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ISO/IEC 20000 Maturity Model

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Resumo

As tecnologias de informação (TI) são hoje o pilar de qualquer organização que necessita de ser competitiva, eficiente e entregar serviços de qualidade aos clientes. Isto significa que, dada esta importância, é fundamental o recurso a boas práticas e *standards* que permitam uma gestão eficaz dos serviços de TI.

Neste sentido, diversas frameworks de TI têm surgido, nos últimos anos, para apoiar gestores e decisores de TI, não só a melhorar a previsibilidade e performance dos serviços de TI, mas também a alinhá-los com os objectivos de negócio.

Um bom exemplo destas frameworks é o ITIL, um conjunto de boas práticas para gestão de serviços de TI muito popular na comunidade e que tem vindo a ser acompanhado, nos últimos tempos, pela implementação de um standard de gestão de serviços de TI - o ISO 20000 - em empresas que desejam alcançar um novo patamar de qualidade na gestão de serviços.

A proposta apresentada neste projecto de investigação é, por isso, altamente relevante e assenta na criação de um modelo de maturidade para ISO 20000. Esta é uma ferramenta que permitirá a qualquer organização não só avaliar o nível maturidade dos seus processos actuais de TI, em particular *Incident e Service Request Management*, mas também obter indicações de como poderá alinhar-se com os requisitos ISO 20000 e obter certificação.

Para alcançar os objectivos definidos, os autores recorreram à metodologia Design Science Research que incluiu várias etapas, entre elas, revisão da literatura, entrevistas com experts de TI e entrevistas com organizações.

Keywords: Modelo Maturidade, ISO 20000, Gestão de Incidentes, Serviços TI, Gestão Serviços de TI

Abstract

Information technology (IT) is nowadays the pillar of any organization that needs to be competitive, efficient and deliver quality services to its customers. This means that, given its importance, it is fundamental to use good practices and standards that allow effective management of IT services.

Therefore, several IT frameworks have emerged in recent years to support IT managers, not only improve the predictability and performance of IT services but also align them with business goals.

A good example is ITIL, a set of best practices for IT service management that has been accompanied, in the last years, by the implementation of the ISO 20000 standard in companies that want to further increase quality of their IT services.

The proposal presented in this research project is to develop a maturity model for ISO 20000, a tool that will allow any organization to not only evaluate the maturity level of its current IT processes, Incident and Service Request Management in particular, but to also serve as a roadmap on how to align with ISO 20000 requirements and obtain certification.

In order to achieve the goals defined in this project, authors used the Design Science Research (DSR) methodology, which included several stages, including literature review, interviews with IT experts and interviews with organizations.

Keywords: Maturity Model, ISO 20000, Incident Management, IT Services, ITSM

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1. Introduction

Nowadays, Information Technology (IT) is a central pillar in every organization. It supports their business, processes and transactions, which are becoming more and more complex and increasingly automated (Sallé, 2004). On the other hand, business and IT managers are continually struggling to align IT with business strategy and goals to provide value and enable competitive advantage (Bhatt & Grover, 2005; Luftman & Kempaiah, 2007; Peppard & Ward, 2005).

These reasons explain the need for implementation of IT Frameworks, a set of guiding principles and good practices (De Haes, Van Grembergen et al., 2013) that help an organization achieve IT/Business alignment, meaning IT must deliver real and measurable value to business. Furthermore, the paradigm shift from management of technology to the delivery of quality IT services reminds organizations that they must manage IT "*as a business*" and focus on their relationship with customers (Van Bon, Kemmerling et al., 2002; Winniford, Conger et al., 2009). This has been explaining the increasing need for IT Service Management (ITSM) frameworks, as service providers are continually striving to improve the quality of the service they provide while, at the same time, try to reduce costs (Brenner, 2006; The Stationery Office, 2001).

In the past decade, the awareness of ITSM frameworks and their adoption has been growing and its value is now widely recognized (Marrone, Gacenga et al., 2014). This was essentially due to ITIL's popularity, now considered a *de facto* ITSM framework (Hochstein, Zamekow et al., 2005; Marrone & Kolbe, 2011), and its proven benefits like IT process uniformization, higher system availability, increased customer satisfaction and better communication across departments (Gacenga, Cater-Steel et al., 2010).

1.1 Problem

Despite ITIL's popularity among organizations, no one can claim or demonstrate compliance (Cots, Casadesús et al., 2014) or official recognition (Disterer, 2009).

The importance of ISO/IEC 20000 is in the fact that it formalizes and documents, processes, procedures and roles that are required to be implemented for effective ITSM, providing a common standard for any business that is committed to increase quality in service management, resulting in increased stability, reliability and security of IT services (Disterer, 2012).

Implementation of standardized and transparent IT processes, increase of customer satisfaction and higher business reputation are part of the benefits that explain why ISO/IEC 20000 certifications have been growing consistently in the past decade (Cots & Casadesús, 2014). Moreover the widespread adoption of ITIL best practices across the globe on organizations of all types, and similarities in both ITIL and ISO/IEC 20000 (Dugmore & Taylor, 2008) encourage organizations seek certification as the next natural evolution step towards ITSM improvement.

However, reaching alignment with ISO/IEC 20000 requirements in order to become successfully audited and certified, is costly and demanding, involving initiating a project with defined stages and tasks whose duration is dependent on company size and complexity (Disterer, 2009). It proves to be even more challenging for companies not having adopted any ITIL practices.

According to the reasons previously presented, we can conclude that organizations don't have tools and expertise to make assessments of individual ITSM processes and validate if they are ready for ISO/IEC 20000 certification.

The usage of Maturity Models have proven to be useful to IT management not only to assess the actual capability of a company and its processes but also to define and prioritize improvement measures and control their implementation (Becker, Knackstedt et al., 2009). They include a sequence of levels (or stages) that together form a desired or logical path from an initial state to company's maturity, serving as a scale to assess its actual position (Pöppelbuß & Röglinger, 2011). Although nowadays we can find a range of ITSM maturity and process assessment models (Proença & Borbinha, 2016), none of them can correctly assess the readiness for an ISO/IEC 20000 certification and neither the ISO documentation itself provides guidance on how to plan process implementation (Picard, Renault et al., 2015).

Despite the fact that a maturity model for ISO/IEC 20000 was already proposed, based on TIPA for ITIL (Picard et al., 2015), it proves only relevant for companies with ITIL best practices already in place and using TIPA for ITIL, which only includes ITIL guidelines, to assess their process capability. Furthermore, the proposed maturity model by these authors only provides a staged approach which they concluded was insufficient to assess company readiness towards ISO/IEC 20000 requirements.

The goal of this dissertation is to **develop a maturity model to help organizations assess individual ITSM processes, in particular, Incident and Service Request Management process, in order to become aligned with ISO/IEC 20000 requirements.**

The proposed model in this dissertation, aims to help organizations with ITSM processes already in place that are looking to comply with ISO/IEC 20000 requirements. This model will help them evaluate their readiness towards certification, acting as a roadmap and enabling them to be prepared in a shorter timeframe.

1.2 Research Methodology

In order to provide a solid background to the development of this research proposal, we used Design Science Research (DSR). This methodology defends scientific rigor and relevance to produce useful artefacts that solves problems and contributes to advances in knowledge (Hevner, 2007; Peffers, Tuunanen et al., 2007). Our proposal will specifically follow Becker et al. (2009) procedural model for maturity model development which complies with DSR guidelines.

According to Becker et al (2009), a maturity model can be considered a DSR artefact, useful to measure organization capability and suggest improvements (Becker, Knackstedt et al., 2009). Therefore, DSR methodology is considered useful in the development of maturity models.

The procedure model for the development of IT maturity models is comprised of 8 steps, below we will present an adapted version of this model, with 5 phases, that will guide the development of the proposed model.

For each phase, we will identify the requirements presented by Becker et al. (2009) and the corresponding dissertation sections in which they are addressed for better identification and follow-up.

Activities	• Literature review • Problem definition	• Comparison of 7 Maturity and Assessment models • Detailed analysis of 2 most relevant maturity models	• Multi-methodological procedure usage • ISO/IEC 20000 process requirements decomposition • Questionnaire • ITSM Expert interviews • Analysis and Final model	• Demonstration: Organization interview and Assessment • Evaluation: Four Principles of Österle *et al*. & Moody and Shanks quality framework • Analysis of Assessment results	• Conclusion • Future work
Becker Requirement	Req. 5 and 6	Req. 1	Req. 2 and Req. 4	Req. 3 and Req. 7	Req. 3 and Req. 2
Dissertation section	Section 1	Section 2	Section 3	Section 4	Section 5

Table 1 - Overall research steps and model development based on Becker et al (2009).

In the first phase, the problem definition is presented by doing a comprehensive literature review of maturity models, with a focus on ITIL and ISO/IEC 20000 related maturity models. In the second phase, a second literature review is done to gather and compare the 7 most known ITSM maturity models and selection of 2 which are the most related to the goal of the proposed model. The third phase, review the new ISO/IEC 33020 requirements regarding development of Maturity models; Identify ISO 20000 processes and isolate Resolution processes; define capability levels and attributes according to ISO/IEC 33020; identify and decompose ISO/IEC 20000 process requirements; conduct interviews with ITSM Experts followed by questionnaire analysis to reach the final model.

In the fourth phase, an Organizational interviews and assessments are conducted, with the proposed model, to evaluate its usefulness and applicability. Reports are generated after all interviews and assessments are done. The model is also evaluated with Four Principles of Österle *et al* (Österle, Becker et al., 2011) and Moody and Shanks quality framework (Moody & Shanks, 2003).

In the fifth phase, conclusions are reach by evaluating the accomplishment of the problem and goal of this project, along with limitations and future work.

All Becker et al. (2009) requirements are covered and identified in each phase with an exception for Requirement R8 - Scientific Documentation, which, because of space constraints is not included in this dissertation but can be provided upon request.

2. Literature review

2.1 ISO/IEC 20000 Standard

ISO/IEC 20000 is a standard for IT Service Management (ITSM), and it is aligned with ITIL. The standard is based on, and supersedes, BS 15000 – a standard developed by the British Standards organization. Its first version – ISO/IEC 20000:2005 - published in December 2005 was a slightly adapted version of BS 15000-1.

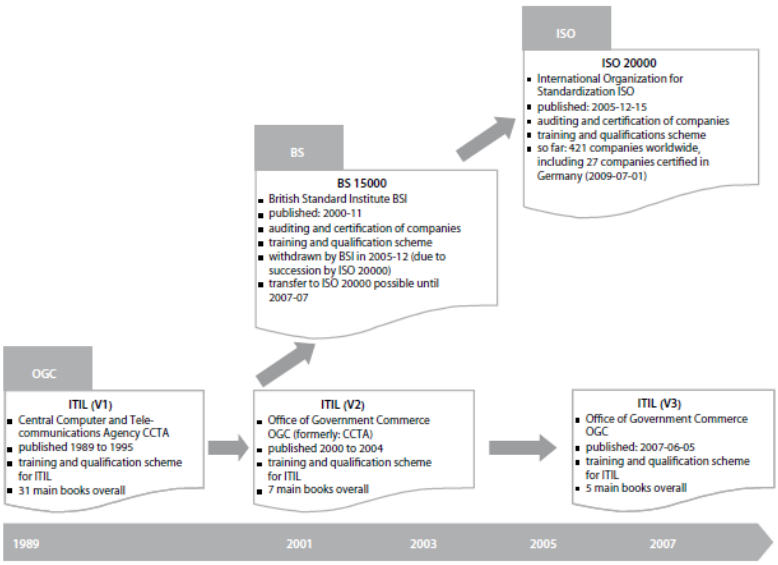

Figure 1 - Origins of ISO/IEC 20000 (Disterer, 2009)

As a standard, it defines a set of requirements against which an organization can be independently audited and, if they satisfy those requirements, can be certificated to that effect. The requirements focus on what must be achieved rather than how that is done (Gannon, Mann et al., 2012).

Although ISO/IEC 20000 and ITIL share some similarities, it is important to understand that they are of different nature – the first is a management standard and the latter a set of best practices. Nevertheless, the best route to achieve ISO 20000 requirements is to implement ITIL best practices (Dugmore & Taylor, 2008; Tanovic, Ribic et al., 2013).

ISO 20000 is comprised of different documents, which are commonly referred to as ‘parts’; these parts are detailed in Table 2 presented below.

ISO/IEC 20000-1:2011	Service-management system requirements
ISO/IEC 20000-2:2012	Guidance on the application of service management systems
ISO/IEC 20000-3:2012	Guidance on scope definition and applicability of ISO/IEC 20000-1

ISO/IEC TR 20000-4:2010	Process-reference model
ISO/IEC TR 20000-5:2013	Exemplar implementation plan for ISO/IEC 20000-1
ISO/IEC TR 20000-10:2013	Concepts and terminology

Table 2 - ISO/IEC 20000 published documents

The first document, namely the ISO/IEC 20000-1 document (ISO/IEC, 2011), is the only part that establishes requirements for a Service Management System (SMS), and therefore, these requirements are the only ones that must be complied with to obtain certification.

The standard core parts are:

- ***Part 1*** - is the formal specification and details the requirements for a service management system.
- ***Part 2*** - provides practical guidance on the implementation of the service management system. It provides detailed information how processes should be implemented in line with the ISO requirements available in Part 1.
- ***Part 3*** - gives guidance on scope definition and applicability of the standard.

The SMS, as defined by ISO/IEC 20000, includes all service management policies, objectives, plans, processes, documentation, and resources required for the design, transition, delivery and improvement of services and to fulfill the requirements (ISO/IEC, 2011).

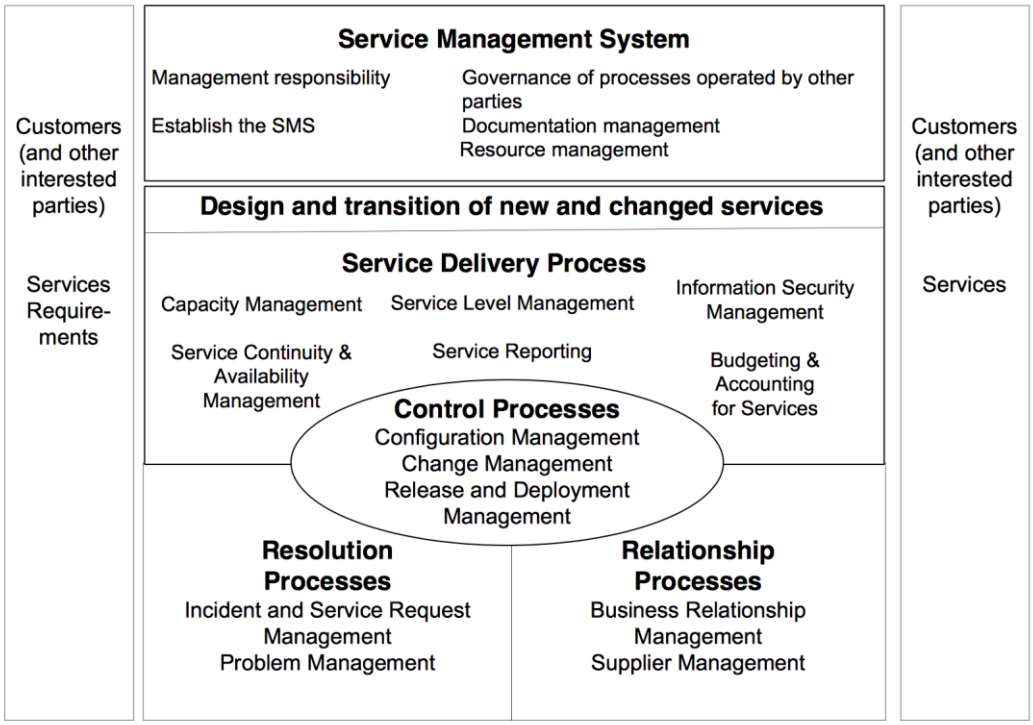

Figure 2 - Service Management System and processes (ISO20000-1:2011)

During service management implementation, most companies need to establish the processes and procedures in accordance with the ISO/IEC 20000-1 specifications and requirements.

Implementation of ISO/IEC 20000 covers all areas of IT – not just the service support and delivery areas - and some areas not directly covered in ITIL (e.g., Security).

It includes four categories of processes which include 13 processes for Security, Capacity, Release, Configuration, and Change Management, as well as Service Continuity and Financial Management (Table 3).

Service delivery processes	Capacity management
	Service level management
	Information security management
	Budgeting and accounting for IT services
	Service reporting and service continuity
	Availability management
Relationship Processes	Supporting business relationship management
	Supplier management in the end to end supply chain
Control Processes	Configuration Management
	Change Management
	Release and deployment management
Resolution Processes	Incident Management
	Problem Management

Table 3 - ISO/IEC 20000 processes

There is a high level of satisfaction on obtaining ISO/IEC 20000 certification, according to a research made by Cots et al. (2016), there are perceived internal and external benefits by organizations on obtaining the ISO/IEC 20000 service management certification. The most important internal benefits reported were service improvement, service standardization, increasing the ability to plan and control, establishment of quality culture, improved capacity for accident recovery and incident reduction. In regards to external benefits, marketing, responding to customer demands and obtaining competitive advantage were the identified benefits (Cots, Casadesús et al., 2016).

2.2 IT Frameworks

Since this dissertation goal is to propose a maturity model for ISO/IEC 20000 standard, the next section includes a brief overview of the most important IT Frameworks - CMMI , COBIT and ITIL – according an extensive literature review and evidence from industry adoption (Betz, 2011; Evelina, Pia et al., 2010; Sezgin & Özkan, 2014).

IT Frameworks include a set of standards and best practices that organizations implement in order to enable effective governance of IT (Mangalaraj, Singh et al., 2014; Robert R. Moeller, 2013), increase quality of services (Cater-steel & Tan, 2005; Duffy & Denison, 2008) and enable process improvement (CMMI Product Team, 2010).

2.2.1 Capability Maturity Model Integration (CMMI)

Capability Maturity Model Integration (CMMI) was developed by the Software Engineering Institute (SEI) and includes practices that help organizations to improve their processes. It is a model for assessing the quality of organizational processes and promotes process improvement in a continuous cycle towards a maturity or capability level (University Carnegie Mellon, 2005).

CMMI is derived from Capability Maturity Model (CMM) developed earlier by SEI, following the initial work published by W. Humphrey (W. S. Humphrey, 1989; W. Humphrey, Sweet et al., 1987). The model was designed for software organizations to improve software development processes and managing their evolution towards maturity (Paulk, 1995).

During its research, the SEI found that processes are a key component to business, since they hold together three critical organizational dimensions: people, procedures and methods, and tools and equipment (Figure 3).

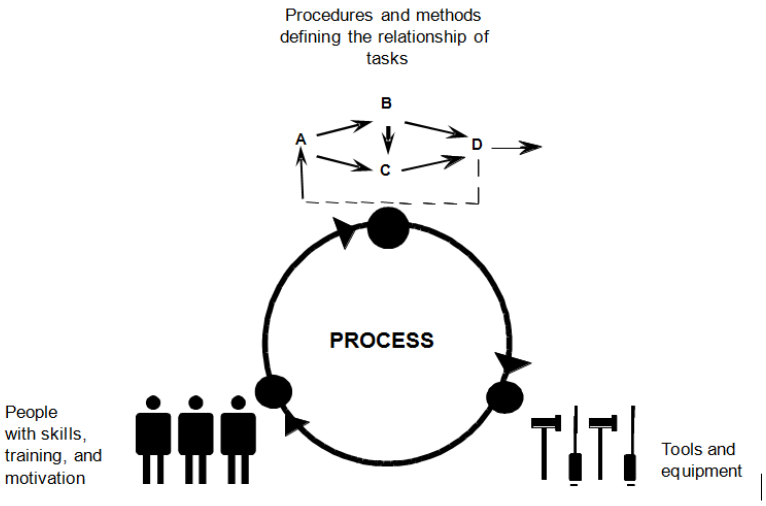

Figure 3 - CMMI three critical dimensions (CMMI Product Team, 2010)

According to CMMI, a focus on processes provides the infrastructure and stability necessary to deal with an ever-changing world and to maximize the productivity of people and the use of technology to be competitive (CMMI Product Team, 2010).

SEI defined a CMMI framework that provides the foundation needed to create CMMI models, training materials and appraisal materials. This foundation includes a range of well-proven components used to construct CMMI models, providing a common ground for existing and future models (CMMI Architecture Team, 2007).

These components are organized in groups called constellations: Acquisition, Development, and Services.

The first CMMI model (version 1.02) was published in 2000 and included all previous CMM models. CMMI version 1.3 was released in November 2010 and includes the following models:

1. CMMI-DEV, aimed for products and services development.
2. CMMI-ACQ, aimed for products and services acquisitions.
3. CMMI-SVC, aimed for service establishment, management and provision.

Organizations can use CMMI to enable process improvement in multiple functional areas, with less investment. CMMI provides a shared vision of improvement for all elements of an organization, providing an efficient and effective improvement and assessment across multiple disciplines and areas.

2.2.2 Control Objectives for Information and related Technology (COBIT)

Nowadays IT is considered a crucial asset not only for businesses day-to-day operations but also to organization strategy as it enables achievement of competitive advantage. For this reason, a specific focus and interest on IT Governance has risen over the last two decades and has now become part of enterprise governance (De Haes, Van Grembergen et al., 2013).

COBIT was created in 1995 by ISACA from the needs of financial and audit community in dealing with increasingly automated environments, COBIT has matured throughout successive versions to become a comprehensive IT management and governance framework.

COBIT 5, which was released in 2012, consolidates and integrates the COBIT 4.1, Val IT 2.0 and Risk IT frameworks into a single framework. It is now considered the *de facto* framework to successfully implement and manage governance of IT, across entire organizations in a holistic manner and regardless of its size (De Haes, Steven; Grembergen, 2009). It helps enterprises in governance and management of IT, generating optimal value by balancing its benefits, risk optimization and resource usage (ISACA, 2013a).

Over its successive versions, COBIT transitioned towards a broader IT Governance and management framework, defining a complete range of tools, metrics, models, and roles for IT processes (Noble, Noble et al., 2013).

COBIT 5 approaches IT management from a business perspective. It maximizes business value while reducing risks related to the use of IT (Oliver & Lainhart, 2012). Although significant satisfaction from using this framework comes mainly from high maturity organizations, it is confirmed that COBIT has a positive effect on business performance providing competitive advantage and increase in profitability (Marrone, Hoffmann et al., 2010).

2.2.3 Information Technology Infrastructure Library (ITIL)

ITIL was created by request of UK Government in the 1980s and launched by the Central Computer and Telecommunications Agency (now OGC) in the UK (Pereira & Mira da Silva, 2010), by that time it was used mainly by government agencies.

ITIL is a framework that describes best practice in IT service management (ITSM). It is focused on the quality of the service being delivered and its continual measurement and improvement, from both user and business perspective (ItSMF, 2011).

From 1999 to 2001, ITIL became the cornerstone for Service Management by introducing the Service Support and Service Delivery disciplines and releasing Version 2. After that it followed a natural progression of alignment between ITIL and BS15000, culminating in today's ISO/IEC 20000 standard and more importantly, ITIL V3 – The Service Lifecycle.

ITIL's primary goal is to improve IT Service quality and its third version (v3) released in 2007 and updated in 2011, consists of 5 core publications: ITIL Service Strategy, ITIL Service Design, ITIL Service Transition, ITIL Service Operation, ITIL Continual Service Improvement.

Each of these books covers a stage on the Service Lifecycle – Figure 4 below. Service Lifecycle integrates four key stages of a service; Strategy, Design, Transition, and Operations. Continuous Service Improvement surrounds the core processes, fostering improvement and change.

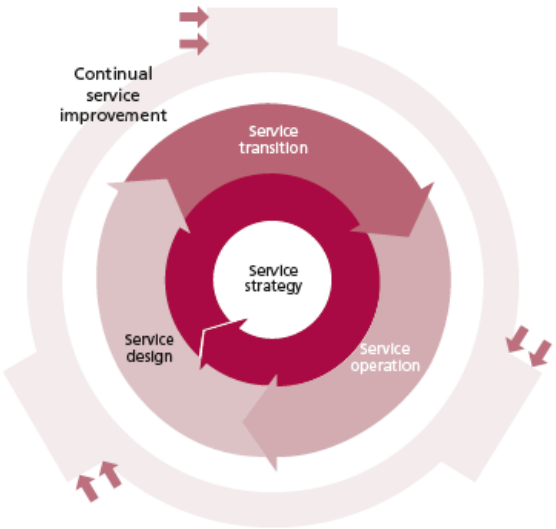

Figure 4 - ITIL Service Lifecycle (ItSMF, 2011)

A key principle within ITIL and across the service lifecycle stages is the alignment of IT with the business it supports, meaning that business needs and requirements should drive all provided services. Moreover, they should also provide measurable value to business objectives and outcomes.

Functions and processes are two essential concepts in ITIL as they are part of the service lifecycle. Functions are units of organizations specialized to perform certain types of work and responsible for specific outcomes. They are self-contained with capabilities and resources (OGC, 2007). Processes are a sequential set of activities designed to accomplish a specific objective. They take one or more defined inputs and turns them into defined outputs.

In Table 4, we have identified all processes and functions related to each lifecycle. In the four lifecycle stages, there are 26 processes and 4 functions – functions are highlighted in grey for differentiation.

Service Strategy	Strategy management for IT services
	Service portfolio management
	Financial management for IT services
	Demand Management
	Business relationship management
Service Design	Design Coordination
	Service Catalogue Management
	Service Level Management
	Availability management
	Capacity management
	IT service continuity management
	Information security management
	Supplier Management
Service Transition	Transition planning and support
	Change Management
	Service asset and configuration management
	Release and deployment management
	Service validation and testing
	Change evaluation
	Knowledge management
Service Operation	Event management
	Incident management
	Request fulfilment
	Problem management
	Access management
	Service Desk (function)
	Technical management (function)
	IT operations management (function)
	Application management (function)
Continual service improvement	Seven-step improvement process

Table 4 - ITIL processes and functions across the lifecycle

ITIL has now become the most popular ITSM framework and first choice in the majority of organizations that want to deliver services more efficiently with more quality and less cost (Pereira & Mira da Silva, 2010).

According to Barafort (Beatrix Barafort, Betry et al., 2009), one of its main advantages is that its publicly available and maintained, making optional hiring a consulting firm to implement and use this framework. This public availability also translates into many tools and applications being built around ITIL.

Other studies point out the ITIL strengths as being highly reliable, cost-efficient being able to control budgets, optimize processes and procedures and also a tool for communication and support for structured work (Cronholm & Persson, 2012).

2.3 Maturity and Assessment Models

In this chapter, a literature review will be made and, after this, a comparison analysis of Maturity and Assessment models. This corresponds to phase 2 of our research methodology, which complies with Becker et al (2009) requirements.

In the past decade, IT management has been increasingly pressured to deploy efficient and effective IT services necessary to deliver value to the business to maintain a competitive advantage (Cater-Steel, 2009; Galup, Quan et al., 2007; Winniford, Conger et al., 2009).

Maturity models have proven to help companies reaching these goals (De Bruin, Freeze et al., 2005). They are valuable in measuring different aspects of a process, group of processes or an organization, including strengths and weaknesses (Proença & Borbinha, 2016). They allow the assessment of the actual situation and the identification of improvement measures (Becker, Knackstedt et al., 2009), for these reasons they are becoming very popular within organizations as a tool for continuous improvement but also for self or third-party assessment (Mettler, 2011).

Its usage had proliferated across a multitude of domains since the concept of measuring maturity was introduced with the Capability Maturity Model (CMM) but since then, maturity and capability definitions have been misused or used imprecisely (Picard, Renault et al., 2015; Van Looy, De Backer et al., 2011), used as synonyms (Wangenheim, Hauck et al., 2010) or to differentiate between enterprise wide process improvement (maturity) or single process or process domain improvement (capability) as originally defined by CMMI (Chrissis, Konrad et al., 2004).

Although maturity model proposals in Information Systems have been popular in the last decade (Poeppelbuss, Niehaves et al., 2011; Proença & Borbinha, 2016; Wendler, 2012), they were subject to many critics in the literature which have accused of being merely descriptive, lacking scientific background and empirical validation. (Maximilian Röglinger, Jens Pöppelbuß, 2012)

One way to overcome this situation is to use official standards related to process maturity/capability assessment in order to take advantage of a common terminology, increased uniformity and consistency of processes (Cots, Casadesús et al., 2014).

The concept of process maturity was initially published by Software Engineering Institute (W. S. Humphrey, 1984; W. Humphrey, Sweet et al., 1987). This earlier work served as basis for

Capability Maturity Model for Software (CMM), which was released years later in 1991, introducing a model to assess and improve software processes (Paulk, 2009).

Following the experience with CMMI framework and later, with the ISO/IEC 15504 standard, the maturity and capability concepts have evolved. The new ISO/IEC 330xx standard, currently provides a revised definition of Maturity Model.

> **Maturity Model**
>
> *A Maturity Model is derived from one or more specified process assessment model(s) that identifies the process sets associated with each of the levels in a scale of organizational process maturity, and relates to the growing ability of an organization to achieve higher levels of a specific process quality characteristic.*
>
> ISO 33001 (ISO/IEC, 2015c)

The concept of Process Assessment Model was firstly introduced by ISO/IEC 15504, following the work of (Radice, Harding et al., 1985). Since the release of this standard, many other models followed this concept (PAM) to create their own assessment models for different purposes. For example COBIT PAM or TIPA for ITIL, which are also considered Process Assessment Models.

In ISO/IEC 330xx, capability is now considered a process quality characteristic and currently defined as:

> **Process Capability**
>
> *Characterization of the ability of a process to meet current or projected business goals.*
>
> ISO 33020 (ISO/IEC, 2015a)

A capability can be assessed by a specific Process Assessment Model, defined in ISO/IEC 33001 as a "*Model suitable for the purpose of assessing a specified process quality characteristic, based on one or more process reference models.*" (ISO/IEC, 2015c)

In this section, Maturity and Assessment models closely related with ITSM will be presented and compared to emphasize their main characteristics and benefits for the organizations.

2.3.1 CMMI-SVC

In 2009, the first version of CMMI for Services (CMMI-SVC) was published, and it was based on two previous models - CMMI for Acquisition and CMMI for Development – but also, on other service management frameworks including ITIL, COBIT, ITSCMM and ISO/IEC 20000.

CMMI-SVC provides guidance, and it is relevant to organizations that deliver services, within the organization itself or to external customers. It covers the activities required to establish, deliver,

and manage services and it contains practices that cover work management, process management, service establishment, service delivery and support and supporting processes.

Although the model represents best practices, all process areas and practices should be interpreted using an in-depth knowledge of CMMI-SVC, organizational constraints, and the business environment (CMMI Product Team, 2010).

CMMI-SVC has 24 process areas, in which 16 of them are core process areas, one is a shared process area, and 7 are service-specific process areas. They represent a group of related practices that, when implemented collectively satisfy a set of goals considered necessary for improving that area.

Each process area includes a set of specific goals and practices, characteristics that must be present to satisfy the process area. They also have generic goals and practices which are common to multiple process areas.

In CMMI-SVC, process areas are organized into four categories: Project and Work Management, Service Establishment and Delivery, Support and Process Management.

The organization should have its service processes mapped to the model process areas, to ensure that progress can be tracked according to the CMMI-SVC model.

CMMI-SRV introduces the concept of **Levels** that describe the evolutionary path recommended for a service-based organization that wants to improve its processes. Levels can also be the outcome of the rating activity in appraisals (SCAMPI Upgrade Team, 2011), done to an entire organization or specific departments.

Levels can be of two types - **Capability** and **Maturity** – which reflect two improvement paths, which CMMI-SRV defines them as two “representations” (Continuous and Staged) – as shown in Figure 5. They both provide ways to improve processes, in order to achieve business objectives.

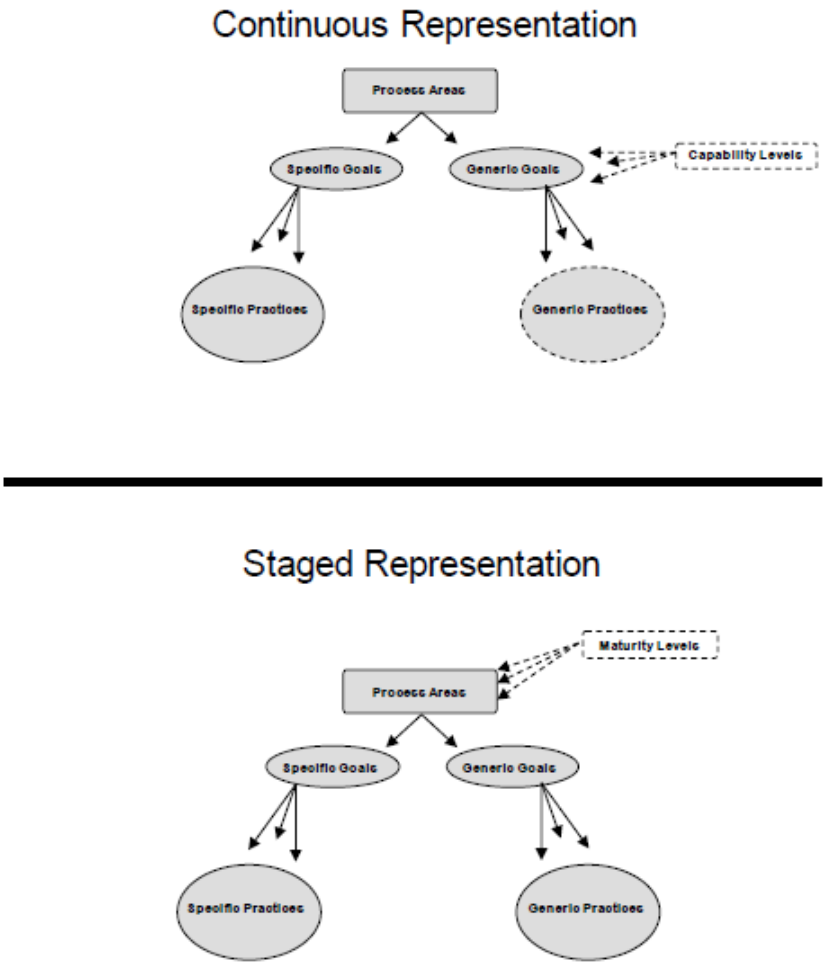

Figure 5 - Continuous and Staged Representations (CMMI Product Team, 2010)

Continuous representation uses capability levels to define the state of the organization's processes relative to its process area, whereas the **staged representation** uses maturity levels to define the overall state of the organization's processes relative to the model.

In Table 5 below, a representation of the two types of improvement paths - continuous and staged - is presented.

Levels	**Continuous Representation** Capability Levels	**Staged Representation** Maturity Levels
0	Incomplete	
1	Performed	Initial
2	Managed	Managed
3	Defined	Defined
4		Quantitatively Managed
5		Optimizing

Table 5 - CMMI-SVC Continuous and Staged levels comparison

Staged and continuous representations provide the same results but are presented differently. They must be chosen, one over another, according to organizational objectives and culture. If the organization knows the processes to improve, the continuous representation would be a good choice, otherwise staged representation is the best option because process areas are organized by maturity levels that will give information about the specific set of processes to improve.

Capability levels

Capability levels are used to measure improvement in individual process areas. They are focused on improvement within a single process area of the model.

A capability level for a process area is achieved when all of the **generic goals** are satisfied up to that level, and also through the application of generic practices or suitable alternatives to the processes associated with that process area.

In the next table (Table 6) process capability levels are described in detail and how they are achieved:

#	Capability level	Description
0	**Incomplete**	An incomplete process means one or more of the specific goals of the process area are not satisfied, and no generic goals exist.
1	**Performed**	The process accomplishes the needed work to produce work products; the specific goals of the process area are satisfied.
2	**Managed**	A managed process is a process that is planned and executed in accordance with policy; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description.
3	**Defined**	A defined process is a managed process that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines.

Table 6 - CMMI-SVC capability levels

Maturity levels

Contrary to capability levels, maturity levels are used to measure multiple process areas in an organization. Maturity levels indicate how advanced the processes are as a whole, in the organization, and how well the organization has achieved capability levels in a broad group of process areas.

Maturity levels measure the overall improvement of the organization. Each process area has a maturity level assigned to it.

In order to measure maturity levels, specific and generic goals have to be obtained, which are related to each set of process areas.

Below is a description table - Table 7 - of different maturity levels for CMMI via a *stage model*.

#	Maturity level	Description
5	**Optimizing**	The organization continually improves its processes having in mind its business objectives and performance needs.
4	**Quantitatively Managed**	Quantitative objectives for quality and process performance are established and they use them to manage processes.
3	**Defined**	Usage of defined processes for managing work.
2	**Managed**	Institucionalization of selected Project and Work Management, Support, and Service Establishment and Delivery processes.
1	**Initial**	Processes are usually ad hoc and chaotic. Often, what happens, as reported, is that a stable environment is not achieved or provided by the organization. This disables processes support.

Table 7 - CMMI-SVC maturity levels

Organizations can achieve progressive improvements in their maturity by achieving control, first at the department level and continuing to the most advanced level - organization-wide continuous process improvement.

2.3.2 ISO/IEC 330xx Assessment Framework

ISO/IEC 330xx is the new international standard released by ISO that revises ISO/IEC 15504 for the assessment and improvement of organizational processes (ISO/IEC, 2015b).

This new standard goes beyond and extends the original scope of ISO/IEC 15504 created as a standard targeting software processes aiming Software Process Improvement (SPI), but in the last decade has widen its scope, being also used to assess capability and maturity in many other contexts like Organizational Maturity (Walker, 2008), IT Service Management (B Barafort, Di Renzo et al., 2002; Mesquida, Mas et al., 2012), IT Security (Humbert, 2016), Automotive sector (VDA QMC Working Group 13 & SIG, 2005), Medical industry (McCaffery & Richardson, 2007) and many others.

The new ISO/IEC 330xx establishes a framework for performing and applying process assessment, which can assess a range of process quality characteristics (Fern & Carpio, 2017). Beyond the process capability, now considered a process quality characteristic (ISO/IEC, 2015b), the new ISO/IEC 330xx can be utilized to assess the safety, efficiency, effectiveness, security, integrity and sustainability of a process (Jung, H. W., Varkoi, T., McBride, 2014).

This new assessment framework defined in ISO/IEC 330xx, includes three elements:

1. **Process models** that define processes, the entities that are the subject of assessment;
2. **Process measurement frameworks** that provide scales for evaluating specified process quality characteristics of the processes;

3. **Documented assessment processes** that provide a specification of the process to be followed in conducting assessments.

At present date, ISO/IEC 330xx comprises eleven parts, presented below.

ISO/IEC 33001:2015	Concepts and terminology (this International Standard)
ISO/IEC 33002:2015	Requirements for performing process assessment
ISO/IEC 33003:2015	Requirements for process measurement frameworks
ISO/IEC 33004:2015	Requirements for process reference, process assessment and maturity models
ISO/IEC 33010	Guide for performing process assessment
ISO/IEC 33014:2013	Guide for process improvement
ISO/IEC 33020	Process measurement framework for assessment of process capability
ISO/IEC 33060	Process capability assessment model for system life cycle process
ISO/IEC 33061	Process capability assessment model for software life cycle processes
ISO/IEC 33063	Process capability assessment model for software testing
ISO/IEC 33064	Process assessment model for safety extensions

Table 8 - ISO/IEC 330xx published documents

The assessment framework established by this ISO is similar to ISO/IEC 15504 but details it and includes three key elements: Process Assessment Model (PAM), a Measurement Framework (MF) and Process Reference Model (PRM), which are presented below.

Process Assessment Model

The PAM is a two-dimensional model that includes Measurement Framework containing a set of process attributes related to the process quality, and a set of processes defined in terms of their purpose and outcomes with defined scope and domain (ISO/IEC, 2015b).

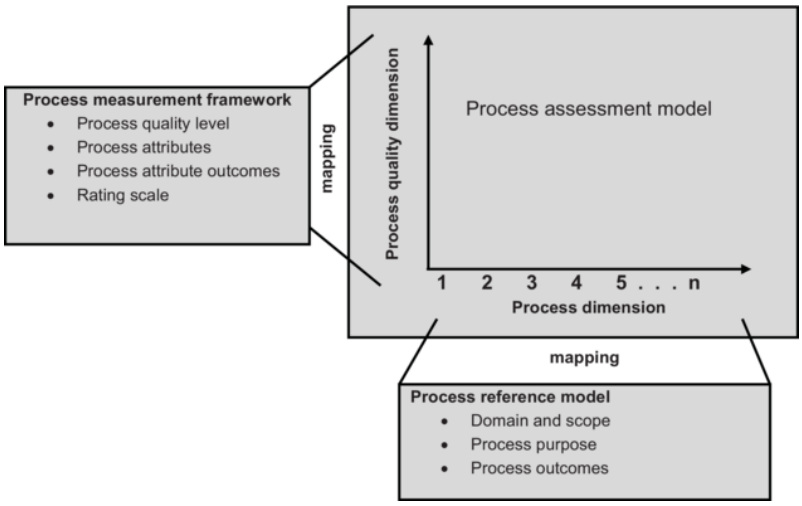

Figure 6 - ISO 330xx Assessment Framework (ISO/IEC, 2015c)

The Measurement Framework can be used to assign a quantitative rating to a quality characteristic of a process and the PRM is composed of a set of definitions of related processes. It also includes an architecture explaining the relationships between these processes.

The assessment output includes a set of process profiles and a process quality level rating for each process, as an option (ISO/IEC, 2015b).

Organizational Maturity

The scope, requirements and conformity rules for Maturity Models, but also for PRMs and PAMs, are now detailed in ISO/IEC 33004 (ISO/IEC, 2015c). The requirements for the assessment of organizational process maturity are provided in ISO/IEC 33002.

Process Capability

Part ISO/IEC 33020 presents the fundamentals that enables the construction of a PAM to assess process capability, presented as a Process Measurement Framework. Process capability levels are presented in a scale, as the document explains: "*Process capability is defined on a six point ordinal scale that enables capability to be assessed from the bottom of the scale, Incomplete, through to the top end of the scale, Innovating*" (ISO/IEC, 2015a).

In Table 9 is presented the process capability levels for this standard.

#	Capability level	Attributes	Description
5	**Innovating**	5.1 Process innovation 5.2 Process innovation implementation	The Predictable process is now continually improved to respond to organizational change.
4	**Predictable**	4.1 Quantitative analysis 4.2 Quantitative control	The Established process now operates predictively within defined limits to achieve its process outcomes.
3	**Established**	3.1 Process definition 3.2 Process deployment	The Managed process is now implemented using a defined process that can achieve its outcomes.
2	**Managed**	2.1 Performance management 2.2 Work product management	The Performed process is now implemented in a managed fashion (planned, monitored and adjusted).
1	**Performed**	1.1 Process performance	The implemented process achieves its process purpose.
0	**Incomplete**		The process is not implemented or fails to achieve its purpose.

Table 9 - ISO/IEC 33020 capability levels and attributes

To calculate the process capability level is necessary to assess and observe the evidence of the achievement of the process attributes. The meaning of these attributes and capability is described in detail in ISO/IEC 33020.

To measure process attributes, it is defined a rating scale on a percentage scale from zero to one hundred percent. This scale represents the percentage of achievement of the process attributes (ISO/IEC, 2015a).

ISO/IEC 33001 defines the process assessment purpose as being able to determine the extent to which the organization's standard processes contribute to the achievement of its business goals and to highlight the focus on continuous process improvement.

The international standard ISO/IEC 33001 also defines the three principal contexts for use of process assessment results: performance improvement, process risk evaluation and performance benchmarking.

2.3.3 COBIT 5 PAM

The COBIT 5 PAM is based on the ISO/IEC 15504 standard. COBIT 5 PAM uses the ISO/IEC 15504 standard capability model and – which is more important – the standard's principle of assessment.

COBIT 5 PAM is an evolution from the previous COBIT 4.1, a maturity model which is more aligned with a generally accepted process assessment standard (ISACA, 2013a).

One comparison study (Pasquini & Galiè, 2013) between the two versions – COBIT 4.1 maturity model and COBIT 5 PAM - mentions that COBIT 5 PAM may take more time to carry out and has higher assessment cost but the results are more precise when compared to 4.1. It is also mentioned that one of the main advantages is that COBIT 5 PAM does a detailed analysis of the process being evaluated giving information on whether the process achieves its goals and generates required outcomes.

COBIT 5 PAM is a pillar of COBIT 5 assessment programme; it provides a basis for the process reference model and the determination of the capability levels. The COBIT 5 PAM model is the basis for the assessment of an enterprise's IT process capabilities against COBIT 5. The assessment process is evidenced-based to enable a reliable, consistent and repeatable assessment process in the area of governance and management of IT.

The process assessment is a **two-dimensional model** of process capability, as shown in Figure 7. It includes a process dimension and a capability dimension.

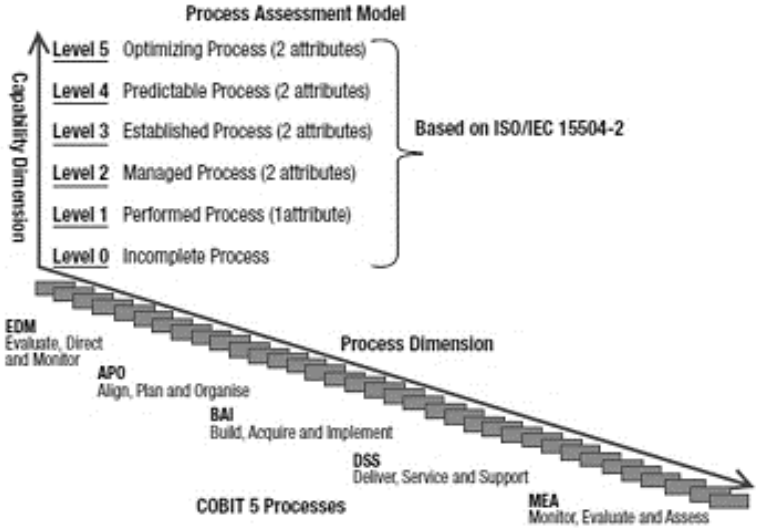

Figure 7 - Overview of COBIT Process Assessment Model (PAM) (ISACA, 2013b)

In the **process dimension**, the processes are defined and classified according to established process categories. In the **capability dimension**, a set of process attributes grouped into capability levels is defined. The process attributes provide the measurable characteristics of process capability.

This Process Assessment Model conforms with ISO/IEC 15504-02 and can be used as a basis for conducting an **assessment of the capability** of each COBIT 5 process (ISACA, 2013b).

Process dimension

The process dimension uses COBIT 5 as the process reference model. COBIT 5 provides definitions of processes in a life cycle (the process reference model), together with an architecture describing the relationships amongst the processes (ISACA, 2012).

The COBIT 5 process reference model (PRM) is composed of 37 processes describing a life cycle for governance and management of enterprise IT. Processes are divided into two main areas: Governance (which includes five governance processes) and Management (includes five domains which have 27 IT processes), as shown in Figure 8.

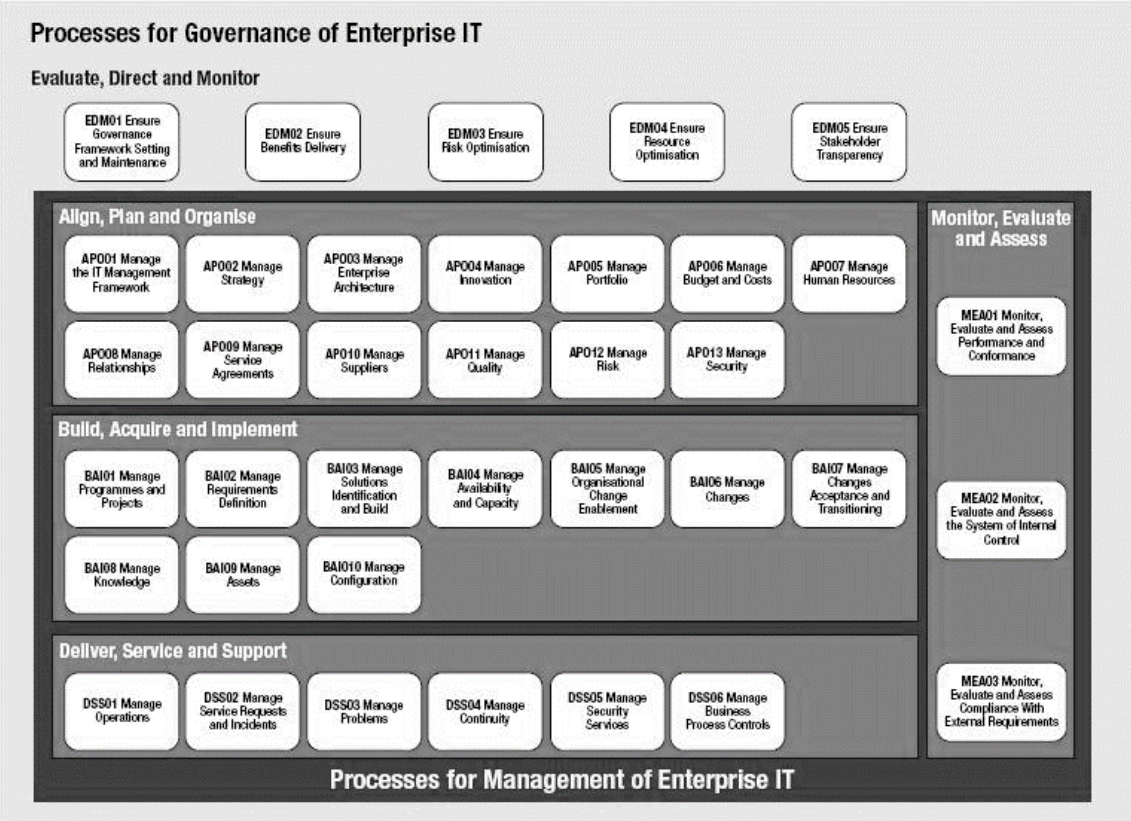

Figure 8 - COBIT 5 Governance and Management processes (ISACA, 2012)

Governance processes ensure that stakeholders needs, conditions, and options are evaluated to determine the achievement of balanced, agreed-upon enterprise objectives. Management processes ensure that the plan, build, run and monitor (PBRM) IT management activities are executed in alignment with the direction set by the governance body to achieve the enterprise objectives.

Capability dimension

The capability dimension provides a measure of a process's capability to meet an enterprise's current or projected **business goals** for the process.

The process capability is expressed regarding the **process attributes** grouped into capability levels. The capability level of a process is determined by the achievement of specific process attributes according to ISO/IEC 15504-2:2003.

This dimension defines six capability levels and nine process attributes, which are illustrated in Table 10 below.

#	Capability level	Attributes	Description
0	**Incomplete process**	-	The process is not implemented or fails to achieve its process purpose.
1	**Performed process**	1.1 Process performance	The implemented process achieves its process purpose.
2	**Managed process**	2.1 Performance management 2.2 Work product management	The previously described performed process is now implemented in a managed fashion (planned, monitored and adjusted).
3	**Established process**	3.1 Process definition 3.2 Process deployment	The previously described process is now implemented using a defined process which can achieve its outcomes.
4	**Predictable process**	4.1 Process measurement 4.2 Process control	The previously described established process now operates within defined limits to achieve its outcomes.
5	**Optimizing process**	5.1 Process innovation 5.2 Process optimization	The previously described predictable process is continuously improved to meet relevant current and projected business goals.

Table 10 - COBIT PAM capability levels and Process attributes

2.3.4 ITIL Maturity Model

The initial work from AXELOS, to measure service management processes, started with the Process Maturity Framework (PMF) which was published and made available as an appendix of ITIL "*Service Design*" publication (Great Britain Cabinet Office, 2011). This PMF can be used either as a framework to assess the maturity of each of the Service Management processes individually or to measure the maturity of the Service Management process as a whole (Great Britain Cabinet Office, 2011). Moreover, it is aligned with the Software Engineering Institute CMMI and their various maturity models including the evolving CMMI-SVC, which focuses on the delivery of services.

In 2013, AXELOS published an updated model named "*ITIL Maturity Model*" and developed a self-assessment service to help organizations improve their IT service management within the ITIL framework (AXELOS Limited, 2013). This self-assessment consists of a set of questionnaires for each process and function across the ITIL service lifecycle. It allows organizations to understand the maturity of their IT service management processes and functions based on the ITIL framework (Rudd & Sansbury, 2013).

This assessment will calculate the maturity of each process or function from answers to the questions within these questionnaires. The quality of the answers to the questions influence accuracy of results.

ITIL Maturity Model defines five levels of maturity. A process or function that doesn't exists is considered to be at Level 0. Authors have defined the maturity scale as follows: Level 1 – Initial; Level 2 – Repeatable; Level 3 – Defined; Level 4 – Managed; Level 5 – Optimized.

The maturity of the Service Management processes is heavily dependent on the stage of growth of the organization as a whole, and its maturity is not only dependent on the maturity of this processes.

Higher maturity levels are obtained by control and standardization which enable a closer alignment between IT and business, meeting organizational objectives (Rudd & Sansbury, 2013).

A given level of maturity is a result of the following six factors - Table 11.

Vision and Strategy	The overall direction as it relates to the role and position of IT within the business.
Steering	The objectives and goals of IT in regards to strategy realization.
Processes	The procedures needed to achieve the goals and objectives.
People	The skills and abilities needed to perform the processes.
Technology	The supporting infrastructure to enable the processes to be carried out.
Culture	The behaviour and attitude required about the role of IT within the business.

Table 11 - Factors that influence maturity levels

Despite the practicality, speed, and cost-effectiveness, it is important to note that this self-assessment include some limitations:

- Relationship and operation assessment on interconnected processes can only be done partially;
- Quality of assessment results is highly dependent on answer quality;
- Maturity level benchmarking can lead to false assumptions in the need for improvement;

2.3.5 TIPA for ITIL

Tudor IT Process Assessment (TIPA) is the result of several years of research conducted at the Public Research Centre Henri Tudor in Luxembourg. The objective was to develop a methodology for performing IT service management process assessments based on an ISO standard.

TIPA framework is based on ITIL's ITSM best practices and ISO/IEC 15504-2 requirements, process attributes and maturity levels for process assessment (Luxembourg Institute of Science and Technology, 2015), covering five levels of process maturity. It maps each process that is assessed onto the scale set by the ISO/IEC 15504 standard. Process maturity is measured by analysing the way the process is performed and managed.

Authors have defined the maturity scale for this model, as follows: Level 1 – Performed; Level 2 – Managed; Level 3 – Established; Level 4 – Predictable; Level 5 – Optimizing.

TIPA has been defined as an interview-based assessment methodology. This methodology is considered the most effective way to gather information concerning the process performance (Adesola & Baines, 2005; Seethamraju & Marjanovic, 2009) and it will help initiate the organizational change required to improve the processes later.

The assessment approach used in TIPA defines an assessment project with six defined phases – as shown in Figure 9 below.

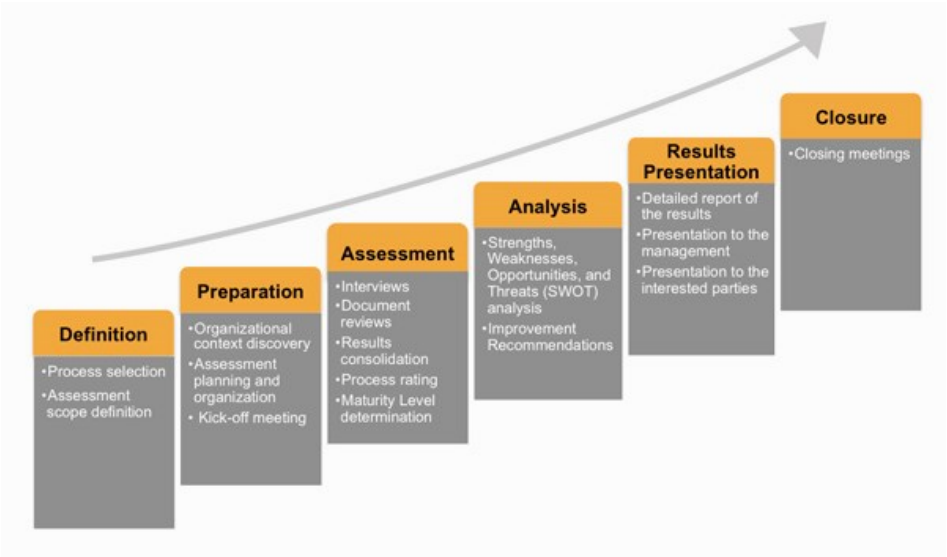

Figure 9 - TIPA assessment project phases (www.tipaonline.org)

From the original TIPA framework emerged the variant TIPA for ITIL, which is well recognized and has now been used for several years to assess the capability of ITSM processes within companies all around the world (Cortina & Alain Renault and Michel Picard, 2014). It consists of the combination of the ISO/IEC 15504 standard for process assessment and the ITSM best practices described in ITIL. TIPA's purpose is to assess if service management processes are implemented in an organization and to measure their maturity levels (Beatrix Barafort, Betry et al., 2009).

Recognized advantages of using TIPA are being vendor-neutral, structured and repeatable evaluation method, enabling process improvement through goal-setting objective measurement leading to improvement of ROI on ITSM projects and allowing standardization to compare process-maturity with other organizations in the industry.

2.3.6 A Maturity Model for ISO/IEC 20000-1 Based on the TIPA for ITIL Process Capability Assessment Model

Some these authors have also worked on a previous paper with title "*Towards a Maturity Model for ISO/IEC 20000-1 Based on the TIPA for ITIL Process Capability Assessment Model*" (Renault, Cortina et al., 2015) in which they explain the preliminary work and assumptions that led to the official maturity model proposed months later, in the same year.

During their research authors found that more and more organizations are using ITIL process improvement approach using TIPA framework (Picard, Renault et al., 2015), they wanted to know what capability levels enterprise processes need to reach to meet ISO/IEC 20000 requirements. Following this need, authors developed and proposed a ISO/IEC 20001 maturity model.

They have identified some issues and challenges in developing this maturity model:

1. ISO/IEC 20000-1 sets requirements on a management system that are not defined as such in ITIL;
2. ITSM processes are defined differently in ISO/IEC 20000-1 and ITIL;
3. ISO/IEC 20000-1 requirements may or may not be present in ITIL processes (requirement misalignment);
4. There is no consensus on an implementation order for these processes.

Moreover, the authors reviewed the characteristics of ISO/IEC 15504 and also the new ISO/IEC 33004 standard and reached the conclusion that the latest is more open than the previous (ISO/IEC 15504-7), as it sets the requirements on how to design a maturity scale, giving freedom to define a custom maturity scale.

For the reasons above, the authors designed an ISO/IEC 33004-compliant Maturity Model for ITSM.

This model was based on existing process assessment models (PAM): on one side TIPA PAM for ITIL which contains 26 ITSM processes and addresses the practices described in ITIL 2011, on the other side the draft ISO/IEC 33070-4 PAM for Information security management which has 12 processes with practices related to all management systems. The Figure 10 below describes the ISO/IEC 20000-1 coverage inrelation to these PAMs.

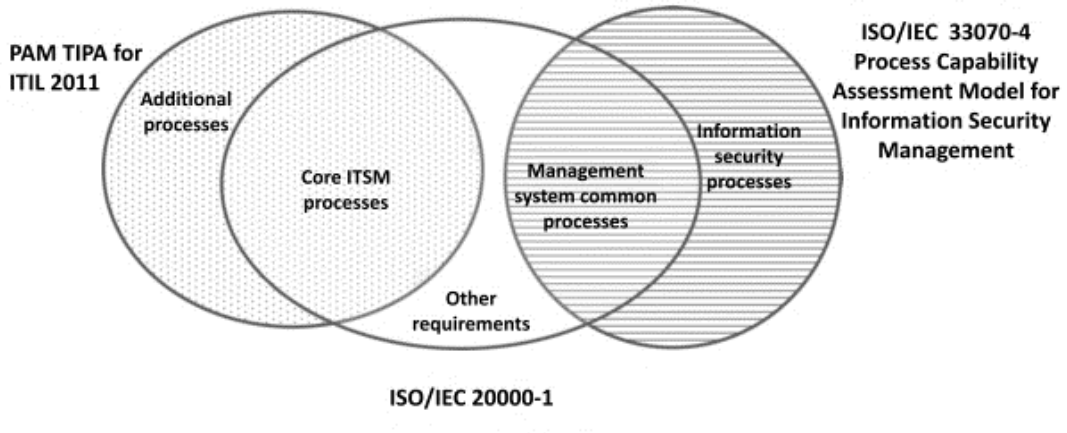

Figure 10 - Coverage of ISO/IEC 20000-1 (Renault, Cortina et al., 2015)

The authors have set up a specific design process using an extended Transformation Process consisting of the following steps:

1. **Identifying elementary requirements**

   The ISO/IEC 20000-1 standard was analysed, and its content was decomposed to extract a list of base requirements, each one related to one subject.

2. **Identifying the processes which cover the elementary requirements**

   Each singular requirement identified in the previous step was then associated with one specific process coming from one of the two process assessment models used as inputs.

3. **Identifying the (base or generic) practices addressing these elementary requirements**

   With each elementary requirement associated with a process, the authors drilled down into that process to select the most appropriate base practice addressing the elementary requirement.

   During this step the authors found the following:

   - 22 elementary requirements were not covered by any process of the two PAMs.
   - No elementary requirement from ISO/IEC 20000-1 is mapped to a capability level upper than 3.
   - No elementary requirement from ISO/IEC 20000-1 is mapped to the following ITIL processes: IT Service Strategy Management, Demand Management, Knowledge Management, Event Management, and Access Management.

4. **Defining the maturity scale**

   The authors decided to start with the 6-levels ordinal scale originally defined in ISO/IEC 15504-7 and they reviewed the definition of levels 1 to 5 according to their experience and the objective of the proposed maturity model.

   The maturity scale is defined as follows: level 1 – Reactive; level 2 – Managed; level 3 – Integrated; level 4 – Governed; level 5 – Optimizing.

5. **Agreeing on the consolidation rules**

   The authors agreed to keep the ISO/IEC 15504-7 consolidation rules as they fit with the context and comply with the requirements contained in ISO/IEC 33004.

6. **Assigning each process to a maturity level**

   During this step, the authors assigned each process from both PAMs to one of the maturity levels previously defined.

7. **Identifying optional and conditional processes**

   To make a maturity model more flexible and usable in different contexts, the authors made some of its processes can be identified as '*optional*' or '*conditional*', as they were not required to comply with the ISO/IEC 20000-1 requirements.

The authors concluded that each organization has its context and there's no silver bullet when it comes to design a set of processes. Nevertheless, the proposed maturity model helps organizations to understand their readiness towards ISO/IEC 20000-1 compliance, and find the gaps in their ITSM implementation.

The proposed model by the authors shows how an organization can evolve from Reactive (Level 1) to Managed (Level 2), and Integrated (Level 3) where it covers the ISO/IEC 20000-1 requirements, including the ones covering the management system. The organization can even go further to level 4 (governed), and ultimately to level 5 (optimizing).

The maturity model proposed in this dissertation will take a different route, as the previous authors concluded, the staged approach is not the best mean to verify readiness towards ISO/IEC 20000 requirements (Picard, Renault et al., 2015).

Our proposal will follow a continuous approach, offering the flexibility of individual process assessments and ISO/IEC 20000 requirements coverage. The authors will also use a different approach, by using updated concepts from ISO/IEC 330xx and following the requirements for developing maturity models published by Becker et al. (2009).

2.3.7 A Maturity Model for implementing ITIL v3

Authors (Pereira & Mira da Silva, 2010) claim that a significant number of organizations fail when trying to implement ITIL, the main problem for resides in the fact that ITIL dictates to organizations "what they should do" but is not clear about "how they should do it."

Following up on the above issues, the authors established the objective of developing a maturity model for ITIL implementation. They started by researching about existing IT maturity models, comparing and detailing their main characteristics, in order to select the most suitable to base their maturity model.

Criteria	Bootstrap	Trillium	PMF	CMM	ITSCMM	CMMI-SVC
Success	Medium	Medium	Very Low	Extremely High	Medium	High
Staged model (SM)/ Continuous model (CM)	Continuous Model	Continuous Model	Both	Staged Model	Staged Model	Both
Number of maturity levels	0-5	1-5	SM: 1-5 CM: 1-5	1-5	1-5	SM: 1-5 CM: 0-5
Scope	Software	Software	Services	Software	Services	Services
Details	Medium	Medium	Low	High	Extremely high	High
Base for	Any model	Any model	Any model	Many Models	CMMI-SVC	----------

Table 12 - Comparison of six maturity models (Pereira & Mira da Silva, 2010)

The results of the research carried out by the authors provided the necessary insights to propose their maturity model for ITIL.

After the analysis and comparison, the authors concluded that “CMMI-SVC” and “ITSCMM” models contain better features than the others based on the following reasons: they are focus on services, ITSCMM is a comprehensive and extreme detailed and CMMI-SVC contains Stage and Continuous Model. The usage of Stage and Continuous Model could give organizations more flexibility during ITIL assessment.

The model proposed by the authors contain unique characteristics such as:

1. Designed specifically to help organizations to measure their ITIL maturity;
2. User guidance during ITIL implementation to reduce the risk;
3. Designed for latest ITIL v3, the Process Maturity Framework (PMF) was aligned to ITIL v3 and simple in terms of its characteristics (goals, practices, etc).

In search of a higher flexibility to organizations concerning ITIL assessment, this model includes a Stage and a Continuous model. To assess a process, the Continuous Model has a questionnaire that will be composed of factors of ITSCMM and CMMI-SVC, previously validated, and everything contemplated by ITIL (process dependencies, specific roles, and responsibilities, documents, plans, etc.).

Organizations that want to implement ITIL but do not know where to start should choose the Staged model. The stage model will tell organizations which processes they should implement first and how far should they go.

The authors presented and discussed the results of the assessment of Incident Management process in two Portuguese organizations. The results showed that they were both at level 1.

The authors admit that the model is not perfect and they identify the pros and cons:

1. Extremely needed in worldwide reality of ITIL implementation

2. Very detailed
3. Can be used to assess and to guide the implementation
4. The stage model follows an incremental path to reduce the initial effort
5. Enables organization to know “where” they are and what they need
6. Organizations that follow this model avoid the most common mistakes of ITIL implementation.

The most important con is that the sequence of implementation processes by stage model might not be the most appropriate for all kinds of businesses.

2.3.8 A Maturity Model of IT Service Delivery

The authors (Flores, Rusu et al., 2011) developed an IT service delivery maturity model to assess the IT service delivery based on traceable information of its current status, based on maturity model properties and IT Service Capability Maturity Model (IT Service CMM).

The proposed IT Service Delivery Maturity Model (SDMM) is a mechanism for formalizing and assessing IT Service Delivery Elements. They are defined as activities, guidelines, performance indicators/metrics, methods/tools and components of SLA, Budget, Cost, and Depreciation related to IT Service Delivery processes.

This model is prescriptive, providing a complete view of five maturity levels that are oriented to formalize the IT service delivery elements.

SDMM shares several characteristics with Pereira’s model. Both of them are based on ITIL processes. SDMM cover IT service delivery elements while Pereira’s model has been designed to cover all ITIL processes.

Authors suggest that SDMM needs more tests to increase its reliability and to overcome the ambiguity of the maturity level scoring.

2.4 Maturity and Assessment model comparison

After a summary and analysis of assessment and maturity models related with ITSM, it will now be essential to make a comparison of the characteristics of the models reviewed. A summary these characteristics is presented in Table 13 below.

Criteria / Model	**CMMI-SVC**	**COBIT PAM**	**ISO 330xx**	**ITIL Maturity Model**	**TIPA**	**ISO/IEC 20000 TIPA**	**ITIL v3 MM**
Official Entity / Authors	CMMI	ISACA	ISO/IEC	AXELOS	LIST[1]	(Picard, Renault et al., 2015)	(Pereira & Mira da Silva, 2010)
Latest version	v1.3 April 2011	v1 2013	2015	v1.2 Oct 2013	v4.1 Jan 2015	v1 Sep 2015	v1 2010
Number of Maturity levels	5	6	6	5	5	5	5
Model type (Maturity / PAM)	Both	Assessment Model	Both	Both	Assessment Model	Maturity	Both
Scope and Focus	Services	Generic	Generic	Services	Services	Services	Services

Table 13 - Maturity model comparison

[1] Luxembourg Institute of Science and Technology

The next table (Table 14) compares the maturity levels of each model and a brief detail of the meaning of each level.

Model / Maturity Level	0		1		2		3		4		5	
	Level name	**Description**	**Level name**	**Description**	**Level name**	**Description**	**Level name**	**Description**	**Level name**	**Description**	**Level name**	**Description**
CMMI-SVC	-		*Initial*		*Managed*		*Defined*		*Quantitatively Managed*		*Optimizing*	
COBIT 5 PAM	*Incomplete*		*Performed*		*Managed*		*Established*		*Predictable*		*Optimizing*	
ISO 15504 (SPICE)	*Incomplete*	Processes not implemented or fail to achieve its purpose	*Performed*	Processes exist but are chaotic, ad hoc and unpredictable	*Managed*	Processes follow a pattern and deliver according to planned	*Established*	Processes are recognized, and procedures have been standardized	*Predictable*	Processes are fully recognized and measured. Performance is achieved and aligned with business needs	*Optimizing*	Processes performance is continually improving to meet business needs and goals
ITIL Maturity Model	-		*Initial*		*Repeatable*		*Defined*		*Managed*		*Optimized*	
TIPA	*Incomplete*		*Performed*		*Managed*		*Established*		*Predictable*		*Optimizing*	
ISO/IEC 20000 TIPA	-		*Reactive*		*Managed*		*Integrated*		*Governed*		*Optimizing*	
ITIL v3 MM	-		*Level 1*		*Level 2*		*Level 3*		*Level 4*		*Level 5*	

Table 14 - Maturity model level comparison

We can conclude that all reviewed models are strictly related to each other as CMMI and ISO/IEC 15504 mostly influenced them. COBIT PAM is closely aligned with ISO 15504, in AXELOS ITIL Maturity Model although level names differ from the other models, their descriptions are aligned with COBIT and CMMI. TIPA uses ISO/IEC 15504 standard for process assessment and capability levels.

The proposed ISO 20000 Maturity Model (Picard, Renault et al., 2015) is based on TIPA, and it is the most recent one – September 2015 and ITIL v3 MM (Pereira & Mira da Silva, 2010) is based on ITSCMM and CMMI-SVC models because they both focus on service, are detailed and the later includes staged and continuous models.

CMM-SRV, AXELOS ITIL Maturity Model, ISO 20000 Maturity Model and ITIL v3 MM do not include level 0 in their models, which is common on stage models, although the AXELOS ITIL Maturity Model refers to the existence of level 0 it in its recent documentation (AXELOS Limited, 2013). ITIL v3 MM (Pereira & Mira da Silva, 2010) it is the only model that doesn't label his maturity levels.

From all analysed models, we have selected two models considered relevant for a detailed analysis, regarding the scope of this proposal.

First proposal is Ruben Pereira's Maturity Model (Pereira & Mira da Silva, 2010), this model is focused on providing a roadmap for ITIL implementation and while it's not aligned with ISO 20000 requirements, it provides clues and groundwork for future development of ITSM maturity models. Following representation terminology from CMMI (Chrissis, Konrad et al., 2004), it proposes staged and a continuous assessment model.

Second proposal is ISO/IEC 20000 TIPA Maturity Model (Picard, Renault et al., 2015) which targets ISO/IEC 20000, its based on ISO/IEC 15504-2 requirements and compliant with new ISO 330xx standard. It proposes a maturity model based on two PAMs: TIPA for ITIL and ISO 33072 PAM for ISM which, after being transformed and combined by the authors, it still cannot fully cover ISO 20000 requirements by 100%.

Below, we present Table 15 that depicts and compares the essential characteristics of these two maturity models, for the development of this proposal. An analysis of requirements published by Becker et al (2009) for the scientific development of IT Maturity models is also included.

In summary, both proposals didn't follow Becker et al (2009) requirements for developing maturity models and they also lack compliance and ability to successfully be used as roadmap to achieve ISO/IEC 20000 requirements: Ruben Pereira's model is designed for ITIL and M. Picard et al model, although it targets ISO/IEC 20000, it doesn't fully cover all of its requirements.

Nevertheless, the groundwork and conclusions reached by these proposals is considered useful, and will be considered in the development of our Maturity Model proposal.

Model	Methodology	**Problem relevance / definition** (R5 + R6)	**Comparison with existing MM** (R1)	**Type of Maturity Model proposed**	**Based on**	**Iterative model development** (R2)	**Iterative model evaluation** (R3)	**Multi-metho-dological Procedure** (R4)	**Target audience evaluation** (R7)	**Scientific documentation** (R8)	**Conclusion**
ITIL v3 MM	Action Research Methodology	Yes. Provide implementation roadmap for ITIL	Yes. Six Maturity models were compared and evaluated	Continuous and Staged	ITSCMM and CMMI-SVC	No	Yes, using Action Research	Yes. Literature review and Action Research	Yes. Seven organization assessments were made and conclusions extracted	*Not specified*	Oriented for ITIL; Not compliant with ISO 330xx
ISO/IEC 20000 TIPA	Built by the Authors	Yes. Guide organizations to achieve ISO 20000 compliance	No	Staged	TIPA for ITIL (ISO 15504 + ITIL)	No	No	No	*Not specified*	*Not specified*	It doesn't fully cover ISO/IEC 20000; Lack of scientific validation; Not compliant with ISO 330xx

Table 15 - Review and comparison of relevant maturity models, according to Becker et al (2009) requirements.

3. Proposal

Although ISO/IEC 20000 has a total of 28 processes, for the purpose of this dissertation we will focus our interest in processes from the Resolution group. This decision is based on the analysis of multiple ITIL adoption studies which present ITIL Service Operation as one most adopted processes by organizations (Cater-steel & Tan, 2005; Iden & Eikebrokk, 2016; Marrone, Gacenga et al., 2014).

Since ITIL is considered the most implemented ITSM framework in organizations, it is also important to compare alignment between ITIL and ISO/IEC 20000 processes. This will help organizations not yet familiar with ISO/IEC 20000 requirements and processes, but willing to attain certification.

In the Table 16 below, a comparison and mapping of ISO 20000 Resolution Processes and ITILs Service Operation processes is presented.

ID	ISO 20000 Process Name	ITIL Process Name	ITIL Book
-	-	Event Management	ITIL 2011 - Service Operation
RES.1	Incident management	Incident Management	ITIL 2011 - Service Operation
RES.2	Service request management	Request Fulfilment	ITIL 2011 - Service Operation
RES.3	Problem management	Problem Management	ITIL 2011 - Service Operation
-	-	Access Management	ITIL 2011 - Service Operation

Table 16 - ISO/IEC 20000 Resolution Processes and ITIL comparison map

As we can see above, ITILs Event and Access Management don't have a matching ISO/IEC 20000 process. Moreover, Incident and Service request management are presented separately only for identification and mapping purposes but, in ISO/IEC 2000 documentation, they are part of the same process with the unique name "Incident and Service Request management".

We will focus our work on Incident and Service Request Management, from the research we have made on the official ISO/IEC 2000 documentation, there were identified a total of 14 requirements.

The model development lifecycle will be iterative and will include **3 steps**, as following:

1. First step, use ISO/IEC 20000 documentation (ISO/IEC 2000-1) to identify and extract requirements from chosen processes. After this, decompose and convert them to Activities in order to be used in the industry expert questionnaire – Appendix A.

2. Second step, conduct semi-structured interviews with 5 industry experts who were involved in ITIL and ISO 20000 implementation projects. Ask them to map Incident and Service Request management activities to capability levels.

3. Third step, analyse all expert interviews and develop a maturity model based on the data analysis of the questionnaires.

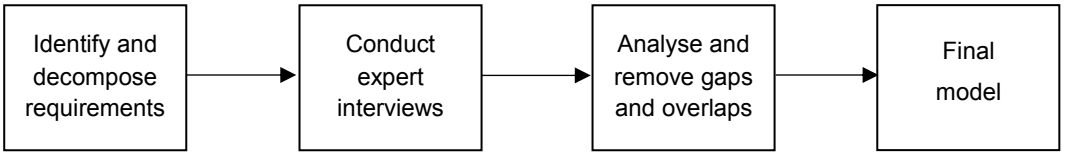

Figure 11 - Model development lifecycle

3.1 Model development

3.1.1 Requirement decomposition

First step for the model development is to identify and extract process requirements, this was done by analysing process requirements details from official ISO/IEC 20000 documentation.

The requirements from these processes were then decomposed, analysing "*shall*" statements, into singular and unique requirements and then converted to activities. These activities were presented in the expert questionnaire, along with ISO 330020 capability levels – Appendix A – with the goal to identify which activities contribute each level outcomes.

3.1.2 Expert interviews

Second step, we have conducted semi-structured interviews with 5 industry experts. The interview guidelines and mapping explanation was sent at least 5 days before the interview to give time to interviewees to reflect on the activity mapping task and produce accurate results. The interviews were made by Skype, were divided in two stages the reason being mapping task needed availability from interviewees.

First stage, interviews started with a brief introduction about the research project and its goals, afterwards they were asked to do mapping between process activities and levels, important to develop our maturity model. For this first stage, we established a deadline of two days for interviewees to complete this task. The second stage happened two days later. We resumed the interviews, asking each interviewee to tell us more about them and their experience with ITIL and ISO 20000, followed by a set of closed and open questions about the relevance a maturity model, importance of Incident Management and their overall opinion about the model. A summary of interviewees profiles is presented in Table 17 below.

ID	Role	Years of Experience	ISO 20000 experience	Country	Interview form	Interview duration (2 stages)
A	IT Service Manager	9	2	Brazil	Skype	6h + 35mins
B	Business Process Consultant	30	6	Portugal	Skype	3h + 40mins

C	Senior Consultant	22	5	Portugal	Skype	1h:30m + 30mins
D	Senior Consultant	23	9	Portugal	Skype	40min + 45min
E	Support Technician	6	4	Brazil	Skype	2h + 35mins

Table 17 - Expert interview details

Throughout the interviews, the feedback and opinions collected from the experts, were continuously contributing the development of the artefact. The artefact reached its maturity when the interviewees started to agree that list of activities was accurate. It is important to note that during this process, 4 additional activities were proposed, regarding: responsibilities (when not defined, activities are not executed), control (to enable process adjustment and improvement) and metrics (useful for monitoring and measure process). Those activities were added to the questionnaire and presented again to all interviewees, in order to map them against the levels.

Final questions were asked to gather their feedback about the importance of ISO 20000 and Incident and Service Request management in organizations. This was important to validate the relevance and usefulness of this proposal. A summary of the most relevant questions and answers is presented in Table 18 below.

Interviewee ID	What are ISO 20000 major implementation difficulties in organizations?	Importance of Incident and Service Request Management process?	Is this proposal complete?
A	No implementation experience.	Customer quality perception and satisfaction.	Yes.
B	Difficult to obtain. Most organizations stay with ITILs best practices.	Important because it is a process that is externally visible to the client.	Yes but adding additional dimensions would be a benefit.
C	People's resistance to change and cross department implementation	Important for customer satisfaction, for continuous improvement and enables quick responses.	Yes. Suggested adding problem management process.
D	Important to have support from senior management, in order to audit and change processes.	Very important. It's visible for the clients so influences perception of organization service quality.	Yes, but proposed additional activities.
E	Not able to answer from organizational perspective.	Important because it supports organization IT Services.	Yes.

Table 18 - Summary of final interview answers

The activity and level mapping results, collected from all interviewees, are presented in the Table 19. The Y axis representing levels and X axis representing the interviewees identification. These results were worked out afterwards, using a specific methodology explained in the third step.

Levels / Interviewees	**Interviewee A**	**Interviewee B**	**Interviewee C**	**Interviewee D**	**Interviewee E**
1.1	A1 A6 A15 A16	A1; A3; A6; A7; A15; A16; A17; A18; A20; A22	A1, A2, A6, A8, A13, A14, A15, A16, A17, A18, A19, A20, A22, A23, A24, A25	A1, A5, A6, A15, A16, A17, A18, A19, A20, A21 e A22	A2
2.1		A26	A2. A4, A19	A26	A2 e A3
	A2 A4 A19	A26	A3, A14, A6, A7	A26	A3
	A3 A5	A27	A5, A8, A9, A11, A13	A26	A8
	A24 A16	A28	A16, A21	A25	A16
	A23	A1; A2; A3; A4; A5; A17; A18; A19	A23	A23, A27	A6
	A23	A1; A2; A3; A4; A5; A17; A18; A19; A20; A21; A25; A27	A8	A28, A8	A3
	A14	A2; A4; A5; A8; A9; A10; A11; A12; A13; A14; A19; A21	A8, A9, A10, A11, A12, A13	A27, A9, A10, A11, A12, A13	A11
	A16	A1; A2; A3; A4; A5; A16; A17; A18; A19; A20; A21	A1, A3, A5	A27	A15
2.2	A1 A3	A1; A2; A3; A4; A18; A19; A23	A6, A7	A2	A3
	A21 A5	A1; A24; A26;	A1, A2, A3, A4, A18, A19	A2	A21
	A2 A4 A19	A1; A2; A3; A4; A18; A19; A23; A1; A2; A3; A4; A18; A19; A23; A24; A27	A5	A2	A1
	A16 A5 A17	A16; A22; A23; A24; A25; A26; A27; A28	A24, A25	A2	A1 e A3
3.1	A3 A5 A18	A1; A2; A3; A4; A8; A9; A10; A11; A12; A13	A1, A2, A3, A4, A18, A19	A2	A31
	A1 A16 A21	A9; A11; A12; A13; A14; A26; A27	A14	A2, A14	A8
	A23	A1; A2; A3; A4; A5; A17; A18; A19; A20; A21; A25; A27	A2, A4, A19, A22, A23	A27	A8
	-	A1; A2; A3; A4	A2, A4, A19	A27	A3
	A24 A25	A26; A27; A28	A5. A24, A25	A26	A25; A26

3.2	A1	A5; A6; A7; A8; A14; A15; A16; A17; A20; A21; A22; A23; A24; A27	A5, A17	A2	A14
	A16	A1; A2; A3; A4; A5; A17; A18; A19; A20; A21; A25; A27	A23, A15	A27	A23
	A23	A26; A27; A28	A8	A28	A23
	A8	A2; A4; A5; A8; A9; A10; A11; A12; A13; A14; A19; A21	A8	A27	A4
	A9	A1; A2; A3; A4, A26; A27; A28	A11, A12, A13	A27	A20 e A21
	A9 A25	A24; A25; A27; A28	A11, A12, A13, A14	A26	A24
4.1	-	A26	A6, A7	A26	A24
	A8 A9	A26	A15, A16	A26	A25
	-	A26	A1, A3, A18	A26	A16
	A14 A16	A26	A2, A4, A19	A26	A24
	-	A26	A2, A4, A19	A26	A12
	-	A26	A2, A4, A19	A26	A22
	A24	A27	A16, A24, A25	A26	A25
4.2	A1 A3	A26	A5	A26	A24
	A24	A27	A25	A26	A25
	-	A26	A2, A4, A19	A26	A16
	A24	A28	A25	A26	A23
	-	A26; A28		A26	A17
5.1		A26; A27; A28	A2, A4, A19	A25	A22
		A27; A28	A25, A28	A25 e A26	A25
		A28	A25	A25 e A26	A25
		N/A - 4.5.2 Plan the SMS	A25	A25	A23
5.2	A7	N/A - Change management;	A25, A24, A2, A4, A19	A29	A16
	A24	N/A - Change management;	A5, A21	A29	A17
	A25	A26; A27; A28	A2, A4, A19, A24	A29	A25

Table 19 - Activity to level mapping results

3.1.3 Activity frequency analysis

Third step, after finishing all interviews, it was necessary to do additional work on the activity mapping in order to be able to develop a model. The following methodology was used to eliminate activity gaps and overlaps, flatten the maturity level hierarchy and present a final model:

1. All activity mapping answers made by the interviewed experts were joined and segmented by maturity level.
2. Capability sublevels were merged into parent levels, defining final maturity levels from 1 to 5.
3. At each level, a frequency analysis was made on all answers to confirm which activities had most answers, considering a maximum of 6 activities per level. If same activity was found repeated across multiple levels, only the first highest frequency occurrence was considered;
4. A final manual analysis was done to include missing activities from previous step, starting from lowest to the higher maturity level, considering the highest to lowest activity frequency.

3.1.4 Final model

Using the approach presented above, we were able to define a model from the collaboration of all expert interviewees, which was represented with five levels and 24 associated activities plus 4 suggested activities by one of the experts, which is illustrated in the Table 20 below.

Activities presented between parenthesis were added manually, according to previous methodology description in step 4. The maturity level titles were adapted from ISO/IEC 33020 official documentation.

Maturity Level	Activities
Level 1 - Performed	A1; A6; A15; A20 (A22)
Level 2 - Managed	A2; A3; A5; A16; A18; A7 (A10; A11; A12; A13)
Level 3 - Established	A4; A8; A14; A19; A23 (A17)
Level 4 - Predictable	A21; A24; A27; A28
Level 5 - Innovating	A25; A26; A29

Table 20 - Proposed Incident and Service Request Maturity Model

A visual representation of the proposed model is presented in Figure 12 and below, an overview of the levels, each level including specific characteristics and his allocated a set of activities, according to the previous activity mapping.

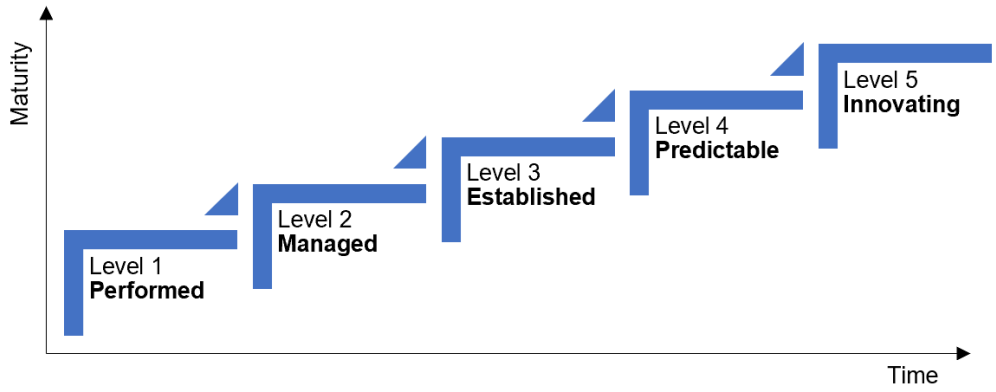

Figure 12 - Proposed Maturity Model representation with 5 stages of increasing maturity

Level 1 - Performed

This is the lowest level of maturity assigned to a process. A process that reaches this maturity level means that has achieved its defined outcomes.

In this particular case, means that there is a procedure that defines the identification, recording, allocation of priority, classification, updating of records, resolution and closure. Impact and Urgency is taken in consideration; customer is kept informed of the situation and when the service target cannot be met, customer is informed, and it gets escalated according to a procedure.

Level 2 - Managed

An organization with a process reaching this maturity level means the process is more structured and is being closely managed.

A process reaching this level has its procedures documented; has a procedure for managing the fulfilment of service requests; impact and urgency is taken in consideration.

Level 3 - Established

A process reaching this maturity level means it's well defined, it's interaction with other processes is established and roles and competencies are identified as part of the process.

In this particular case, personnel can access and use relevant information which includes the CMDB; Major incidents have a procedure and Top management ensures that there's a responsible for managing major incidents.

Level 4 - Predictable

Reaching this maturity level means that the process operates between the defined limits and process is measured to evaluate its performance.

In this particular case, customers are informed when service targets cannot be met and major incidents are managed according to documented procedure.

Level 5 - Innovating

This is the highest level of maturity. An organization having a process reaching this maturity level, means the process is continuously being improved.

In this particular case, major incidents are reviewed and, an effort is made to identify additional opportunities for improvement.

4. Demonstration and Evaluation

This chapter corresponds to the fourth phase of our Research Methodology based on DSR, named "*Demonstration and Evaluation*". In order to demonstrate and evaluate the effectiveness, adequacy and relevancy of the artefact as a solution to the problem.

4.1 Demonstration

In this part, we are going to demonstrate the capacity of the developed artefact in solving the problem. This will be executed by applying the artefact in an organization through an interview.

Although our goal was to interview more organizations, unfortunately, from our numerous contacts, only one organization accepted to be interviewed, within our established deadline.

The organization was interviewed using a questionnaire with closed and open questions and an activity assessment table – Appendix B. The organization operates in the Automation Digitalization industry and having an IT department with around 6.000 people. The interviewee is an IT Manager with 14 years experience.

This organization follows some of the ISO/IEC 20000 standard guidelines, is aware of its benefits but is still not certified. Two major reasons were provided by the interviewee: first, the organization has a very complex structure with processes involving multiple departments; second, the certification was not demanded by their clients or projects were the organization is involved.

Below, Table 21, we present the Incident and Service Request Management activity assessment of this organization, which was part of the questionnaire using in the interview – Appendix B.

ID	Activity	Implemented? (Y / N)	Maturity Level
A1	Is there a procedure for incidents to define: a) Identification; b) recording; c) Allocation of priority? d) Classification; e) Updating of records? f) Updating of records? g) Escalation; h) Resolution? i) Closure	Y ☒ / N ☐	1
A2	Is this procedure documented?	Y ☒ / N ☐	2
A3	Is there a procedure to managing the fulfilment of service requests from recording to closure?	Y ☒ / N ☐	2
A4	Is this procedure documented?	Y ☒ / N ☐	3
A5	Are incident and service requests managed according to the procedures?	Y ☒ / N ☐	2
A6	Prioritization of incidents Do you take in consideration impact and urgency?	Y ☒ / N ☐	1
A7	Prioritization of service requests Do you take in consideration impact and urgency?	Y ☒ / N ☐	2
A8	Does personnel involved in incident can access and use relevant information?	Y ☒ / N ☐	3
	Does the relevant information include:		
A10	- service request management procedures?	Y ☒ / N ☐	2
A11	- known errors?	Y ☒ / N ☐	2
A12	- problem resolutions?	Y ☒ / N ☐	2
A13	- the CMDB?	Y ☒ / N ☐	2
A14	Is the information about the success or failure of releases and future release dates, from the release and	Y ☐ / N ☒	3

	deployment management process, being used by the incident and service request management process?		
A15	Do you keep the customer informed of the progress of their reported incident or service request?	Y ☒ / N ☐	1
A16	If service targets cannot be met, do you inform the customer and interested parties and escalate according to the procedure?	Y ☒ / N ☐	2
A17	Are major incidents classified and managed according to a procedure?	Y ☒ / N ☐	3
A18	Do major incidents have a procedure?	Y ☒ / N ☐	2
A19	Is this procedure documented?	Y ☒ / N ☐	3
A20	Are major incidents managed?	Y ☒ / N ☐	1
A21	Are major incidents managed according to documented procedure?	Y ☒ / N ☐	4
A22	Is top management informed of major incidents?	Y ☒ / N ☐	1
A23	Does top management ensure that a designated individual responsible for managing the major incident is appointed?	Y ☐ / N ☒	3
A24	After the agreed service has been restored, are major incidents reviewed to identify opportunities for improvement?	Y ☒ / N ☐	4
A25	Are they reviewed to identify opportunities for improvement?	Y ☐ / N ☒	5
A26	Process metrics for efficiency, effectiveness/quality, compliance, and customer satisfaction/business alignment are defined, measured, analyzed and reported.	Y ☒ / N ☐	5
A27	The process owner establishes: - Responsibilities and authorities for process are defined, assigned and communicated (through process description and/or RACI matrix) by the process owner; Resources and information for the process are identified, made available, allocated and used: and manages interfaces between involved parties.	Y ☒ / N ☐	4
A28	Personnel is trained in the incident and service request processes	Y ☒ / N ☐	4
A29	Change management includes incident and service request improvement change types	Y ☐ / N ☒	5

Table 21 - Organization Incident and Service Request Management activity assessment

After finishing the interview, the assessment data is analysed and the artefact applied. Each activity is evaluated in terms of implementation and is classified according to their maturity.

We can verify that this organization has 24 activities implemented from a total of 28 activities. This represents an 86% requirements coverage for this process. The graph presented below – Figure 13 – illustrates the activities implemented in this organization. Two activities classified in level 3 and two activities in level 5 were assessed as not implemented.

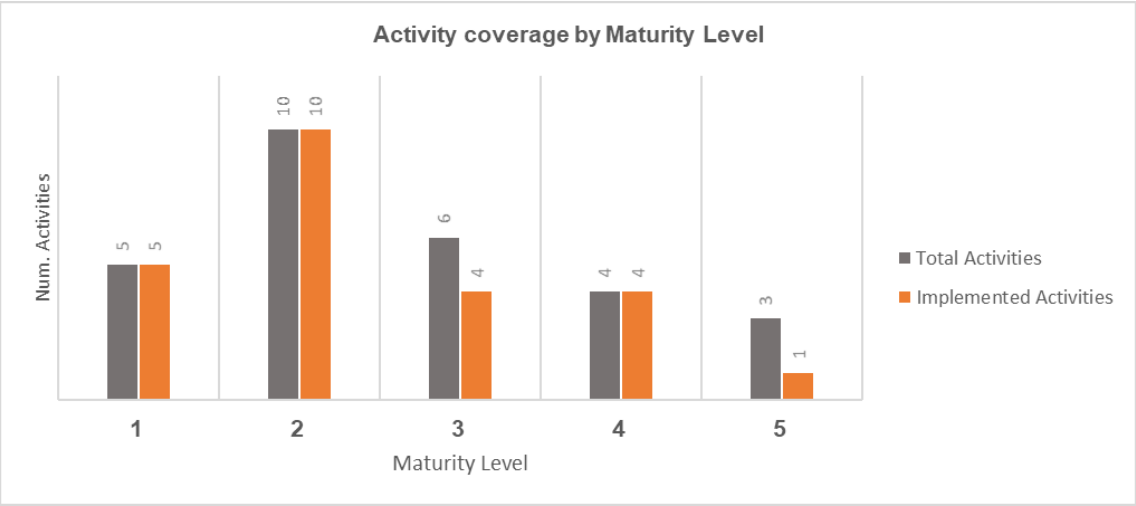

Figure 13 - Process activity coverage results by maturity level

After applying the rating scale defined for our model to the process assessment, we can conclude that the process maturity is rated as **Level 3**. The rating rationale follows ISO/IEC 33020 specifications and is calculated analysing the achievement criteria of all levels (from lowest to highest), considering the activities assessed in each level.

In Figure 14 below, we can verify the accomplishment by maturity level and the maturity reached by this process - highlighted in black.

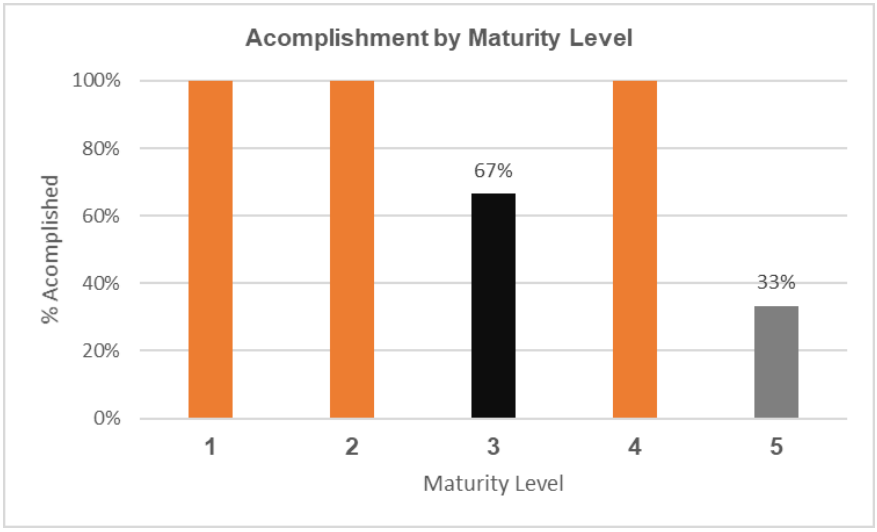

Figure 14 – Acomplishment and Process Maturity Level

The interviewee from this organization validated the usefulness of artefact as it is important to expose which activities from this process are implemented or not and also measure what is the process coverage in terms of ISO 20000 activities, giving an objective overview of how distant the implemented process is from ISO 20000 compliance.

It was noted by the interviewee that ISO 20000 certification is important to formalize organizational processes, in order for people and departments to work in a more efficient and structured way.

His opinion was that this may, later on, reflect in the satisfaction of their (internal) clients and, as a consequence, the achievement of business goals.

With this evaluation it became proved that the artefact can be applied in a real case, is useful and has the capability of solving the problem.

4.2 Evaluation

In this part, we are going to evaluate the artefact. The goal is to validate the adequacy of the artefact as a solution to the problem. For the purpose of this evaluation, we followed proposals from two academic contributions, commonly used in DSR research projects, to demonstrate the relevancy of the artefact:

1. **Four Principles of Österle *et al***: This provides a contribution to increase rigor in design-oriented information systems research (Österle, Becker et al., 2011). These principles result from a contribution of 10 authors, supported by 111 full professors to validate the artefacts. The principles are:

    a. Abstraction
    b. Originality
    c. Justification
    d. Benefit

2. **Moody and Shanks Quality Framework**: This framework resulted from a research on how to evaluate and improve the quality of data models (Moody & Shanks, 2003). It uses the perspective of stakeholders and proposes the following quality factors:

    a. Completeness
    b. Integrity
    c. Flexibility
    d. Understandability
    e. Correctness
    f. Simplicity
    g. Integration
    h. Implementability

4.2.1 Application to the Maturity Model (*artefact*)

Having previously defined our evaluation methodology, in this part we will apply it to the artefact we have developed, in order to evaluate the functionality and usefulness of the artefact.

The **Four Principles of Österle *et al*** were applied to validate the artefact with the following results:

1. **Abstraction**: The artefact can be applied to any company, regardless of the size, industry or nature;

2. **Originality**: The artefact was not considered as totally original by interviewees, they knew about other maturity models that were also used to assess ITSM process activities. Nevertheless, the methodology and rigor used in the development of this artefact was a distinctive factor when compared with other models.

3. **Justification**: The motivation and relevancy of the problem justify the artefact by itself.

4. **Benefit**: The artefact provides benefits, since it provides a tool for organizations assess their processes in order to become compliant with ISO 20000 requirements.

From the application of these principles, we can conclude that all principles were achieved. However, it is appropriate to discuss the complete achievement of **originality** principle since the artefact was not completely original. The originality was attained by using a rigorous methodology which was not seen on previously published artefacts.

Applying the Moody and Shanks Quality Framework to the artefact, generated the following results:

1. **Completeness**: The artefact is not fully complete. Other process activities from ISO 20000 must be added in order to be turned into a full ISO 20000 maturity model.

2. **Integrity**: The artefact was a result of literature review and interviews that enabled to identify gaps and overlaps in other models.

3. **Flexibility**: The artefact is flexible, meaning the organization can complete the model by adding more activities from other ISO 20000 processes.

4. **Understandability**: Maturity models are very well known in the IT community and ISO 20000 processes derive from ITIL, the most widely known ITSM framework.

5. **Correctness**: The artefact is valid and correct, according to the organization on which it was demonstrated.

6. **Simplicity:** The artefact is easy to apply and assess maturity. This is one of the reasons why maturity models are popular in the IT community.

7. **Integration**: The artefact makes possible to organizations, from any size, to assess their ITSM processes and serving as guideline to improve and comply with ISO requirements. This is consistent with the problem.

8. **Implementability**: Implementation of the artefact, in terms of process assessment is assured and straightforward, having no requirements to the organization.

Almost all quality factors from this framework were accomplished. Only **completeness** was not fully fulfilled since it was not possible to incorporate all ISO 20000 processes into the artefact. Besides this fact, these results prove the capability of the proposed model.

5. Conclusion

Throughout the development of this dissertation it was made clear that ITSM and its frameworks are a very important topic in any organization delivering IT Services to their clients. The pressure to be efficient, cost effective and deliver high quality services are on the top concerns of organizations and is well illustrated throughout the comprehensive literature review we have done, and also, the expert and organization interviews we have made.

Particularly, it became clear the high importance of Incident and Service Request management process. This is explained by the fact that it is the only process that interfaces the organization with their end client and, for this reason, delivers the perception of service quality to the market and influences how the organization is perceived in comparison with other competitors and overall client expectations.

It was also interesting to note, during our interviews, that organizations have priorities established to continuously improve their processes and, in line with that, the usage of maturity models has been reported, by all interviewees, to be valuable tools to assess ITSM processes. Their advantages are, not only to take an actual snapshot of their processes, but to serve has a guide to further improve the quality and efficiency of their processes.

All interviewees also stressed the importance of being aligned with ISO standards, particularly ISO 20000. The two main reasons were: to be competitive, in comparison with other organizations, and to be compliant in order participate in public tenders. This also proves the importance and relevance of our dissertation to the community.

From all of what is said above, we can conclude that the proposed model not only provides new insights to the academic and ITSM community but, most important, using a proven research methodology (DSR) combined with specific methodology to create maturity artefacts, offers a ISO 20000 maturity model that enables organizations, from any sizes, to assess their processes and provides a roadmap for improvement and alignment with ISO 20000 standard requirements.

5.1 Future work

Due to time and space constraints of this dissertation, it was only possible to propose a maturity model for Incident and Service Request Management process. Nevertheless, the steps and methodology used in the development of this model could be extrapolated and further iterated to include all ISO 20000 processes, giving priority to Problem management, which a process closely related with Incident and Service Request management. This was, in fact, suggested by one of the interviewees.

It was also mentioned, from expert interviews, that it was interesting to detail the model further by including additional dimensions in order to give depth to process requirements.

Additionally, it was very clear to us that model demonstration in more organizations would provide additional feedback and data which would certainly enhance the overall quality of the model.

Future iterations would also include refined activity/capability level mapping criteria with process and activity implementation guidance.

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7. Appendix

7.1 Appendix A: Expert Questionnaire

Questionnaire

ISO 20000 Incident and Service Request Management activities and generic practices identification

You are being asked to participate as a volunteer in a research project conducted by a Master student of Computer Science and Management at ISCTE-IUL (Lisbon). This study goal is to assess and validate the minimum ISO 20000 generic practices in order to usefully build a useful process maturity model.

The results of this questionnaire are confidential and only used for the purpose of this dissertation. The researcher will not identify you or your company by name in any report using information obtained from this questionnaire.

Final report will be sent to all participants, by email.

Thank you for your participation!

1. Personal information

Your Name *(optional)*	
What is your Role?	
How many Years of Experience do you have?	
How many Years of Experience with ITIL do you have?	
How many Years of Experience with ISO 20000 do you have?	

2. Experience details (optional)

Have you already assisted in ISO 20000 implementation?	
How many organizations have you assisted?	
How many ISO 20000 processes have you assisted implementation, per organization?	

3. ISO/IEC 20000 Incident and Service Request Management Activity to Outcome mapping

Please evaluate the Incident and Service Request Management ISO 20000 process activities (table 1) and required outcomes for each capability stage presented in the tables below.

According to your experience and expertise, please match **one or more activities to one capability level** (table 2 to table 10), using appropriate activity ID. Once an activity is attributed to one level, it cannot be used again.

If you find necessary to add other activities not present in this list, but used by organizations, please feel free to add them in the empty slots below, with appropriate ID.

Activity list

ID	Activity
A1	There is a procedure for incidents to define: a) Identification; b) recording; c) Allocation of priority; d) Classification; e) Updating of records? f) Updating of records? g) Escalation; h) Resolution? i) Closure
A2	This procedure is documented
A3	There is a procedure to managing the fulfilment of service requests from recording to closure
A4	This procedure is documented
A5	The incident and service requests are managed according to the procedures
A6	Prioritization of incidents: impact and urgency is taken in consideration
A7	Prioritization of service requests: impact and urgency is taken in consideration
A8	The personnel involved in incident can access and use relevant information
	The relevant information includes:
A10	- service request management procedures
A11	- known errors
A12	- problem resolutions
A13	- the CMDB
A14	The information about the success or failure of releases and future release dates, from the release and deployment management process, is being used by the incident and service request management process
A15	The customer is kept informed of the progress of their reported incident or service request
A16	When service targets cannot be met, the customer and interested parties are informed and gets escalated according to the procedure
A17	Major incidents are classified and managed according to a procedure
A18	Major incidents have a procedure
A19	This procedure documented
A20	Major incidents are managed
A21	Major incidents are managed according to documented procedure
A22	Top management is informed of major incidents
A23	Top management ensures that a designated individual responsible for managing the major incident is appointed
A24	After the agreed service has been restored, major incidents are reviewed
A25	Are they reviewed to identify opportunities for improvement

Table 1 - Incident and Service Request management activities

Process Capability indicators (Level 1 to 5)

Capability Level 1 : Performed process
1.1 - Process performance

If this Outcome is achieved means that the process purpose is attained.

ID	Attribute Outcome	Activity ID
1a	Process defined outcomes are achieved: • incidents are recorded and classified; • incidents are prioritised and analysed; • incidents are resolved and closed; • incidents which are not progressed according to agreed service levels are escalated; • information regarding the status and progress of reported incidents is communicated to interested parties.	

Table 2 - Outcomes from level 1.1

Capability Level 2 : Managed process
2.1 – Performance Management

If all Outcomes are achieved, it means the process is implemented in a managed fashion (planned, monitored and adjusted).

ID	Attribute Outcome	Activity ID
2a	Objectives for the performance of the process are identified;	
2b	Performance of the process is planned;	
2c	Performance of the process is monitored;	
2d	Performance of the process is adjusted to meet plans;	
2e	Responsibilities and authorities for performing the process are defined, assigned and communicated;	
2f	Personnel performing the process are prepared for executing their responsibilities;	
2g	Resources and information necessary for performing the process are identified, made available, allocated and used;	
2h	Interfaces between the involved parties are managed to ensure both effective communication and clear assignment of responsibility.	

Table 3 - Outcomes from level 2.1

2.2 – Work Products Management

ID	Attribute Outcome	Activity ID
2.2a	Requirements for the work products of the process are defined;	
2.2b	Requirements for documentation and control of the work products are defined;	
2.2c	Work products are appropriately identified, documented, and controlled;	
2.2d	Work products are reviewed in accordance with planned arrangements and adjusted as necessary to meet requirements.	

Table 4 - Outcomes from level 2.2

Capability Level 3 : Established process

3.1 – Process Definition

ID	Attribute Outcome	Activity ID
3a	A standard process, including appropriate tailoring guidelines, is defined and maintained that describes the fundamental elements that must be incorporated into a defined process;	
3b	The sequence and interaction of the standard process with other processes are determined.	
3c	Required competencies and roles for performing the process are identified as part of the standard process;	
3d	Required infrastructure and work environment for performing the process are identified as part of the standard process;	
3e	Suitable methods and measures for monitoring the effectiveness and suitability of the process are determined.	

Table 5 - Outcomes from level 3.1

3.2 – Process Deployment

ID	Attribute Outcome	Activity ID
3.2a	A defined process is deployed based upon an appropriately selected and/or tailored standard process;	
3.2b	Required roles, responsibilities, and authorities for performing the defined process are assigned and communicated;	
3.2c	Personnel performing the defined process are competent on the basis of appropriate education, training, and experience;	
3.2d	Required resources and information necessary for performing the defined process are made available, allocated and used;	
3.2e	Required infrastructure and work environment for performing the defined process is made available, managed and maintained;	
3.2f	Appropriate data are collected and analyzed as a basis for understanding the behavior of the process, to demonstrate the suitability and effectiveness of the process, and to evaluate where continual improvement of the process can be made.	

Table 6 - Outcomes from level 3.2

Capability Level 4 : Predictable process

4.1 – Quantitative Analysis

ID	Attribute Outcome	Activity ID
4.1a	The process is aligned with quantitative business goals;	
4.1b	Process information needs in support of relevant defined quantitative business goals are established;	

4.1c	Process measurement objectives are derived from process information needs;	
4.1d	Measurable relationships between process elements that contribute to the process performance are identified;	
4.1e	Quantitative objectives for process performance in support of relevant business goals are established;	
4.1f	Appropriate measures and frequency of measurement are identified and defined in line with process measurement objectives and quantitative objectives for process performance;	
4.1g	Results of measurement are collected, validated and reported in order to monitor the extent to which the quantitative objectives for process performance are met.	

Table 7 - Outcomes from level 4.1

4.2 – Qualitative Control

ID	Attribute Outcome	Activity ID
4.2a	Techniques for analyzing the collected data are selected;	
4.2b	Assignable causes of process variation are determined through analysis of the collected data;	
4.2c	Distributions that characterize the performance of the process are established;	
4.2d	Corrective actions are taken to address assignable causes of variation;	
4.2e	Separate distributions are established (as necessary) for analyzing the process under the influence of assignable causes of variation.	

Table 8 - Outcomes from level 4.2

Capability Level 5 : Innovating process

5.1 – Process Innovation

ID	Attribute Outcome	Activity ID
5.a	Process innovation objectives are defined and support the relevant business goals;	
5.b	Appropriate data are analyzed to identify opportunities for innovation;	
5.c	Innovation opportunities derived from new technologies and process concepts are identified;	
5.d	An implementation strategy is established to achieve the process innovation objectives.	

Table 9 - Outcomes from level 5.1

5.2 – Process Innovation Implementation

ID	Attribute Outcome	Activity ID
5.2a	Impact of all proposed changes is assessed against the objectives of the defined process and standard process;	
5.2b	Implementation of all agreed changes is managed to ensure that any disruption to the process performance is understood and acted upon;	
5.2c	Effectiveness of process change on the basis of actual performance is evaluated against the defined product requirements and process objectives.	

Table 10 - Outcomes from level 5.2

4. Final questions

According to your experience, what are ISO 20000 major implementation difficulties in organizations?	
Do you find Incident and Service Request management process important in an organization? Why?	
Taking into account the goal of this proposal, do you think its complete?	
What would you add / change in this proposal?	
Taking into account your experience, do you think it will be useful? Why?	
Do you think it could be used to assess any organization, from SMBs to big organizations?	

7.2 Appendix B: Organization Questionnaire

Questionnaire

ISO 20000 Incident and Service Request Management

Process Assessment and Maturity

You are being asked to participate as a volunteer in a research study conducted by a Master student of Computer Science and Management at ISCTE-IUL (Lisbon). This study is designed to assess the maturity of processes according to ISO/IEC 20000 requirements on selected companies with established IT departments.

The results of this questionnaire are confidential and only used for the purpose of this dissertation. The researcher will not identify you or your company by name in any report using information obtained from this questionnaire;

Final report and results will be sent to all participants, by email.

1. Personal information

Your Name *(optional)*	
What is your Role?	
How many Years of Experience do you have?	

2. Company information

What is your Organization name *(optional)*	
Organization Industry	
Total employees on IT Department	
Total employees on Organization	

3. ITSM information

Does the company have all resolution processes (incident, service request and problem management) implemented?	Y ☐ / N ☐
Did the company follow ITIL framework?	Y ☐ / N ☐ / Don't know ☐
Did the company follow ISO/IEC 20000 standard guidelines?	Y ☐ / N ☐ / Don't know ☐
Is the company aiming to achieve ISO 20000 certification?	Y ☐ / N ☐ / Don't know ☐

4. Incident and Service Request Management Process Assessment

Please evaluate process activities and outcomes already implemented in your organization and reply accordingly. If in doubt or if you don't fully fulfil the requirement, please answer "NO".

ID	Activity	Implemented? (Y / N)
IS.1	Is there a procedure for incidents to define: a) Identification; b) recording; c) Allocation of priority d) Classification; e) Updating of records f) Updating of records g) Escalation; h) Resolution i) Closure	Y ☐ / N ☐
IS.2	Is this procedure documented?	Y ☐ / N ☐
IS.3	Is there a procedure to managing the fulfilment of service requests from recording to closure?	Y ☐ / N ☐
IS.4	Is this procedure documented?	Y ☐ / N ☐
IS.5	Are incident and service requests managed according to the procedures?	Y ☐ / N ☐
IS.6	Prioritization of incidents - Do you take in consideration impact and urgency?	Y ☐ / N ☐
IS.7	Prioritization of service requests Do you take in consideration impact and urgency?	Y ☐ / N ☐
IS.8	Does personnel involved in incident can access and use relevant information?	Y ☐ / N ☐
	Does the relevant information include:	
IS.10	- service request management procedures?	Y ☐ / N ☐
IS.11	- known errors?	Y ☐ / N ☐
IS.12	- problem resolutions?	Y ☐ / N ☐
IS.13	- the CMDB?	Y ☐ / N ☐
IS.14	Is the information about the success or failure of releases and future release dates, from the release and deployment management process, being used by the incident and service request management process?	Y ☐ / N ☐
IS.15	Do you keep the customer informed of the progress of their reported incident or service request?	Y ☐ / N ☐
IS.16	If service targets cannot be met, do you inform the customer and interested parties and escalate according to the procedure?	Y ☐ / N ☐
IS.17	Are major incidents classified and managed according to a procedure?	Y ☐ / N ☐
IS.18	Do major incidents have a procedure?	Y ☐ / N ☐
IS.19	Is this procedure documented?	Y ☐ / N ☐
IS.20	Are major incidents managed?	Y ☐ / N ☐
IS.21	Are major incidents managed according to documented procedure?	Y ☐ / N ☐
IS.22	Is top management informed of major incidents?	Y ☐ / N ☐
IS.23	Does top management ensure that a designated individual responsible for managing the major incident is appointed?	Y ☐ / N ☐
IS.24	After the agreed service has been restored, are major incidents reviewed to identify opportunities for improvement?	Y ☐ / N ☐
IS.25	Are they reviewed to identify opportunities for improvement?	Y ☐ / N ☐
IS.26	Process metrics for efficiency, effectiveness/quality, compliance, and customer satisfaction/business alignment are defined, measured, analyzed and reported.	Y ☐ / N ☐
IS.27	The process owner establishes: - Responsibilities and authorities for process are defined, assigned and communicated (through process description and/or RACI matrix) by the process owner; Resources and information for the process are identified, made available, allocated and used: and manages interfaces between involved parties.	Y ☐ / N ☐

IS.28	Personnel is trained in the incident and service request processes	Y ☐ / N ☐
IS.29	Change management includes incident and service request improvement change types	Y ☐ / N ☐

5. Final evaluation questions

Considering your experience, do you find that a Maturity for ISO 20000 and its processes is important? Why?	
Do you find Incident and Service Request management process important in an organization? Why?	
Taking into account the goal of this proposal, do you think its complete? What would you change or add?	
Do you think this model could be used to assess organization from any size, from SMBs to big organizations?	