in a glance which are the services (and from which books) that ITIL provides to its external environment. It should however be noted that those are not IT services, but business ones, since they represent a general behavior that is realized by ITIL business processes and not actually its implementation.

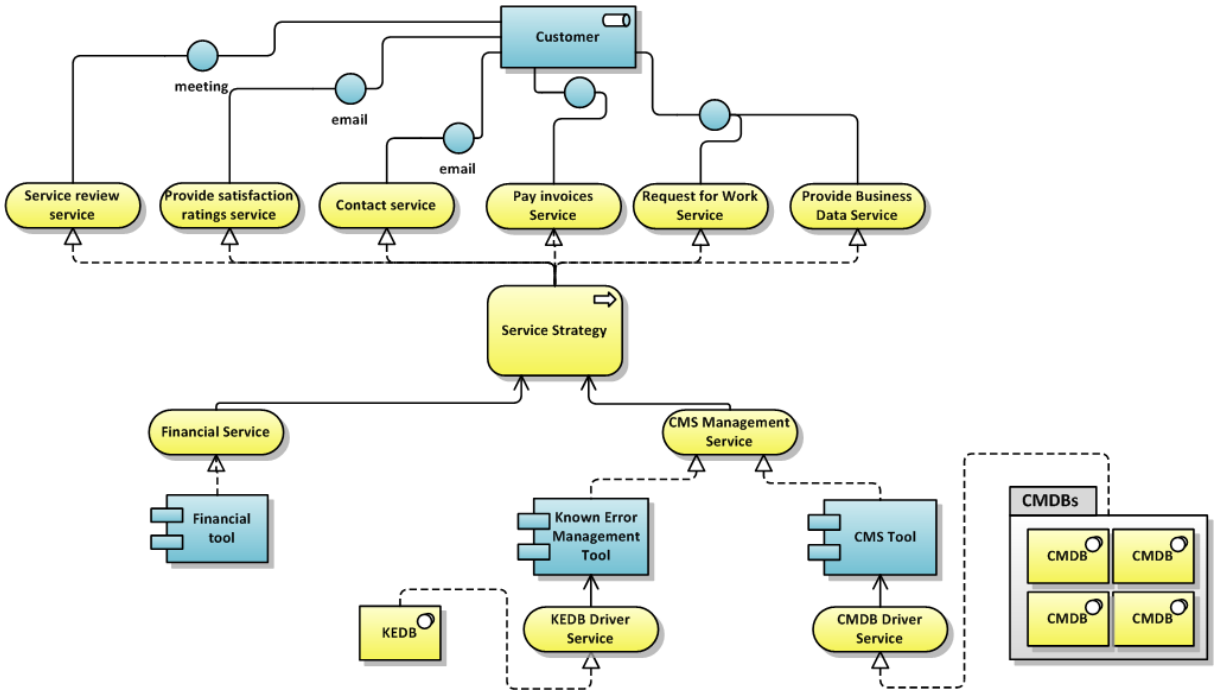


Figure 5.1: Detail of ITIL overview model. Full model available in `http://db.tt/TF0Ycdoh`

It also shows which are the applications (and respective services) that ITIL uses to support its processes, and also the infrastructure components (the databases and its services) that support those applications. It provides a top view with ITIL core processes as a black box system that provides services to the environment while using application and infrastructure ones. Actually, this model gives a meta Service Catalog: ITIL's service list.

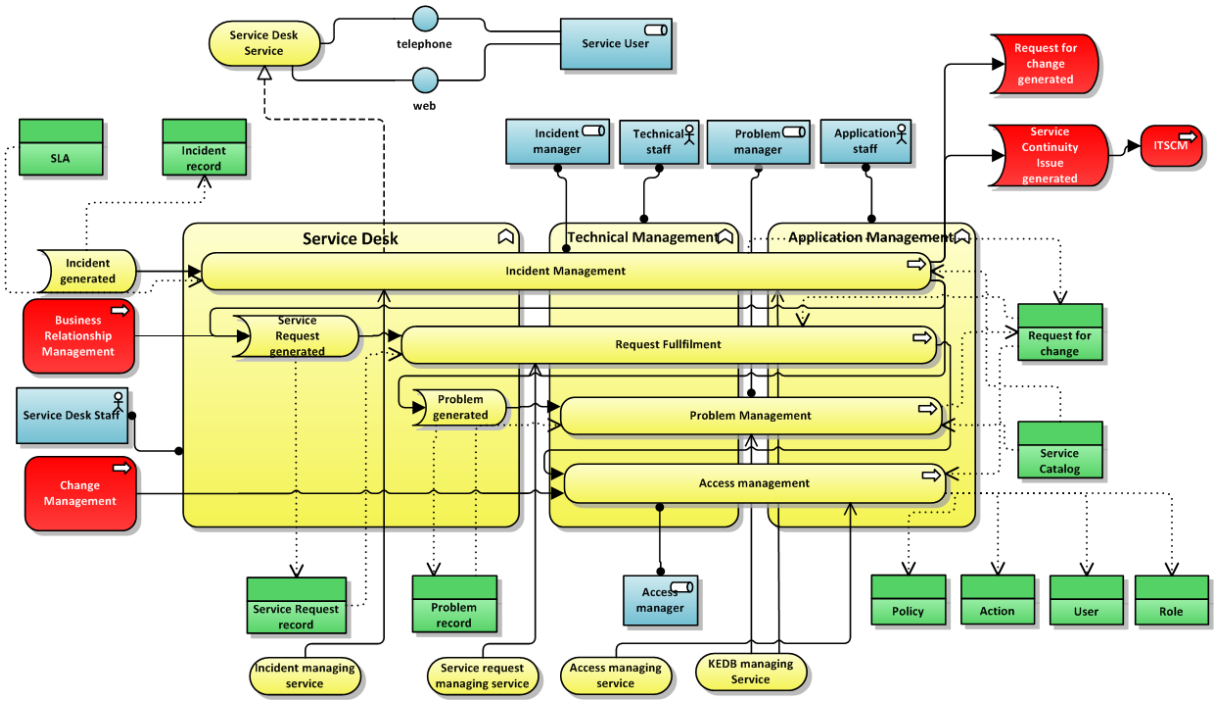


Figure 5.2: Detail of Service Operation model. Full model available in `http://db.tt/wmrivNof`

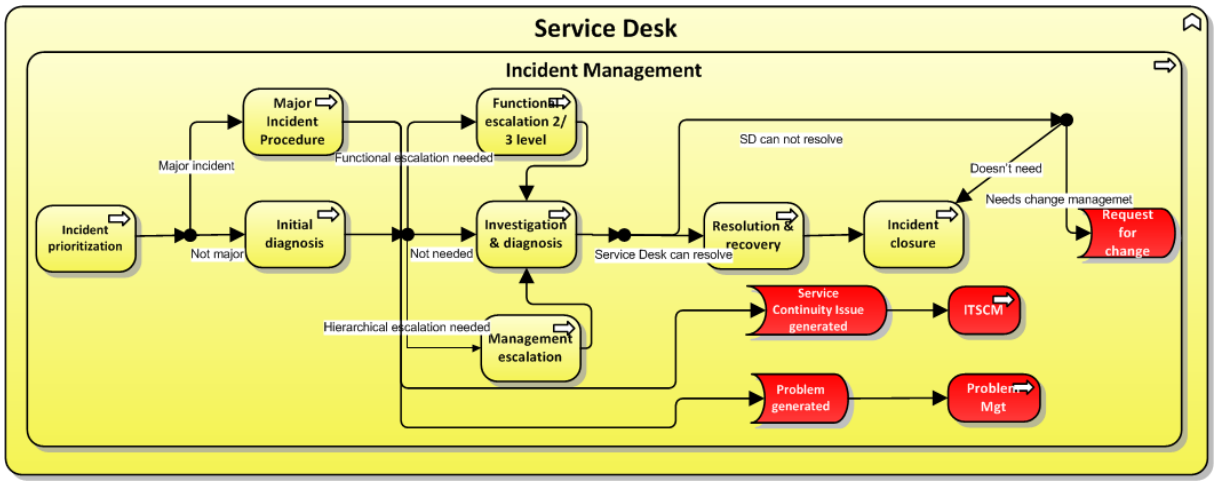


Figure 5.3: Detail of Incident Management model. Full model available in `http://db.tt/7MlcqXvR`

Next, we have a second model using the *ITIL Process Viewpoint* (detail in Figure 5.2), where we zoom into one of the ITIL books, the Service Operation one. Here we can see all its processes, events, functions, business objects, applications and databases. Finally, we aim for a deeper fine-grained representation and used the *ITIL Process Detail Viewpoint* to model the Incident Management process (detail in Figure 5.3). This allows us to look inside this process and see all its individual activities, which business objects they manipulate and what services they use and expose.

These models were chosen to demonstrate how ArchiMate can be used to show different ITIL views, directed to different stakeholders with different concerns. Yet, the three models remain consistent, since the processes inputs and outputs, business objects, business events, business applications and infrastructure services are the same but on different granularity levels.

Besides this 3-model pack, we actually produced a full set of models, one for each of the other ITIL books. Together, our ITIL core representation are the models for the whole ITIL 26 processes and 4 functions, built with the *ITIL Process Viewpoint*.

These models are our proposal for a formal representation of ITIL and a tool for architects to use ITIL components and relationships to design ITSM organizations and also to check for best practices' compliance and maturity, by building *as-is* models with the current organization's ITIL processes and *to-be* models representing the ITIL maturity level where the organization plans to stand in the near future.

5.2 Motivation Models

Using the concept mapping we had identified earlier for the ITIL motivation (section 4.4, page 25), we analyzed the official ITIL books, going through all its processes' and functions' descriptions. In fact, we had already done this on a first iteration when we were identifying the ITIL BMM concepts. This time, however, we were not looking for the concept's class, but for its instances. For example, instead

of looking up for concepts that resembled ArchiMate's "goal", we were now searching for references of its ITIL counterparts "mission, goal, objective" and gathering its instances like "detect service events" or "ensure only authorized users can use services" in Service Operation.

Following this procedure, we eventually compiled a set of elements which are, in our opinion, the most relevant motivation items for every ITIL process. This assumption is based on the elements' own relevance through the official books and general ITIL sources. However, being ITIL a set of best practices, built upon IT service providers different opinions and experiences, we also concede that some practitioners could include other elements or leave some of these out.

Thereby, we do not claim that this is the only motivational representation of ITIL, we say instead that based on our mapping, on the identified concepts and on our perception, this is our proposed ITIL BMM model and its ArchiMate representation. We therefore welcome (and encourage) that these models are revised by the ITIL community itself to reflect, as ITIL does, the majority of its practitioners' opinions.

Figure 5.4: Notation for ArchiMate Motivation Concepts (adapted from The Open Group (2012))

With these concepts' instances we also produced several models. Here we shall only present a small set of them. The models were built using the ArchiMate Motivation Extension, to which we have already presented its metamodel (Figure 2.3, page 10) and in Figure 5.4 we present its concepts' notation.

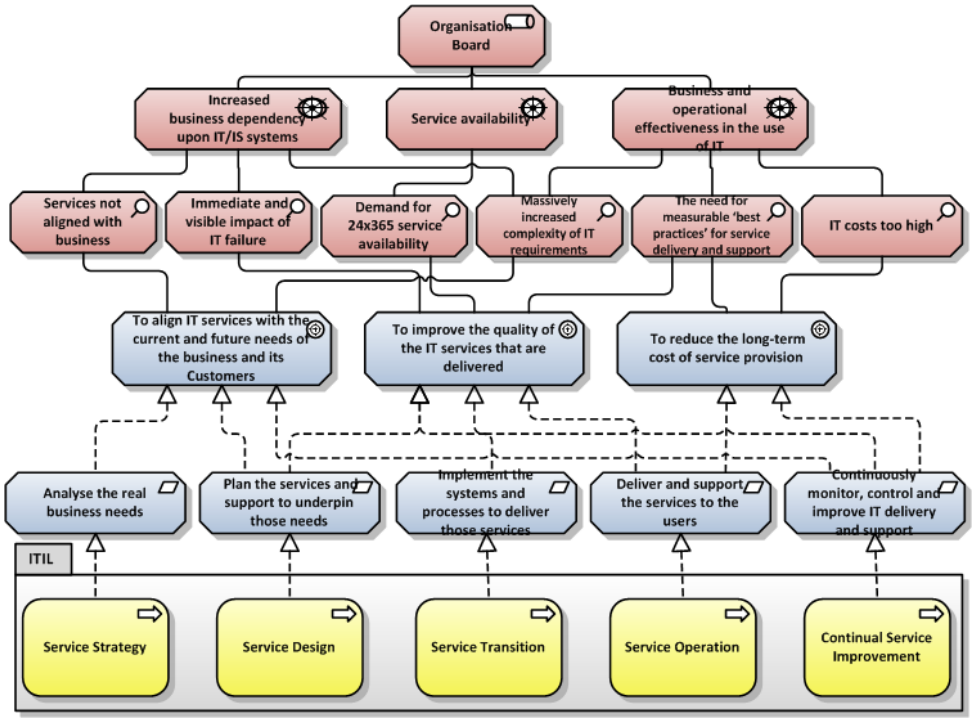


Figure 5.5: ITIL business motivation model overview (`http://db.tt/xRiyqm6Q`)

The first (Figure 5.5) uses the *ITIL Motivation Viewpoint* to represent an ITIL overview with all its five books. Its utility is to understand in a glance why there was the need for creating ITIL in the first place. What was its overall motivation, the industry concerns, the outcomes of the assessments about those concerns, what were the set goals to solve the identified issues, the needed requirements to fulfill the goals, and, at last, which of the books implements those requirements.

Afterwards, in Figure 5.6 we zoom into one of the ITIL books, the Service Operation one. Using the same *ITIL Motivation Viewpoint*, we can now see an expanded set of drivers, assessments, goals and requirements that are related and realized by the Service Operation book.

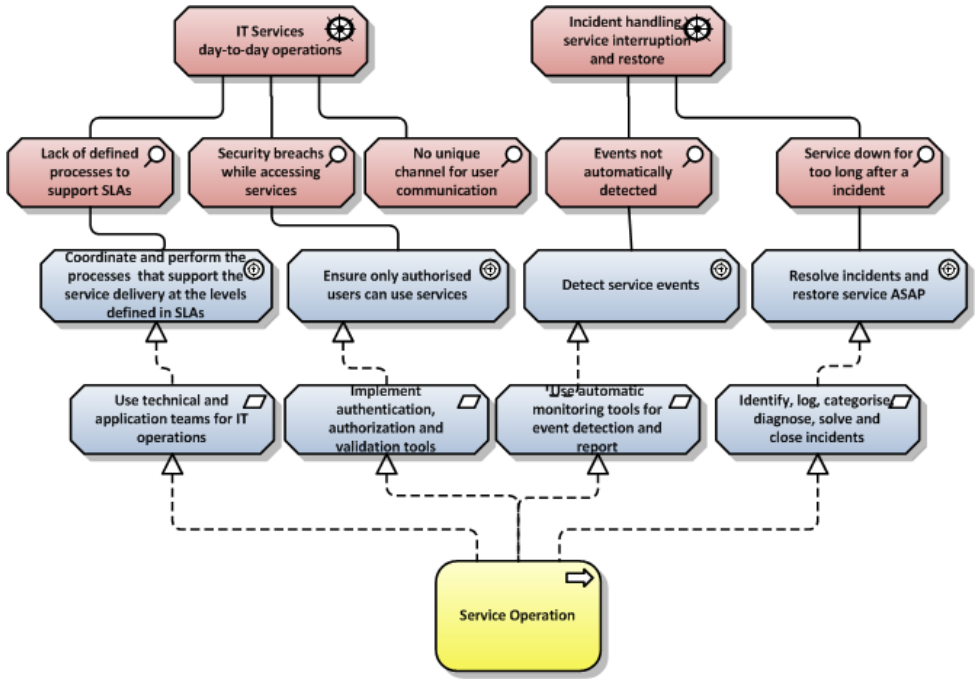


Figure 5.6: Detail of Service Operation. Full model available at (`http://db.tt/OO7r7de5`)

In Figure 5.7 we aimed for a deeper fine-grained representation and focused on the Incident Management process. This allows us to look to this process and see which are its motivational elements and how are they realized by requirements, now in a process scope.

Finally, to show how we can use these models to align business and IT, we present a model where we show, for several Incident Management requirements, which are the specific activities from this process that realize each one of the requirements. This uses the *ITIL Requirements Realization Viewpoint* and allows doing a complete trace starting from a business concern and navigating through assessments, goals and requirements until we reach the actual activity (or other core architecture element) that realizes business strategy (Figure 5.8).

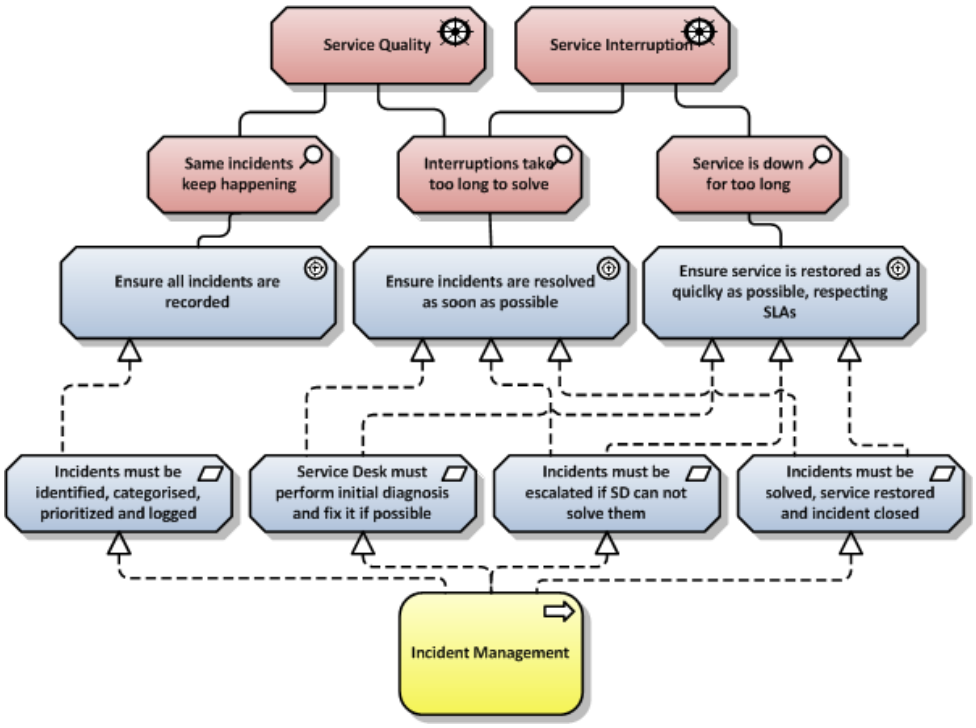


Figure 5.7: Detail of Incident Management. Full model available at (`http://db.tt/15hxwU2N`)

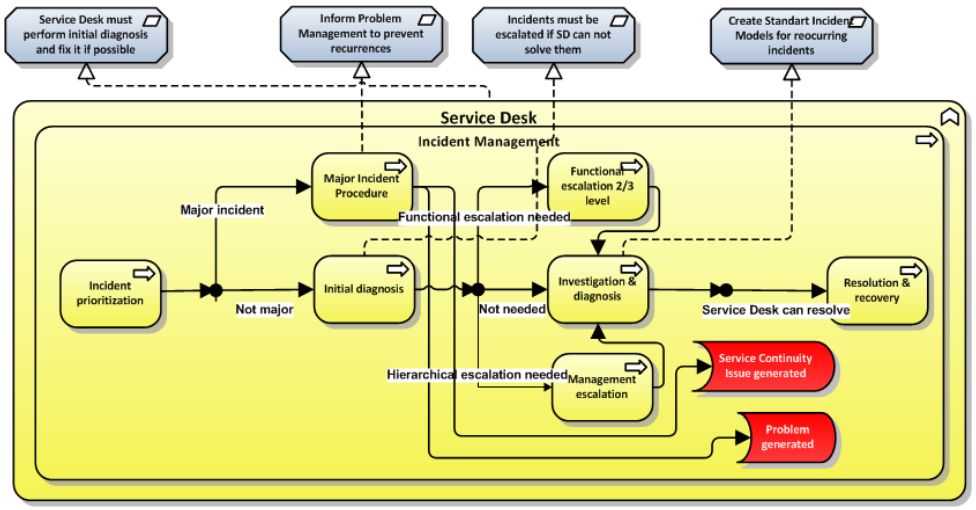


Figure 5.8: Realization of Incident Mangement motivation (`http://db.tt/7MlcqXvR`)

Again, these models were chosen to demonstrate how ArchiMate can be used to show different ITIL views, directed to different stakeholders with own concerns. Yet, the three models also remain consistent, since the elements are similar but on different granularity levels.

Overall, we used the *ITIL Motivation Viewpoint* to produce all the models that represent the complete ITIL business motivation model. Together, this part of our work consists on a set of models with the whole ITIL 26 processes and 4 functions motivation model, representing for each book and each process the whole set of drivers, assessments, goals and requirements.

Therefore, with these models we are able to design better organizations according to ITSM best practices, since we can identify what are the most relevant concerns and drivers for each organization, and trace them down through goals, principles and requirements to the specific ITIL book, process and activity that realizes them. This way we can achieve business/IT alignment by ensuring that the ITIL processes that will be implemented have a direct match to the organization's concerns and strategy.

5.3 Modeling an IT Service Provider

To demonstrate how our viewpoints and models can be used to add value to real organizations, we have contacted eChiron and asked them for the opportunity to perform a demonstration of our work.

eChiron is a Portuguese IT outsourcing service provider with offices in Lisbon and Madrid. It started in 2000 as an application service provider (ASP) that also offered hosting solutions. One year later, eChiron broadened its scope and turned into an IT Outsourcing Service Provider, becoming a benchmark organization on Managed Services in Portugal. In 2006, eChiron added Business Process Outsourcing to its offer and in 2009 it was one of the first Portuguese organizations to offer virtualization and cloud computing services.

In Figure 5.9 we present a model of eChiron's organizational structure. It has a Board of Administration, a Quality department and a Marketing one. There are also business function units like Human Resources and Finance, Customers Services, and Consulting.

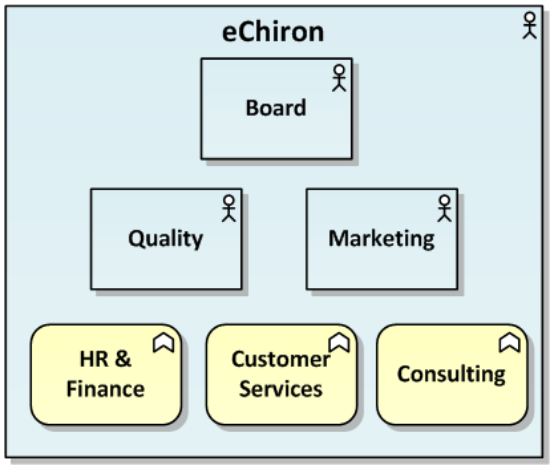


Figure 5.9: eChiron's organizational structure

Since our architecture addresses IT service providing we shall just focus on the Customer Services business unit. This unit has a Director, and several teams: Service and Account Management, System Design and Implementation, Pre-sales, and Customer Service & Support. This latter unit is then divided into 3 business functions: Remote Customer Service, Mobile Customer Service and Service Support & Automation. In Figure 5.10 we present its organizational structure.

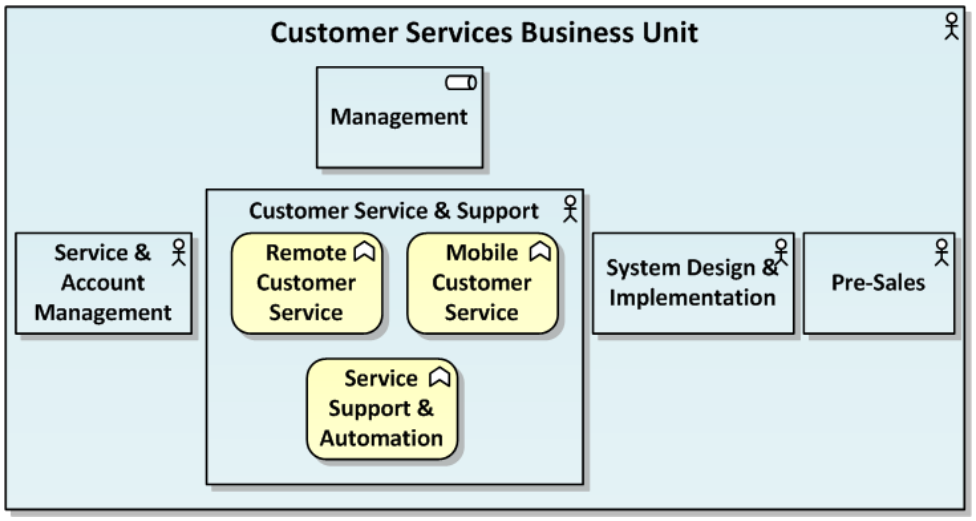


Figure 5.10: eChiron's Customer Services' organizational structure

As an IT outsourcing service provider, eChiron has its business functions and resources dispersed through several locations. In Figure 5.11 we present the eChiron architecture elements spread through eChiron's headquarters, data center, disaster recovery, vaulting and customer headquarters' locations.

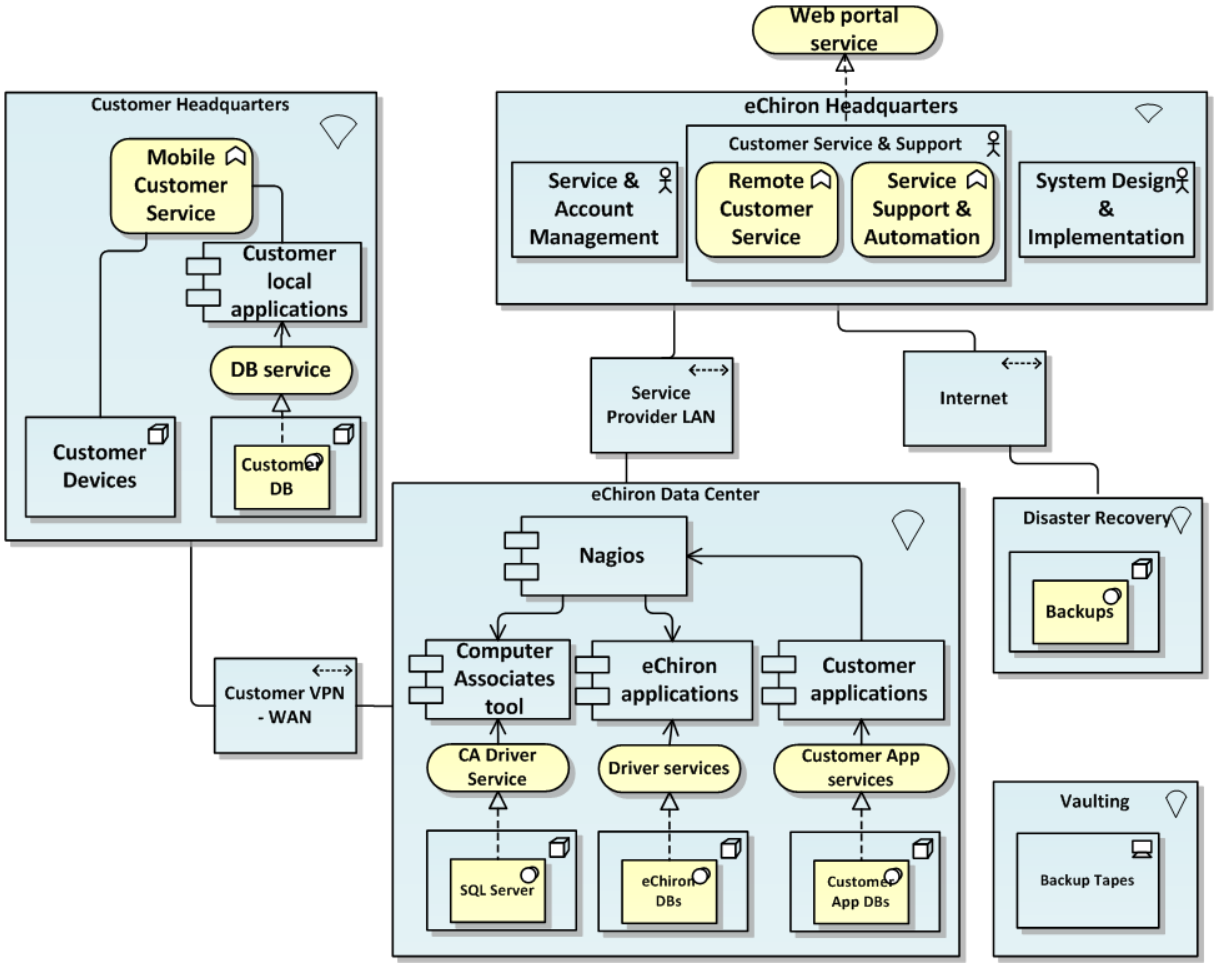


Figure 5.11: eChiron architecture using the IT Service Provider Viewpoint

In this model, we used one of our proposed viewpoints, the *IT Service Provider Viewpoint*. Therefore, in the top right we have eChiron's headquarters with Service & Account Management, Remote Customer Service, Service Support & Automation, and System Design & Implementation. Service & Account Management handles customer relationships and service level agreements.

Remote Customer Service handles incidents and requests from customers. There is also a team for Service Support & Automation to aid on incident resolution and recovery. System Design & Implementation handles requests for change, or unsolved incidents. Customer Service & Support also has a web portal where customers can report incidents or requests.

On the other hand, eChiron also has Data Centers (bottom center) where it keeps its data and infrastructure. These Data Centers are also used for storing and managing its customers' IT. On the left, we have the customer's location where eChiron may provide Mobile Customer Services for Desktop Management, and/or application or infrastructure management if the customer keeps any IT in its facilities. Finally, on the bottom right we have the Disaster Recovery and Vaulting locations.

These 3 models provide a clear representation of eChiron as a Managed Services provider, starting with an holistic organizational view and ending with a clear vision of how eChiron's organizational units and business functions operate and collaborate with its customers from several locations.

However, we also wanted to show how to use our architecture to assure compliance with ITIL best practices. In fact, to provide IT services to its customers, eChiron implemented and follows the majority of ITIL processes. We will not address them all, because that would be quite an endeavour. Instead, we will just show a few examples on how we can assign our ITIL models to eChiron architecture to demonstrate compliance to ITIL standards.

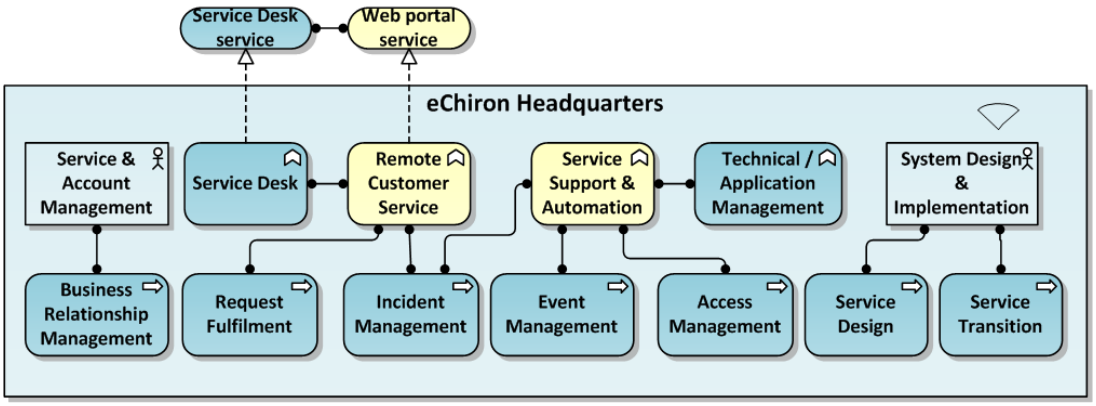


Figure 5.12: eChiron headquarters' architecture using the ITIL Compliance Viewpoint

We shall use the *ITIL Compliance Viewpoint* which uses an *assignment* relationship to link core elements to the correspondent ITIL elements from our models. In Figure 5.12 we present this viewpoint applied to eChiron's headquarter's architecture.

In this model, we assigned the Service & Account Management unit to ITIL's Business Relationship

Management process since they address similar concerns and activities (this unit could as well be assigned to other ITIL processes, like, for instance, the Service Level Management one). On the other hand, for the System Design & Implementation unit we assigned it to ITIL Service Design and Service Transition books. Please take note that we have increased the scope and performed the assignment to an ITIL book instead of a process. In fact, in these viewpoints the level of detail depends on the ITIL parts we want to focus, and in this demonstration we are more interested in the Service Operation book.

Thus, the Remote Customer Service can be assigned to ITIL's Service Desk function, Request Fulfillment, and Incident Management processes. As for the Web portal it is assigned to the Service Desk service. eChiron's Service Support & Automation is also assigned to Incident Management (because of incidents that are escalated), to Event and Access Management processes, and to ITIL's Technical and Application Management functions.

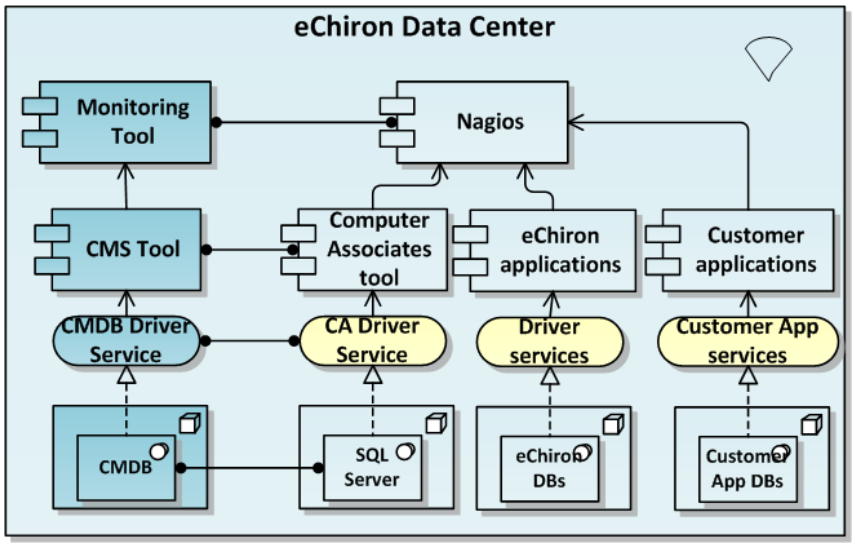


Figure 5.13: eChiron data center's architecture using the ITIL Compliance Viewpoint

At the Data Center location, eChiron has installed a customized version of Nagios, an industry standard IT infrastructure monitoring software. This tool monitors and generates alerts for eChiron's (and its customers) infraestructure and services, such as: servers, switches, links and application services. eChiron also uses a tool from Computer Associates Tecnhologies to support several IT service management processes.

Therefore, following our compliance approach, we can see in Figure 5.13 that eChiron's Nagios software is assigned to ITIL's monitoring tool, the services management tool from Computer Associates is assigned to ITIL's Configuration Management System tool, and there is an SQL Server database that can be assigned to ITIL's Configuration Management Databases. Thus, this model shows how eChiron application and infrastructure architectures are compliant with ITIL best practices.

Next, we analyzed the architecture of its customers. In fact, sometimes they just move all their IT to eChiron, which is uninteresting from our modeling point of view. However, there are several customers

to whom eChiron provides services of Desktop Management and a few where they have some IT at their own premises. In Figure 5.14 we model one of these cases. Although much of the support is still remotely provided by eChiron's Customer Service & Support, sometimes there is an on site team (Mobile Customer Service) that handles and manages customer's devices, applications and infrastructures. Thus, this team can also be assigned to ITIL's Technical and Application Management functions.

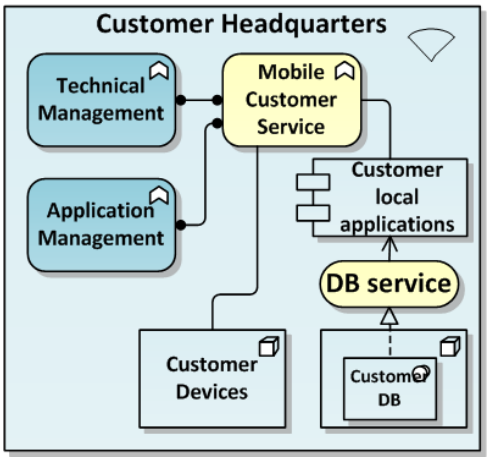


Figure 5.14: eChiron customer's architecture using the ITIL Compliance Viewpoint

Finally, as an example of how these viewpoints can be used to address different granularity levels, we zoom to our ITIL Incident Management model and assign eChiron's units and business functions to the process activities (Figure 5.15). Therefore, it is the Remote Customer Service that handles the initial diagnosis, and investigation & resolution activities; eChiron's Service Support & Automation can be assigned to incident escalation; and incidents that can not be solved will go to eChiron's System Design & Implementation, which is assigned to the Technical/Application Management functions of ITIL.

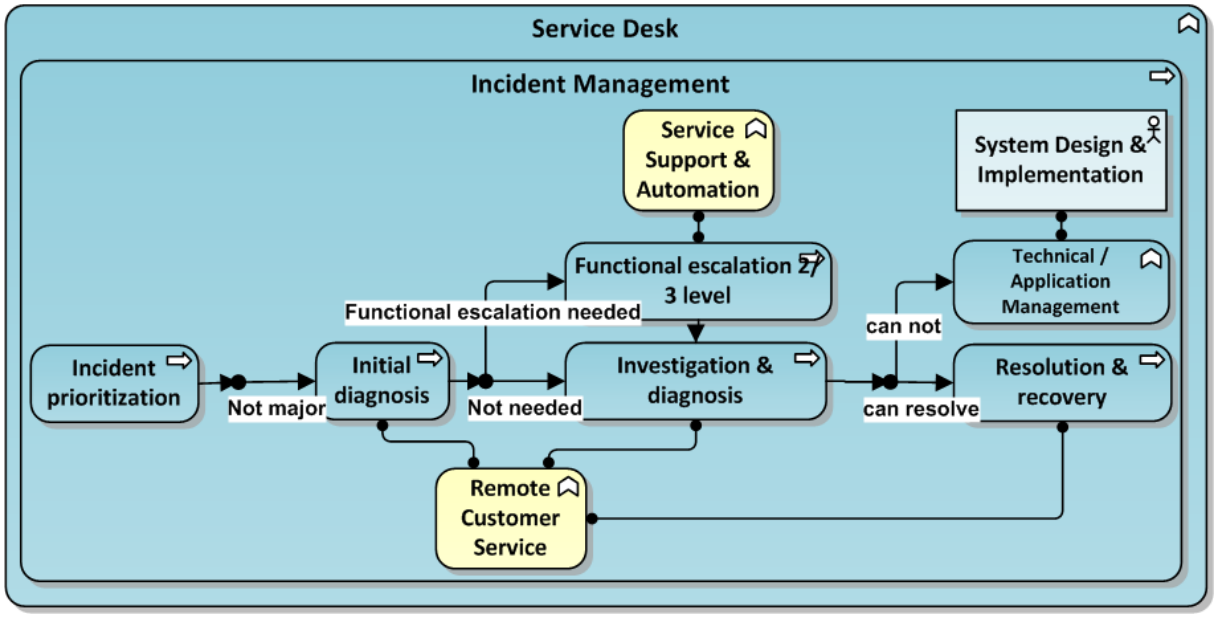


Figure 5.15: eChiron architecture assigned to ITIL Incident Management process

Basically, these models are just a small sample of the expressive power of this approach. In fact, this can be done to every ITIL process that eChiron implements and any scope can be used, from an overall vision where we just assign ITIL books to eChiron's business units, to the detail of assigning each of eChiron's business activities to the actual activities of ITIL processes. Therefore, we believe this can become a valuable tool to demonstrate compliance to ITIL and to international standards for IT Service Management, like ISO20000, for instance.

This set of models was later validated by eChiron, that acknowledged it represented (a short and summarized part of) their achitecture. Furthermore, since eChiron is actually starting to use ArchiMate to represent its own architecture we hope this work can help to set the foundations and provide guidance to that representation.

5.4 Implementing ITIL on ArchiSurance

The ArchiSurance Case Study is a fictitious example developed to illustrate the use of the ArchiMate modeling language in the context of the TOGAF framework (Jonkers et al., 2012). The Case Study concerns the insurance company ArchiSurance, which has been formed as the merging of three previously independent companies. The Case Study describes the baseline architecture before the merging and then a number of change scenarios. TOGAF ADM is then used to go from that baseline architecture to a target one with ArchiSurance after the merging.

Since this is a running example that is widely used across the ArchiMate community (Lankhorst et al., 2009; Jonkers et al., 2009; The Open Group, 2012; Lankhorst and the ArchiMate team, 2004; Lankhorst and Drunen, 2007b; Meertens et al., 2012) and on ArchiMate courses (Jonkers et al., 2012) we thought it would fit our demonstration purposes. Moreover, The Open Group "expects the Case Study to evolve over time, and encourages its members to add new aspects and views or create new change scenarios, as long as they are consistent with the original case description and models" (Jonkers et al., 2012).

That said, we start by pointing out that our models are indeed consistent with the existing ones, since we do not subtract anything but add ITIL instead. In fact, our baseline architecture is the target of the ArchiSurance example. Our premise is that after the merging, ArchiSurance was facing the same problems that several other organizations face when they decide to use ITIL.

Thus, we will use the exact same approach that is used on the ArchiSurance scenarios examples: we will use the TOGAF ADM and ArchiMate to represent an architecture change from a baseline ("as-is") of ArchiSurance (after the merging) to a target ("to-be") architecture with the implementation of ITIL Service Operation. Along the demonstration we will use the most suitable viewpoints. Some are from our ITIL set while others are already part of the ArchiMate specification.

Therefore, in the *Phase A: Architecture Vision* we establish an architecture effort and initiate an iteration

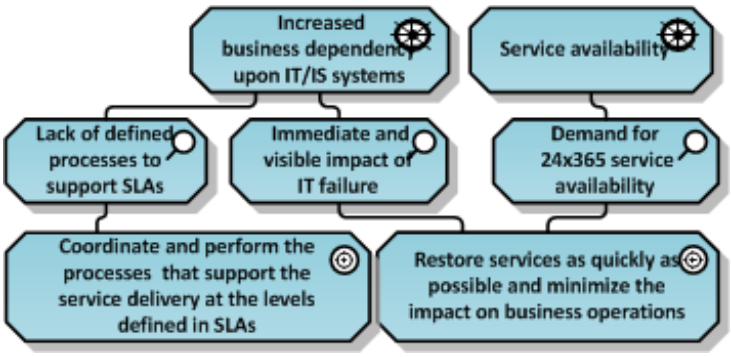


Figure 5.16: Detail of Business Goals and Principles

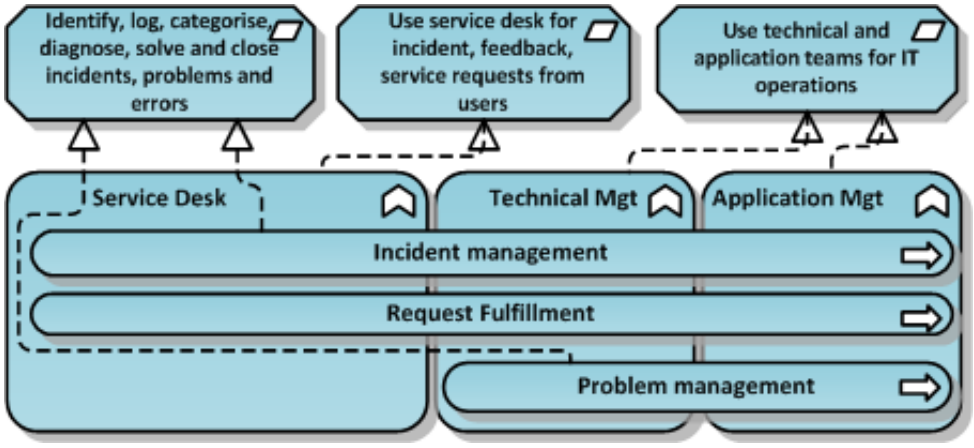


Figure 5.17: Detail of *ITIL Requirements Realization viewpoint*

of the architecture development cycle by setting its scope, constraints, and goals. We use the *ITIL Motivation Viewpoint* to show some relevant drivers, assessments and goals (Figure 5.16). Goals are the basis for requirements, so the next viewpoint we developed was the Goal Refinement viewpoint, which allows to model the refinement of goals into more concrete goals, and its refinement into requirements that describe the properties that are needed to realize the goals (Jonkers et al., 2012). Both of these views were based on our earlier ITIL motivation models.

Our next model was built with the Introductory Viewpoint, where a simplified notation is typically used at the start of a design trajectory, when not everything needs to be detailed yet, or to explain the essence of an architecture model to non-architects that require a simpler, more intuitive notation (Jonkers et al., 2012). Next, we moved on to *Phase B: Target Business Architecture and Gap Analysis* where we show how the target architecture realizes the key business requirements.

For this purpose, TOGAF specifies a Business Footprint diagram. In ArchiMate, this can be expressed using the Requirements Realization viewpoint, which allows the designer to model the realization of requirements by the core elements, such as business actors, business services, business processes, application services, application components, et cetera (Jonkers et al., 2012). Since we will be using only ITIL elements and relationships, we will use the *ITIL Requirements Realization Viewpoint* (Figure 5.17).

Still on this phase we also show the results of a global gap analysis for the business architecture (Figure 5.18). In both of these views we used the elements from the business layer of our core ITIL models (ITIL services, processes and functions), integrating them with ArchiSurance EA models in this latter view. The light elements represent the existent baseline components where the dark represent the ones in the plateau target, the ITIL components.

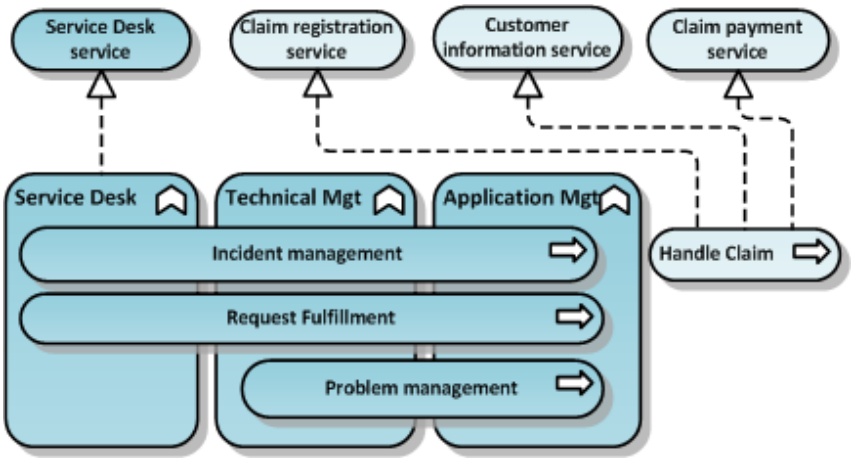


Figure 5.18: Detail of target Business Architecture

Afterwards, we moved on to *Phase C: Target Application Architecture and Gap Analysis*, where we use an *Application Communication Viewpoint* (Figure 5.19) to show the proposed target situation for the application landscape, with the results of a global gap analysis for this layer. In the front office, shared service center, and back office several ITIL component applications were introduced, like the CMS portal or the Monitoring and Control Tool, with the latter being used to monitor all ArchiSurance baseline applications (in the figure we omitted the relationships for clarity sake).

Next, it was time for *Phase D: Target Technology Architecture and Gap Analysis*, where we use the *Infrastructure Viewpoint* to show the target situation for the infrastructure (Figure 5.20). Here we introduced ITIL artifacts as the CMS portal or the KE portal which are deployed on the existing (baseline) ArchiSurance infrastructure.

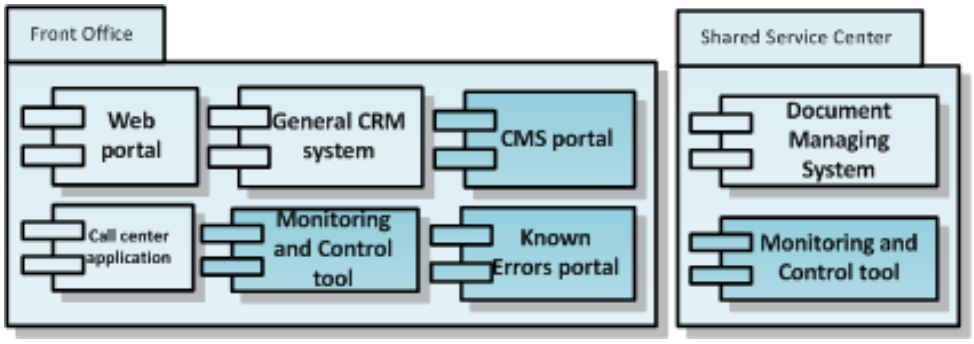


Figure 5.19: Detail of target Application Architecture

The following step, for Implementation and Migration Planning, TOGAF 9 introduces for Phases E and F the transition architecture, representing a possible intermediate situation (“plateau”) between the base-

line and the target. We used ArchiMate's *Migration Viewpoint* to show the baseline, target, and transition architectures, as well as their relationships. Finally, transition architectures enable the planning of implementation projects such as Service Desk, Request Fulfillment or Problem Management.

The sequence of these projects depends on which of the transition architectures is selected. This can be shown in a Project Context diagram to link work packages to the functions, services, processes, applications, data, and technology that will be added, removed, or impacted by the project.

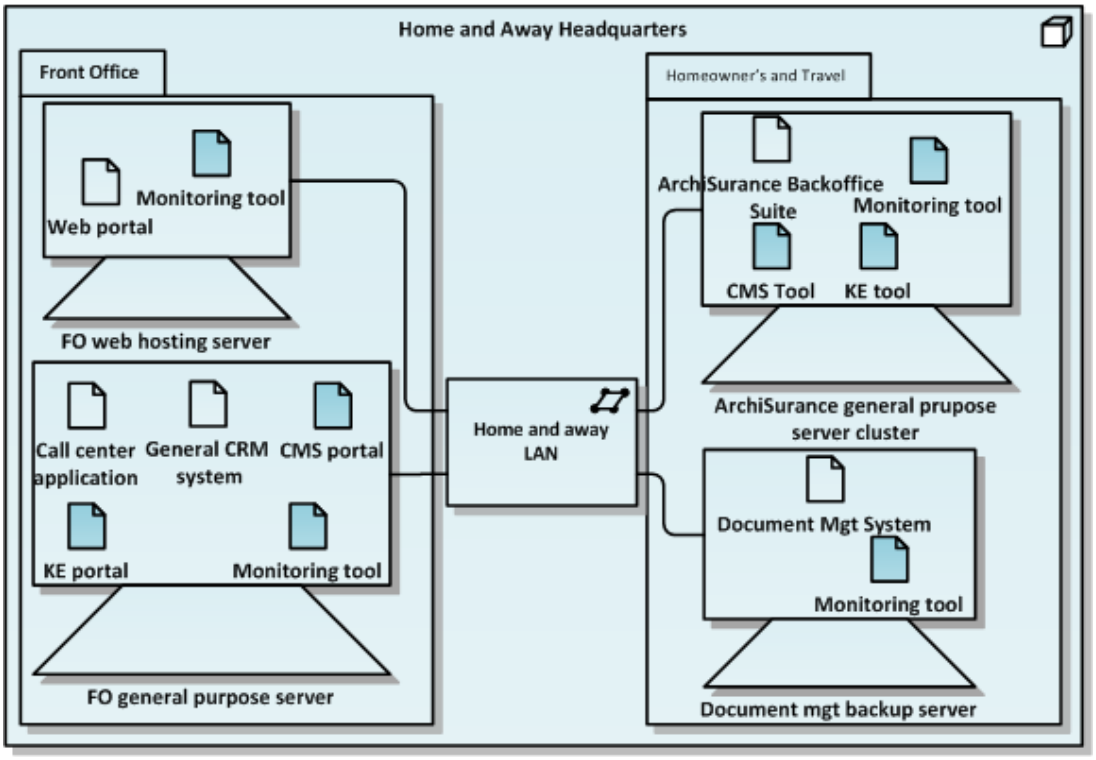


Figure 5.20: Detail of target Infrastructure Architecture

To summarize, we used our motivation models for phase A: architecture vision, and our core models for the remaining phases, namely the business, application and infrastructure gap analyses. At the end, we can look at the models and see that in every EA layer, new ITIL components have sprout, complementing (and changing) the existing architecture.

Thus, we demonstrate both of the proposals that support our EA:

- **ArchiSurance is an organization with a EA representation and an ITIL implementation, where the ITIL components (and relationships) are subsets (in every layer) of the EA ones**;
- **we implemented ITIL on a organization represented by an EA, using an EA method (TOGAF ADM) like if it was any other architecture change**.

In this section the figures are just simplified versions of some of our models, we have an extended set of full models representing all the TOGAF ADM cycle in ArchiSurance.

5.5 Architecture-based ITIL Valuation

In this section, we will start to model an ITIL process in ArchiMate using the Valuation extension concepts and afterwards we will demonstrate how we can use an adapted IT portfolio valuation method and an architecture-based approach to assert the value of two ITIL processes.

5.5.1 Modeling the value of ITIL Event Management process

We begin this demonstration by showing how the valuation concepts can be used to improve the representation of ITIL processes. We will use the Valuation Extension that Iacob et al. (2012) proposed (and we introduced in section 2.4.3, page 11) and we present in Figure 5.21 its concepts' notation.

Figure 5.21: Notation for ArchiMate Valuation Concepts (adapted from Iacob et al. (2012))

In Figure 5.22 we present the Event Management process of ITIL's Service Operation book. We used the *ITIL Value Viewpoint* to demonstrate the expressive power of the proposed language fragment, and to show how we can represent an ITIL process from an EA perspective using several architectural, strategy and valuation concepts. The choice of Event Mgt is purely arbitrary as it could have been any other process.

The motivation elements (top) were already defined in our motivation models, but now we join them with the valuation elements, showing how risks relate to assessments, how resources and capabilities realize the processes' requirements, and how core artifacts (services, application components) are assigned to resources.

Beginning with the drivers, we have "Event detection and Event recovery", then we show the results of assessments on these drivers and the risks related to them. For instance, to solve the "Events are not detected" issue we face the risk of not "establishing the right level of filtering" or "being unable to realize sufficient funds".

Afterwards, we have the goals that must be achieved, to solve "events are not detected" the goal is "Ensure issues are detected and resolved promptly, and hopefully before any users are impacted". Then, to achieve these goals we must realize some business requirements, which are "There must be a service monitoring tool that listen to service events" and "Must have error detection and alert mechanisms".

Here is where the valuation concepts start to come into place. In earlier models we just considered that the "Monitoring and control service" or the "Monitoring and control tool" realized these requirements. However, with valuation concepts we can decouple resources and capabilities from the actual artifacts

that implement them. In fact, it is the “Event detecting” and the “Event reporting” capability that actually realize the “Must have error detection and alert mechanisms” requirement. The application is just an artifact that holds this capability.

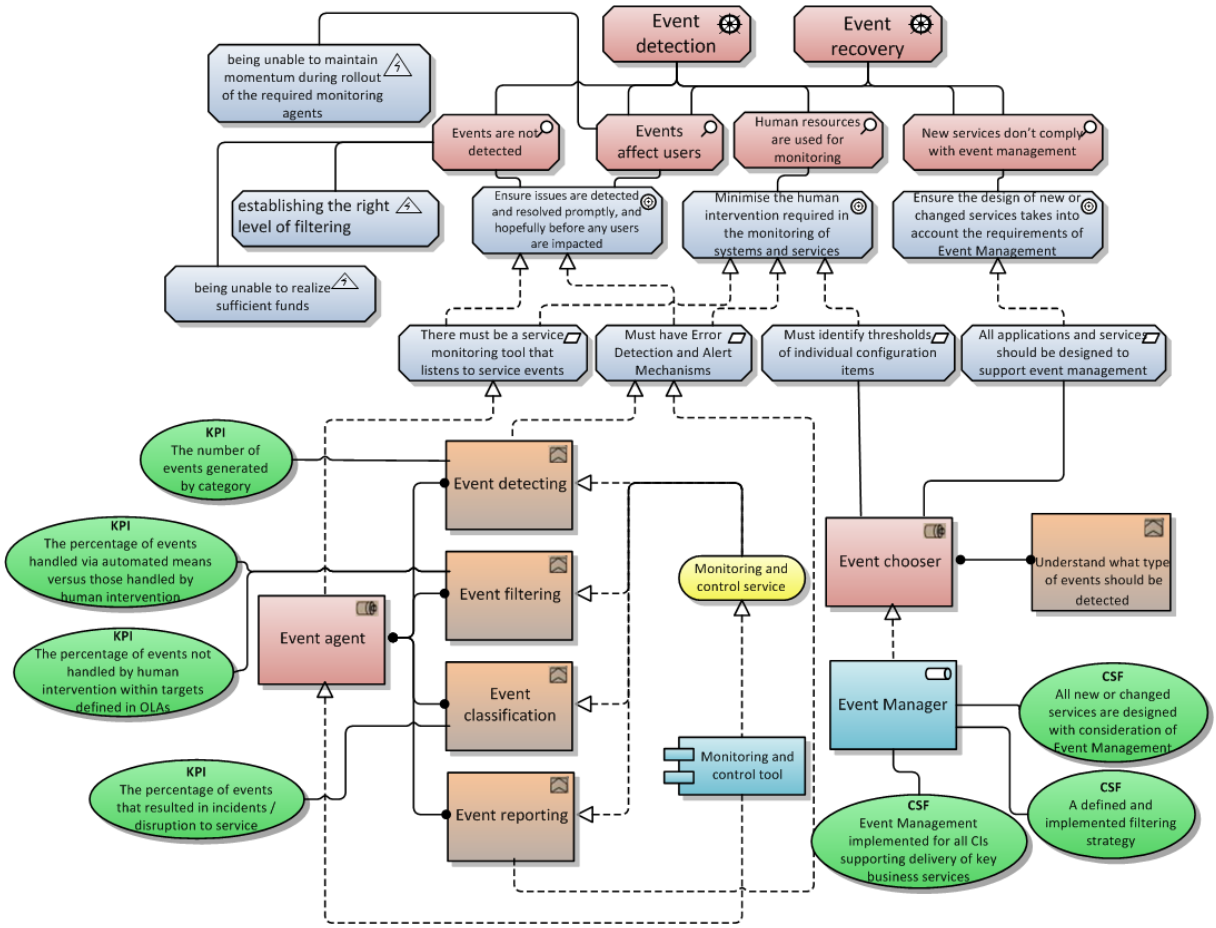


Figure 5.22: Motivation, KPIs, CSFs, resources, capability and risks in ITIL's Event Management

This approach importance is better understood if we look to the “Event chooser” resource with the “Understand what type of events should be detected” capability. This resource is realized by the “Event Manager”. In fact, what we know is that there must be something that chooses events and decides which ones should be monitored. Without the valuation concepts we would just say that the “Event Manager” realized those requirements, attaching a role to a requirement.

However, by introducing a resource/capability layer we can now say that a requirement is realized by resources with a set of capabilities, and we could easily exchange the Human element for an application component if we could acquire one with that same capabilities without changing the remaining architecture.

Moreover, we also added Key Performance Indicators (KPI) and Critical Success Factors (CSF) to our models. These concepts are modeled as Value, following Iacob's proposal to use attributes for the specification of a value type, for its measures (mostly expressed in terms of quantifiable KPIs) and for its nominal or ordinal measurements (Iacob et al., 2012).

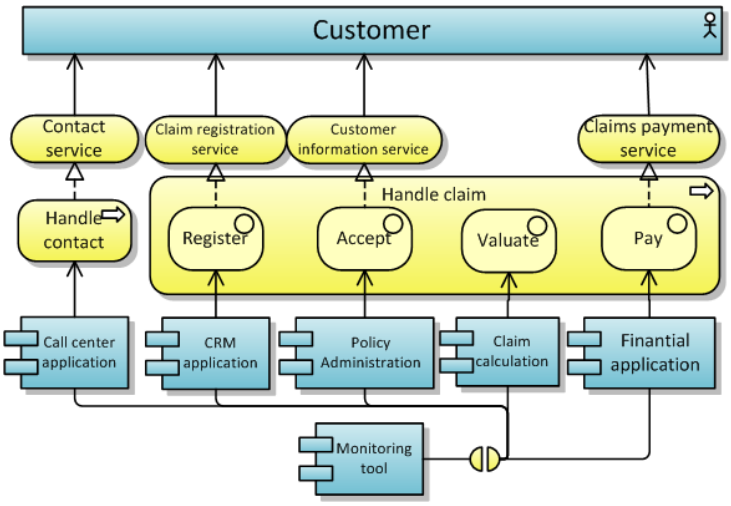


Figure 5.23: Business services, activities and the applications that support them

5.5.2 Architecture-based valuation of IT service management

In this subsection we shall revisit ArchiSurance. Our premise now, is that after the merging, ArchiSurance was facing the same problems that several other organizations face when they decide to use ITIL. In fact, they were having issues with one of their most important business processes: the claim handling one (Figure 5.23). This process allowed customers to register a claim, get feedback about its acceptance, know how much compensation would they get and finally getting paid. It had an huge contribution to customer satisfaction and any perception of a fault could drive customers away.

However, since the number of customers has increased after the merging, there have been problems with the IT services, as these were often down or malfunction, and ArchiSurance decided to use ITIL best practices to turn their IT service management more effective and efficient. They wanted to guarantee automatic event detection and recovery, and also wanted that their IT services had quality, were rarely interrupted and that service restoration would happen as soon as possible.

We have shown earlier that we could use ITIL motivation templates to discover which ITIL processes match the organization's motivation. In this scenario, following that approach, it leads us to the motivations of ITIL Incident Management and Event Management processes. Nevertheless, ArchiSurance did not have enough resources to implement both, so how should they choose which one would add more value to their organization?

The *handle claim* process has a set of activities that uses several applications. These are already monitored by a small tool that just checks if the applications are running and restarts them when they are not. There is also a contact service exposed by the ArchiSurance call center that handles customers and registers incidents reported by them. The *handle claim* process can happen by calling ArchiSurance by phone or by using this feature on the organization's web portal. Figure 5.23 shows a model of this architecture in ArchiMate (for clarity sake we do not show the application services provided).

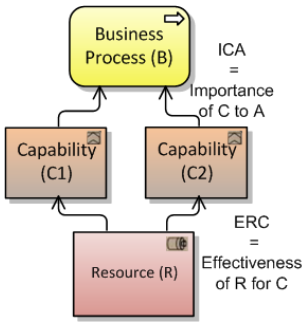


Figure 5.24: Adapted Bedell's method with capabilities, resources and business processes

In fact, some capabilities of ITIL's Event and Incident Management processes are already provided but not to all their extent nor how they are advised according to ITIL best practices. Thus, using a similar approach to Bedell's method, we propose to compare how effective are the current capabilities of Event and Incident management against the importance of these capabilities to the business process.

In Figure 4.5 (page 30) we showed how to include capabilities and resources in the Bedell method. However, in this case, since the business process is the same, its importance to the organization goals is also the same, so we do not need that part of the analysis. Moreover, we are not only interested in IT capabilities but in overall resource capabilities, which will mostly correspond to IT but can as well be people, roles, processes or any other architectural artifact.

On the other hand, we will also simplify the demonstration by calculating the importance of the capabilities to the entire business process instead of doing it for each of its activities. That said, Figure 5.24 shows our valuation model where we compare the effectiveness of a set of capabilities of organizational resources against the importance of those capabilities to a business process.

Thus, in order to calculate the effectiveness of resource capability we need measurable performance indicators. In fact, in our ITIL Event Management model (Figure 5.22) we had already associated ITIL KPIs to capabilities, so we will use them to assert how effective are the current ArchiSurance resources on providing those capabilities. Thus, to calculate this effectiveness, ArchiSurance should first define the KPIs with the levels they want to reach, then measure those KPI values on the *as-is* architecture and finally normalize them to a 0 to 10 scale, where 10 are the *to-be* values.

Furthermore, for the importance of the capabilities to the business process, Bedell suggests workshops to determine values also in the range from 0 to 10 for these variables. Alternatively, one could assign percentages to a decomposition relation, such that the percentages of all sub-goals sum up to 100.

Figure 5.25 is a model that represents the effectiveness of the ArchiSurance actual resources to deliver the capabilities of ITIL Event and Incident Mgt processes, along with these capabilities' importance to the *handle claim* process. The arrows from the resources to the capabilities carry the values of how effective are current enterprise resources to deliver these capabilities.

Likewise, the value in the arrows that connect capabilities to the *handle claim* process represents the

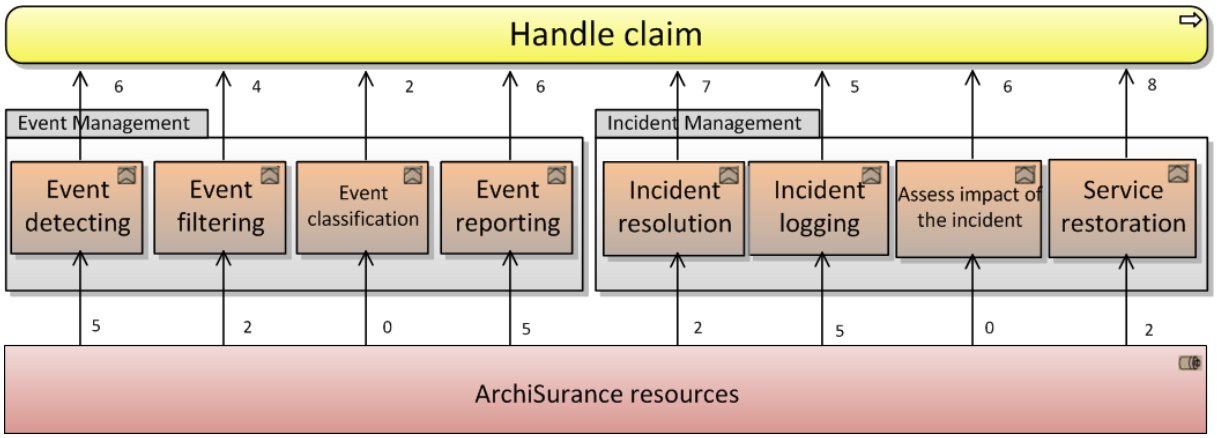


Figure 5.25: Adaption of Bedell's method to valuate ITIL capabilities

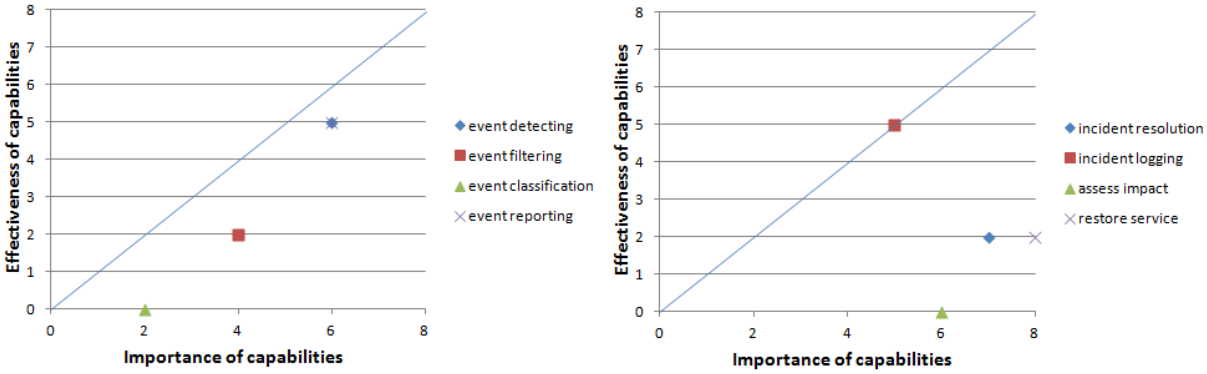


Figure 5.26: Importance and effectiveness of Event Mgt (left) and Incident Mgt (right) capabilities

importance of each capability for the business process. These values are based on our personal interpretation in this context and are presented only for demonstration purposes and obviously lack rigor. In a real situation, and as we already mentioned, the *effectiveness* values could come from KPIs measurements and *importance* could come from stakeholders interviews or workshops. However, the selection of rules and associated techniques to assign the input values should be aligned with the desired way of working and thinking of business and IT management (Quartel et al., 2010).

In Figure 5.26 we compare for each ITIL process the effectiveness and importance of their capabilities, according to the values we identified. The diagonal line represents perfect balance between the importance of a capability and the effectiveness of a resource to deliver that capability. For instance, we can see that the capability "Incident Logging" is in perfect balance for ArchiSurance, but the other Incident Management capabilities are overall lower than the Event Management ones.

Finally, we can calculate the overall efectiveness of each ITIL process. This is given by:

$$effectinevess = \frac{\sum ERC \times ICA}{\sum ICA} \tag{5.1}$$

In our example this means that in the *as-is* architecture, enterprise resources already have an effective-

ness of 3.7 on providing Event Management capabilities, against 2.75 for the Incident Management ones. Therefore, we should choose to invest on Incident Management since ArchiSurance resources are less effective on providing these process capabilities (versus its importance) to the *handle claim* business process. However, since the “Incident Logging” capability is already in perfect balance, ArchiSurance should try to keep the IT that implements this capability and only acquire resources that have the remaining Incident Management capabilities.

This line of reasoning could also be extended to cover all ArchiSurance business processes, including their importance for each of ArchiSurance business goals. This would allow to calculate which would be the ITIL processes that would add more value to the organization as a whole.

Chapter 6

Evaluation

This chapter is the "Evaluation" step of the DSRM process, where we will evaluate our proposal. We will start to use the Wand and Weber (1993) ontological analysis method to evaluate our concept mappings, and afterwards we will use the Moody and Shanks Framework (Moody and Shanks, 2003) and interviews to ITIL experts to evaluate our models.

6.1 Wand and Weber Method

To evaluate the three concept mappings (core, motivation and value) from ITIL to ArchiMate we will perform an analysis according to two criteria: completeness and clarity. This analysis is based on the Wand and Weber ontological evaluation of grammars method, where we compare two sets of concepts to identify four ontological deficiencies (Figure 6.1):

- **Incompleteness**: can each element from the first set be mapped on an element from the second? - the mapping is incomplete if it is not total.
- **Redundancy**: are the first set elements mapped to more than a second set element? - the mapping is redundant if it is ambiguous.
- **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.
- **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 concepts in ITIL 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.

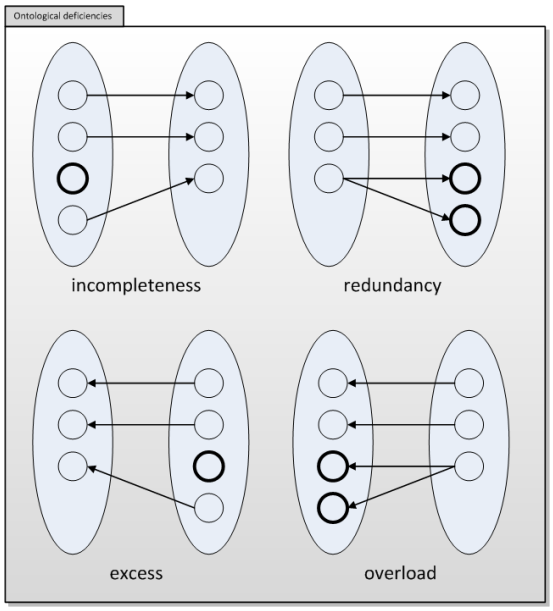


Figure 6.1: Ontological deficiencies

Therefore, we can not say our mapping is **complete**, because there is not in ArchiMate the ITIL Product concept (a tangible item). Moreover, sometimes the completeness stems from the fact that in some cases (KPIs, CSFs, and metrics) ArchiMate has elements generic enough to accommodate these (value), so our mapping does not reflect exactly the actual element meaning, but its generic meaning. Therefore, any extension to specialize and accurately represent these concepts would be much welcomed. In fact, there is already a recent proposal by Reis (2012) to represent KPIs in ArchiMate.

As for **redundancy**, there is sometimes more than one ArchiMate element to represent a ITIL concept. This happens in information, application relationship and database access, because ITIL is not much specific on application and infrastructure layers' descriptions. On the other hand, we also find it on the valuation concepts, because ITIL does not define "competence" as a concept itself. However, its definition of resource is much closer of competence than Iacob's resource itself.

This makes sense because competence is a specialization of resource and ITIL resources are mostly intangible. We could avoid the deficiency by mapping ITIL resources always as a Iacob resource, to allow a straightforward modeling, however we would advise to check each resource beforehand and model it as resource or competence whether it is something tangible or not.

The problem with redundancy, is that the "correct" ArchiMate concept has to be chosen according to context and experience, and although this choice is rather easy for human architects, it can be a serious problem for automated model transformations.

We also find **excess**, as ArchiMate has concepts that are not defined on ITIL as meaning or representation. One could argue that implicitly they actually exist with their ArchiMate definitions, where meaning is "the knowledge or expertise present in a business object" and representation "a perceptible form of the information carried by a business object", but the concepts themselves are not mentioned in ITIL.

Finally, we also have **overload**, when there are several ITIL concepts to only one from ArchiMate, like Business Role, Business Interface, Contract, Application component, Node, Device and Business object. We have also found overload on the motivation concepts. This happens because, as we have mentioned before, ITIL does not explicitly define a BMM or identifies its concepts.

Therefore, since we have to derive motivation elements from ITIL textual descriptions, it was predictable that several ITIL concepts would match an ArchiMate one. This deficiency can lead to problems if we ever wanted to do the opposite process: to go from an ArchiMate ITIL motivation model back to ITIL again. To avoid this, while modeling, we should include in ArchiMate's object attributes a reference to the original ITIL concept it was mapped from, to allow an eventual reverse mapping.

In fact, although we have found instances of every deficiency, they seldom occur and their effects can be effectively minimized while modeling. In fact, for **completeness** we can not only map tangible products, but even these are not that relevant in ITIL itself: they are only mentioned to differentiate them from the ITIL not tangible ones. On **redundancy**, the only problem would be not being able to automate ArchiMate generation for a small set of ITIL concepts; **excess** does not actually bring a problem at all; and as for **overload**, the mapping can be always reversed if we annotate the ArchiMate object properties' with the name of the ITIL concept that may arise ambiguity.

6.2 The Moody and Shanks Framework

For evaluation of our ITIL models (core and motivation), we used the Moody and Shanks (2003) framework for model quality management which proposes the following quality factors:

- **Completeness** refers to whether the model contains all user requirements;
- **Integrity** is the definition of business rules or constraints from the user requirements to guarantee model integrity;
- **Flexibility** is defined as the ease with which the model can reflect changes in requirements without changing the model itself;
- **Understandability** the ease with which the concepts and structures in the model can be understood;
- **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;
- **Simplicity** means that the model contains the minimum possible constructs;
- **Integration** is related to the consistency of the models within the rest of the organization;

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

Hence, for **completeness** we can say our models contain all user requirements, because they include all the relevant elements and relationships to describe an ITIL process and its motivation. For **integrity** our models have all the ITIL rules and constraints, namely the ones that address which are the processes to be implemented, and their business objects, application and infrastructure dependencies. They also have **flexibility** because parts of the models can be dropped out according to the organization own ITIL implementation, not affecting the overall outcome.

As for **understandability** the concepts and structures used are ITIL, EA and ArchiMate ones, which are easily recognizable for people in these fields. In fact, and as a side note, when we evaluated our ITIL models through interviews, everyone quickly understood them. For **correctness** our ITIL models were built by a method that mapped every ITIL concept to the correct ArchiMate one, followed by its representation according to every ArchiMate rule and convention.

We can also find **simplicity** because we worried on developing a set of views that focuses on representing only the relevant information for their target stakeholders. Concerning **integration**, one of the goals of representing ITIL on ArchiMate was actually to allow to integrate its models with the organization EA representation. And finally, for **implementability** we demonstrate that the models can be used in a literature case study and on a real IT service provider organization.

6.3 Interviews

To assert the models' utility and correction we looked for a suitable data generation method. We wanted to meet ITIL professionals and present them our work, while asking questions and gathering feedback according to their field of expertise. Interviews seemed the right choice since it allows asking questions that are open-ended and explore emotions, experiences or feelings that cannot easily be observed or described via pre-defined questionnaire responses Oates (2006).

However, we also wanted to have some quantitative data analysis, so, at the end of the interviews, we also asked our guests to fill out a small survey regarding our models.

Therefore, we interviewed 13 specialists, from different areas but all with a strong ITIL background. Our interview subjects were professionals with different ITIL skills and with distinct occupations, from diverse nationalities and countries, including Phd students, university teachers, researchers, enterprise architects, managers and process owners at distinct, different sized organizations.

Along the interviews, the same vision of ITIL as just a process architecture was very much present amongst the majority of our interviewees. In fact, when introduced to the suggestion that the ITIL books also mentioned another three dimensions that could be represented and modeled, our subjects would

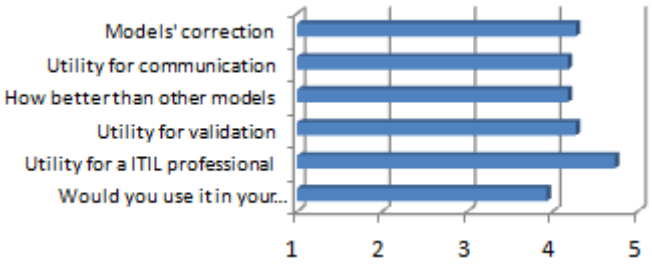


Figure 6.2: Form answers

frequently turn skeptical and doubt our claim. However, when we finally showed them the models, their opinions promptly changed. “Never had thought of ITIL this way”, “amazing how you can look at an entire book in just one model” and “now we can finally see which are the services ITIL offers for the environment” were some of the sentences they used, as they all agreed that this overall architecture vision would benefit ITIL implementation.

The remainder of the interviews served to present our motivation, explain our models, our mapping method, the reasoning process behind it and gather ideas and suggestions for further work. At the end of the interviews we asked the subjects to fill out a six question multiple choice survey about our work.

The questions were: 1 - How do you classify the models’ correction?, 2 - How do you classify its utility for stakeholder communication?, 3 - Comparing with other ITIL graphic models you know, how do you rate this one?, 4 - How do you classify its utility for ITIL validation?, 5 - How do you classify its utility for someone who is leading the ITIL implementation on an organization? and 6 - If all ITIL books and processes were modelled this way, would you use it in your organization?

The multiple choice answers had 5 levels and ranged from None/Poor/No (1) to Very Useful / Very Good / Always (5). On Figure 6.2 we present for each question its average rating.

Strangely, we see that the lowest score is in the question where we ask if the subject would use the models, while the highest is where he asserts the models’ utility for ITIL practitioners. When asked about this paradox, subjects commonly answered that albeit impressed with the models, they already had a set of processes, tools or methods for their practice. Although out of the scope of this paper, one could see it as evidence on how organizations resist to change even when they truly believe the new way is better.

Finally, we also want to point out that by the nature of ITIL itself (a set of best practices) we are aware that true model validation will probably never occur. Therefore, our goal was instead to ensure that our models reflected ITIL processes in their generality, according to how practitioners conceive and understand them. We do wish however that these models are further assessed and evaluated by the ITIL community in order to make them closer to the overall consensus of what is ITIL and how its processes’ work.

6.4 Architecture-based Valuation

As for the evaluation of our architecture-based valuation demonstration, we also do not want to claim that the adaptation of the Bedell's method is the best method to perform an ITSM valuation. Our purpose was mainly to present an example and an illustration on how we could use representations of ITIL value along with architecture-based methods to perform ITIL and ITSM valuation.

Furthermore, we actually think that architecture-based valuation models must be enriched by including the risks but also the costs of the resources (human or technology) that have the identified capabilities, to better understand and calculate the actual return of investment (ROI) from each ITIL process implementation. The costs may be modeled as the Value concept as Iacob et al. (2012) proposed while the risks are already in our ITIL models and relate to drivers assessments.

For instance, we could use Oliveira et al. (2010) method that considers risks; financial data; process improvement, benefits and costs; net present value, internal rate of return and payback period to assess the value of each ITIL process to the organization. It would therefore be interesting to address it from an architectural point of view.

Chapter 7

Conclusion

Along the years, several governance frameworks were developed, focusing on distinct perspectives. Two of them, EA and ITIL, have grown to be worldwide standards, having thousands of practitioners today. However, having two distinct approaches often results on duplication of investments, costs and wasted resources. To address this, we have been working on a specific Enterprise Architecture for organizations that need to manage IT services.

Thus, we have argued the need to align and integrate EA and ITIL through an EA specialization and a common frame of reference, a graphical modeling language. Hence, we have proposed **an EA specialization for organizations that need to manage IT services. An EA with its own set of principles, concepts, methods, and an ArchiMate representation**. An holistic solution that uses ITIL elements as architecture components, to align ITSM with business strategy and organizational engineering.

7.1 Contributions

Therefore, these are the research contributions of this dissertation:

- the definition and discussion of ITIL principles according to the EA approach;
- a concept mapping between ITIL and ArchiMate, placing ITIL elements on EA domains;
- the Business Motivation Model for ITIL, using OMG business motivation model;
- a concept mapping between ITIL BMM and ArchiMate's Motivation extension;
- a concept mapping between ITIL value and Iacob's proposed ArchiMate's Valuation extension;
- 9 new ArchiMate viewpoints to represent this architecture;

- a method based on TOGAF ADM that uses our models as inputs;
- a set of ArchiMate models for the whole ITIL 26 processes and functions, representing ITIL core;
- a set of ArchiMate motivation models for the whole ITIL 26 processes and functions, representing ITIL business motivation model;
- discussion and analysis of how architecture-based valuation methods can be used to assert the value of ITIL processes on organizations.

Moreover, we also performed a demonstration on an IT Service Provider, eChiron, where we have shown how our models and viewpoints can be used to model organizations and check for ITIL compliance.

In hindsight, we should however emphasize that the main contributions are the architecture's principles, concept mappings, viewpoints, and process core and motivation models. In fact, besides their value in the architecture representation, the process models also add something that ITIL lacked: formal models for knowledge sharing, stakeholder communication and to contribute to ITIL discussion and validation. Furthermore, the motivation models will allow to choose the right ITIL processes to implement, based on each organization's concerns, assessments and goals.

7.2 Research Communication

To communicate our work we have published 5 articles: 4 in international conferences and 1 in an international journal:

- "ITIL Business Motivation Model in Archimate" (Vicente et al., 2013c), *International Conference on Exploring Service Science 1.3 (IESS)*; Porto, Portugal; February, 2013. It proposes our ITIL BMM.
- "Using ArchiMate and TOGAF to Understand the Enterprise Architecture and ITIL Relationship" (Vicente et al., 2013a), *8th International Workshop on Business/IT-Alignment and Interoperability (BUSITAL), CAiSE 2013 Workshops*; Valencia, Spain; June, 2013. The paper proposes our view of the EA/ITIL relationship and how one can use EA methods for ITIL implementations.
- "Using ArchiMate to Represent ITIL Metamodel" (Vicente et al., 2013b), *15th IEEE Conference on Business Informatics (CBI)*; Vienna, Austria; July, 2013. This paper proposes our ITIL metamodel.
- "The Value of ITIL in Enterprise Architecture" (Vicente et al., 2013d), *17th IEEE International EDOC Conference*; Vancouver, Canada; September, 2013. It analyzes ITIL valuation in the Enterprise Architecture perspective.
- "A Business Motivation Model for IT Service Management" (Vicente et al., 2014), *International Journal of Information System Modeling and Design (IJISMD)*, January, 2014. It proposes the

principles, the motivations and the models of our proposed architecture.

IESS is the only european conference on Service Science, CBI and EDOC are both IEEE conferences, BUSITAL is a workshop from a top conference (CAISE) and IJISMD is a top ranked journal. Additionally, we have also submitted another paper to the 11th *International Conference on Service Oriented Computing (ICSOC 2013)* about the ITIL metamodel. Finally, we are preparing a final manuscript that covers the whole thesis work to submit to the *Information Systems Management* journal.

7.3 Future Work

The architecture methods we have described here were presented to set the foundations of a discussion about using architecture-based approaches to implement ITIL and valuate its processes. The purpose was mainly to demonstrate how our approach integrates (and is consistent) with current research in these fields, and we believe these topics should be further addressed in future work to complement and extend this thesis' proposals.

Furthermore, we want to point out that this thesis also wishes to raise awareness about using Enterprise Architecture for best practices in specific domains, which in this case is IT (ITIL/ITSM), but could as well be purchasing or logistics. In fact, by defining the motivations and architecture in each domain, one can design specific organizations and evaluate their best practices' compliance and maturity levels.

On the other hand, our models are based on elements which are, in our opinion, the most relevant for every ITIL process. This assumption is based on the elements' own relevance through the ITIL literature. However, being ITIL a set of best practices, built upon IT profissionals' opinions and experiences, we concede that some practitioners could include other elements or leave some of these out.

Thereby, we do not claim that this is the only representation of ITIL, we say instead that based on our mapping, on the identified concepts and on our perception, these are our proposed ArchiMate models. We therefore welcome (and encourage) that these models are revised by the ITIL community itself to reflect, as ITIL does, the majority of its practitioners' opinions.

In short, in times where cost and value generation are such important drivers, IT governance, more than ever, should turn organizations more effective and efficient. Enterprise Architecture does not tell us how to design specific organizations that have IT service management as a main concern, and ITIL can not help on the overall organizational engineering.

Therefore, we hope this work can help to join the best of both worlds, one enterprise architecture that integrates the EA and ITIL approaches, two worldwide standards, complementary on organizations, with distinct IT and organizational perspectives, yet so close that have much more to gain from aligning together instead of walking apart.

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