ISCTE Business School
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USING BPM TO IMPROVE IT SERVICE MANAGEMENT: AN INCIDENT MANAGEMENT CASE STUDY

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Abstract

Business process management is a methodology focused on the continuous improvement of business processes, providing for this a collection of best practices. These best practices enable the redesign of business processes to meet the desired performance. By using this methodology, organisations can improve their business processes to achieve their objectives.

IT service management defines the management of IT operations as a service. There are several IT service management frameworks available, consisting in best practices that propose standardizing these processes for the respective operations. By adopting these frameworks, organisations can align IT with their business objectives.

The objective of this research is to understand how business process management can be applied for the improvement of IT service management processes. To achieve this goal, a case study is conducted for the improvement of the time performance of an incident management process, as it is a process that, to the best of our knowledge, has not been analysed for this objective.

The results obtained identified three best practices – activity automation, activity elimination and integral technology – as the best suited for the improvement of the time performance of the analysed incident management process. Using a simulation tool for business processes, it was revealed that the employment of these best practices in the analysed incident management process eliminates the effort required in the 1st support level and reduces in 10.7% the average processing time in the 2nd support level.

Keywords: business process management; IT service management; process improvement; incident management

JEL Classification System: Business Administration: IT Management (M15); Dissertation (Y40)

Resumo

A gestão de processos de negócio é uma metodologia focada na melhoria contínua de processos de negócio, indicando para isso um conjunto de melhores práticas. Estas melhores práticas permitem o redesenho dos processos de negócio para obter o desempenho desejado. Através da aplicação desta metodologia, as organizações conseguem melhorar os seus processos de negócio para alcançarem os seus objectivos de negócio.

A gestão de serviços de TI define a gestão das operações de TI como um serviço. Existem divesas frameworks para gestão de serviços de TI, consistindo em melhores práticas que propõem processos-padrão de TI para as respectivas operações. Com a adopção de frameworks, as organizações conseguem alinhar as TI com os seus objectivos de negócio.

O objectivo desta investigação é perceber como é que a gestão de processos de negócio pode ser aplicada para a melhoria de processos de gestão de serviços de TI. Para atingir este objectivo, é conduzido um caso de estudo para a melhoria de desempenho do tempo num processo de gestão de incidentes, sendo este um processo que, de acordo com o conhecimento adquirido, ainda não foi analisado com este objectivo.

Os resultados obtidos identificaram três melhores práticas – automação de atividades, eliminação de atividades e introdução de novas tecnologias – como as mais ajustadas para a melhoria de desempenho do tempo no processo de gestão de incidentes analisado. Recorrendo a uma ferramenta de simulação de processos de negócio, foi revelado que a aplicação destas melhores práticas no processo de gestão de incidentes analisado elimina o esforço necessário no 1º nível de suporte e reduz em 10.7% o tempo médio de processamento no 2º nível de suporte.

Palavras-chave: gestão de processos de negócio; gestão de serviços de TI; melhoria de processos; processo de gestão de incidentes

Sistema de Classificação JEL: Gestão de Negócios: Gestão de TI (M15); Dissertação (Y40)

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1. Introduction

1.1.Theme

Change is a constant in business environments. Classic management authors, such as Porter (1980), helped to understand that change, whether of the internal or of the external environment, affects organisations and that it is an issue that should be addressed. As Harmon (2014: 19) argues, “change and relentless competition call for constant innovation and for constant increases in productivity, and those, in turn, call for an even more intense focus on how work gets done. To focus on how the work gets done is to focus on business processes”. This means a continuous call for business process (BP) change and improvement (Harmon, 2014). For this challenge, business process management (BPM) appears as a discipline for the management of BPs focused on continuous improvement (Dumas *et al.*, 2013). Aalst (2013: 1) argues that BPM has the “potential for significantly increasing productivity and saving costs” and also states that “BPM has a broader scope: from process automation and process analysis to operations management and the organization of work”, providing different ways to approach change and to improve BPs. Best practices have been proposed for improvement initiatives, consisting in redesign heuristics to modify BPs and align them with business objectives (BO) (Mansar and Reijers, 2007; Hanafizadeh *et al.*, 2009).

With the increasingly pressing developments in communication and technology, IT is seen today as “an integral part and fundamental to support, sustain, and grow a business” (Mohamed *et al.*, 2012: 1), being impossible for many organisations to function and succeed without it (Sallé, 2004). IT became a complex and dynamic landscape in organisations (Jamous *et al.*, 2016). With this, came the need to align IT operations with the BO, which led gradually to the *servitization* of IT operations (Conger *et al.*, 2008). Thus, IT service management (ITSM) arose. In order to help organisations to perform ITSM, several IT frameworks were proposed, providing managers and organisations with customer-centred sets of processes and best-practices, for managing IT operations and aligning them with their BO (Marrone and Kolbe, 2011). As the literature shows (Galup *et al.*, 2009; de Sousa Pereira and Mira da Silva, 2012; Valiente *et al.*, 2012; Iden and Eikebrokk, 2013), the most used of these frameworks is Information Technology Infrastructure Library (ITIL). A recent report about the current state of ITSM indicates that 47% of the surveyed IT managers employ ITIL or some of its processes in their ITSM strategy, being the most adopted IT framework (BMC and Forbes Insights, 2017).

1.2. Objectives

The constant need for change, competitiveness and innovation in organisations compels managers to analyse its BPs and find improvement opportunities (Harmon, 2014). Being BPM a discipline that integrates process-oriented improvement initiatives (Mahy *et al.*, 2016), it is relevant to understand if it can be employed to improve IT services, which are based on processual ITSM frameworks. This research focuses on revealing how BPM can be employed for the improvement of the ITIL's incident management process (IM process), one of the most adopted ITSM processes (Gupta *et al.*, 2008; TSO, 2011; Mahy *et al.*, 2016). Being an underexplored topic, an exploratory case study is conducted to elicit qualitative insights, following the methodology proposed by Yin (2009). Table 1 presents the objectives of this dissertation.

ID	Objectives
1	Explore the relationship between BPM and ITSM processes
2	Understand how BPM can improve the IM process
3	Produce managerial recommendations for improvement of the IM process

Table 1 - Objectives of the dissertation

1.3. Structure

This dissertation consists of five chapters, among which this first chapter is included, as an introduction to the subject and to the research problem.

The second chapter is where a literature review is conducted to explore and understand the state-of-the-art of the problem research on this dissertation.

In the third chapter, the methodology used in this research is presented, describing the rational process applied to perform this study and answer the research questions.

The fourth chapter is dedicated to the conduction of the case study, following the established plan in the third chapter. The results are presented, and some managerial recommendations are produced based on those results. Discussion and comparison of the results with the related work found in the second chapter is also performed.

In the fifth chapter, formal conclusions about the whole research performed are developed.

2. Literature Review & Theoretical Background

This section introduces the main concepts and topics addressed by this dissertation, providing a solid theoretical foundation for the further development of the research, by exploring its underlying main topics: BPM, BP improvement, ITSM and IM process.

2.1.Business Process Management

Although the focus on BPs only emerged in the 1990's with the works published by Davenport & Short and Hammer & Champy (Roeser and Kern, 2015), BPs have always been part of the organisations, whether in a formal or informal ways. BPs define the tune and performance of an organisation when delivering a service or a product to a customer (Dumas *et al.*, 2013).

One of the most known definitions is given by Davenport (1993: 5), stating that a BP is "a structured, measured set of activities designed to produce a specified output for a particular customer or market. It implies a strong emphasis on how work is done within an organisation, in contrast to a product focus's emphasis on what. A process is thus a specific ordering of work activities across time and space, with a beginning and an end, and clearly defined inputs and outputs: a structure for action". Dumas *et al.* (2013: 5), in a 20-year updated definition, establish "business process as a collection of inter-related events, activities and decision points that involve a number of actors and objects, and that collectively lead to an outcome that is of value to at least one customer".

BPs allow organisations to reach its BOs efficiently and effectively by enabling the coordination and connection of its resources (Weske, 2012). Thus, the management and improvement of BPs is vital for organisations, as it allows to achieve BOs while also coping with change (Harmon, 2014).

2.1.1. Definition & Evolution

According with Kohlbacher (2010), process-oriented organisations apply BPM. Today, several works and authors addressing BPM can be found in the literature, reflecting that BPM is a mature discipline (Aalst, 2013). This is evidenced also by the growth in the number of conferences and journals dedicated to the matter (Houy *et al.*, 2011).

Thus, several definitions of BPM are found in the literature, as Table 2 exemplifies.

Authors	Definition
Weske (2012: 5)	"Business process management includes concepts, methods, and techniques to support the design, administration, configuration, enactment, and analysis of business processes."
Aalst (2013: 1)	"Business process management is the discipline that combines knowledge from information technology and knowledge from management sciences and applies this to operational business processes."
Dumas *et al.* (2013: 1)	"Business process management is the art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities."

Table 2 - Definitions of business process management

Several other definitions can be found in the literature. Harmon (2010) explain BPM as the result and evolution of three BP traditions (see Figure 1):

- Business management (ex: Michael Porter's management theories, balanced scorecard).
- Work simplification/quality control (ex: total quality management, six sigma).
- IT tradition (ex: BP reengineering, enterprise resource planning).

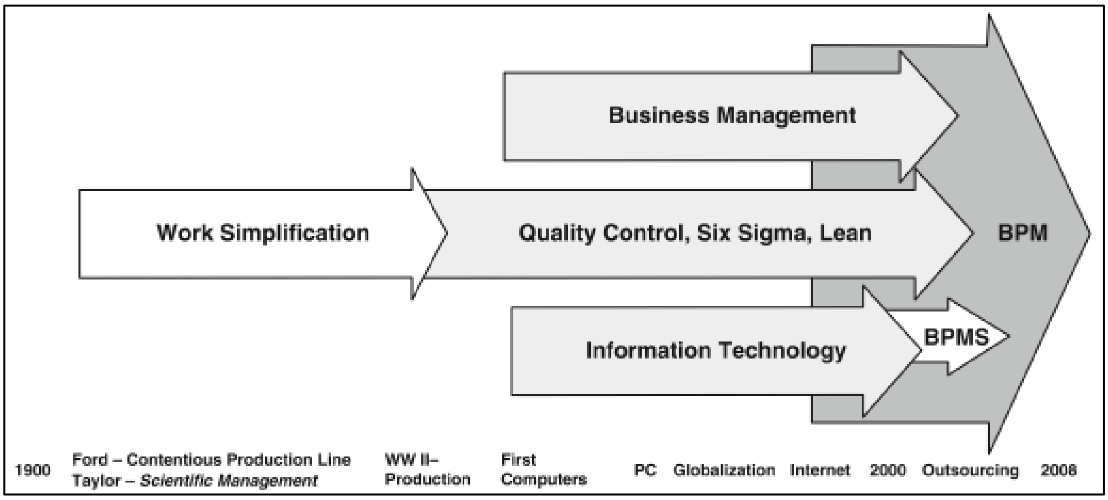

Figure 1 - The three business process traditions described by Harmon (2014: 38)

Authors such Dumas *et al.* (2013), Harmon (2010), and Aalst (2013) trace the origins of BPM back to Taylorism and Fordism, to Adam Smith's division of labour, and even mention the evolution of workers' capabilities since the prehistoric times.

2.1.2. Business Process Management Lifecycle

BPM, by implying a continuous commitment to manage BPs, requires a lifecycle methodology with structured steps and feedback that establish a managerial practice in organisations, which is the premise for continuous improvement and to meet the BOs (de Morais *et al.*, 2014). This BPM lifecycle is based in principles such as modelling and documentation of BP, customer-orientation, constant assessment of the performance of BP, a continuous approach to optimization and improvement, following best practices for superior performance, and organisational culture change (Pyon *et al.*, 2011). Several BPM lifecycle proposals appeared, contributing for the growth of BPM as a concept. Figure 2 depicts the BPM lifecycle proposed by Dumas *et al.* (2013), as example.

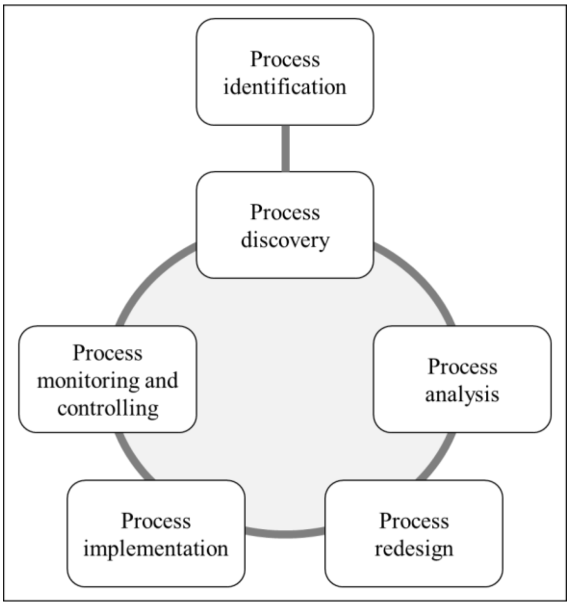

Figure 2 - Business process management lifecycle proposed by Dumas e*t al.* (2013)

Authors such as Hammer (2010), Houy *et al.* (2011), Weske (2012), Aalst (2013) and de Morais *et al.* (2014) also proposed BPM lifecycles, all of them consisting in structured methodologies targeted at the continuous monitoring and improvement of BP, which include concepts, tools, techniques and methods from the different BP traditions. By applying BPM lifecycles, organisations can address BP change and identify the improvements required to achieve the desired BOs (Harmon, 2010; Dumas *et al.*, 2013). Different proposals of BPM lifecycles can be found in the literature.

2.2. Heuristic-based Business Process Improvement

"Every good process eventually becomes a bad process. No process stays effective forever in the face of change" (Hammer, 2010: 12). As concluded by Harmon (2014), to adapt to change and answer to competition, BPs must be continuously changed and improved. In modern organisations, where BPs are the functional basis for work, BP improvement initiatives can not be put aside (Kohlbacher, 2010). Until BPM appeared, BP improvement initiatives were scarce, unplanned and often involuntary, being more a consequence of other actions, since the focus was not in BP (Dumas *et al.*, 2013). However, this changed with BPM.

2.2.1. Performance Improvement

BPM lifecycle requires organisations to continuously assess how the BP performance is (Dumas *et al.*, 2013; de Morais *et al.*, 2014). Whenever the BOs established by the organisations are no longer met, BPs must be targeted for improvement initiatives (Aalst *et al.*, 2016). BOs consist in key performance indicators (KPI) that are based in performance dimensions, meaning that any BP improvement initiative should meet the performance dimensions that consist the KPIs, and thus the BOs of the organisation (Dumas *et al.*, 2013; Aalst *et al.*, 2016). Usually, these KPIs concern performance dimensions such as time, cost, quality and flexibility (Mansar and Reijers, 2007; Dumas *et al.*, 2013; Aalst *et al.*, 2016). Figure 3 depicts the trade-offs existing between those four performance dimensions. Awareness of these trade-offs is imperative for any BP improvement initiative, being the performance dimensions the measures in which a BP improvement is evaluated (Aalst *et al.*, 2016).

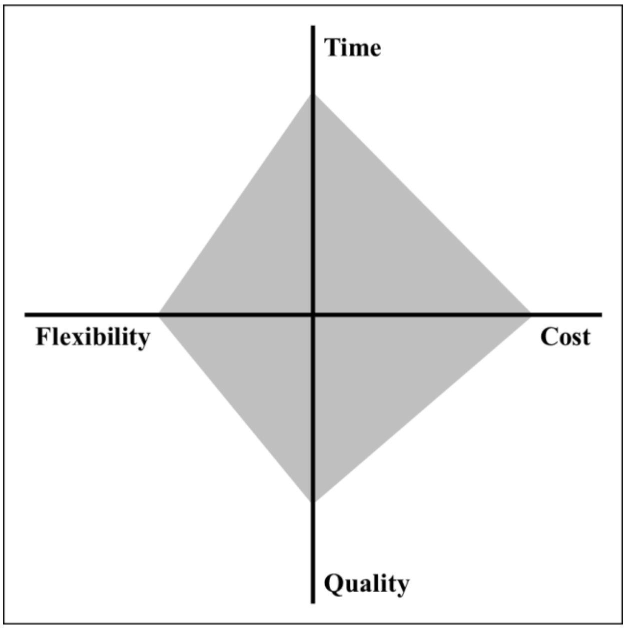

Figure 3 - Trade-offs between performance dimensions, adapted from Dumas *et al.* (2013)

2.2.2. Redesign Heuristics

BPM methodologies follow the best practices existent for the improvement of BPs (Pyon *et al.*, 2011; de Morais *et al.*, 2014). The work of Dumas *et al.* (2013) suggests a framework with heuristics identified as best practices for the improvement of BP, shown in Table 3.

Category	Redesign heuristics	Impact in the performance dimensions			
		Time	Cost	Quality	Flexibility
Customer	Control relocation	.	-	+	.
	Contact reduction	+	-	+	.
	Integration	+	+	.	-
Business process operation	Case types	+	+	-	-
	Activity elimination	+	+	-	.
	Case-based work	+	-	.	.
	Triage	.	-	+	-
	Activity composition	+	+	.	-
Business process behaviour	Resequencing	+	+	.	.
	Parallelism	+	-	.	-
	Knock-out	-	+	.	.
	Exception	+	-	+	-
Organisation structure	Case assignment	.	.	+	-
	Flexible assignment	+	-	.	+
	Centralization	+	-	.	+
	Split responsibilities	.	.	+	-
	Customer teams	.	.	+	-
	Numerical involvement	+	-	.	-
	Case manager	.	-	+	.
Organisation population	Extra resources	+	-	.	+
	Specialist-generalist	+	.	+	-
	Empower	+	.	-	+
Information	Control addition	-	-	+	.
	Buffering	+	-	.	.
Technology	Activity automation	+	-	+	-
	Integral technology	+	-	.	.
External environment	Trusted party	+	+	.	-
	Outsourcing	+	+	.	-
	Interfacing	+	.	+	-

Table 3 - Framework presented by Dumas *et al.* (2013)

This framework presents a total of 29 BP redesign heuristics, each one corresponding to a best practice for BP improvement identified in the literature (Dumas *et al.*, 2013). This framework categorizes those BP redesign heuristics by nature and details the impact of the employment of each one of them in four performance dimensions. Concluding, the framework of Dumas *et al.* (2013) provides a set of best practices that organisations can employ to redesign BP, in order to improve BP performance, according with the BOs.

2.3. IT Service Management

The new millennium saw an evolution of the IT functions within organisations (Sallé, 2004). Where before there were technology-oriented IT functions, today IT functions aim at providing IT services to organisations (Sallé, 2004; Galup *et al.*, 2009; Marrone and Kolbe, 2011). The concept behind this is ITSM, that is focused in the servitization of IT and enables organisations to manage IT function as another business unit (Conger *et al.*, 2008; Valiente *et al.*, 2012).

2.3.1. Definition

ITSM concept is well established in the literature, with several works produced around this topic (Iden and Eikebrokk, 2013). Some authors lay definitions for ITSM, as Table 4 presents.

Authors	**Definition**
Galup *et al.* (2009: 124)	"Information Technology Service Management (ITSM) is a subset of Service Science that focuses on IT operations such as service delivery and service support."
Mesquida *et al.* (2012: 240)	"ITSM is a process-oriented discipline which combines process management and industry best practices into a standard approach for optimizing IT services."
Iden and Eikebrokk (2013: 512)	"ITSM is defined as an approach to IT operations that is characterized by its emphasis on IT services, customers, service level agreements, and an IT function's handling of its daily activities through processes."

Table 4 - Proposed definitions of IT service management

Other definitions can be found in the literature. As Winniford *et al.* (2009) state, ITSM has grown as a concept due to the appearance of ITSM frameworks.

2.3.2. IT Service Management Frameworks

In the 1980s, with the growing complexity of IT and the pressure to manage IT functions like a business unit, several ITSM frameworks started to be developed based on concept of service management (Conger *et al.*, 2009; Melendez *et al.*, 2016). These ITSM frameworks consist in standards that collect the best practices for IT management and propose IT processes for IT operations, which allows organisations to meet their BOs by providing IT services effectively, assuring their quality by establishing service level agreements (SLA) (Winniford *et al.*, 2009; de Sousa Pereira and Mira da Silva, 2012; Mesquida *et al.*, 2012; Melendez *et al.*, 2016).

Figure 4 indicates the top five most used ITSM frameworks by organisations, according with the report of BMC and Forbes Insights (2017).

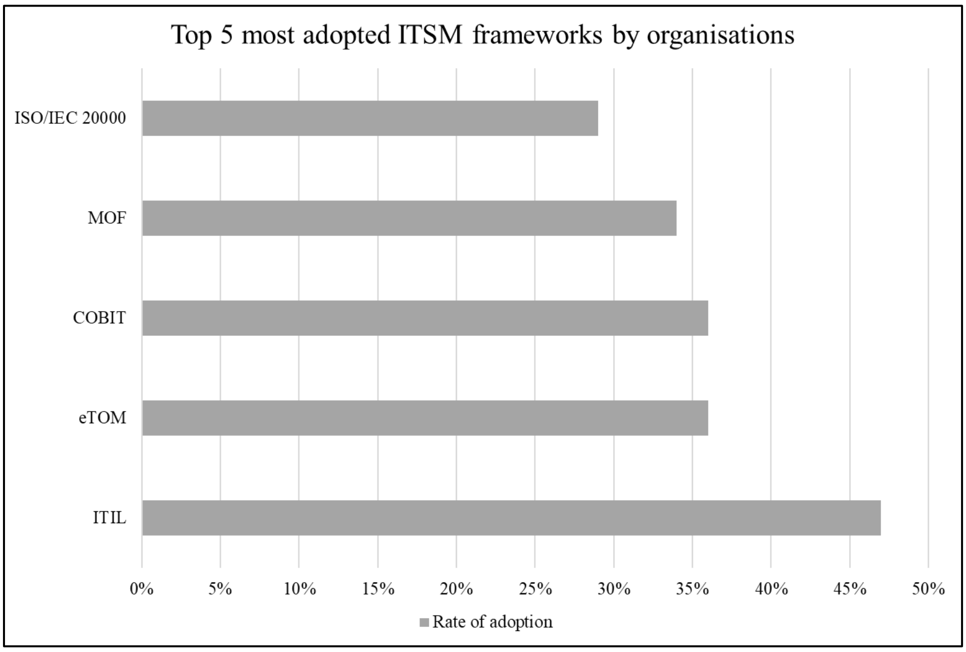

Figure 4 - Top five most adopted IT service management frameworks by organisations

The chart shows that ITIL, with a 47% rate of adoption, is the most adopted ITSM framework by organisations. ITIL is the oldest and best-established ITSM framework, having had its last version published in 2011 (Iden and Eikebrokk, 2013).This framework consists in five books that cover the IT service lifecycle and establish a total of 26 IT processes regarded as best practices for the effective management of IT services (Ghrab *et al.*, 2016; Mahy *et al.*, 2016). One realizes that, when adding all the five rates of adoption, the total value is over 100%. According with the report, this is due to the adoption of more than one ITSM framework by organisations, which indicates that these frameworks complement each other (BMC and Forbes Insights, 2017).

2.4. Incident Management Process

As seen in the previous sections, ITSM frameworks define IT processes to provide IT services, being ITIL the most adopted framework by organisations. One of the best practices proposed by the ITIL framework is the IM process.

The IM process is established in the ITIL 4th volume *Service Operation*, as the process "responsible for managing the lifecycle of all incidents" (TSO, 2011). An incident is an abnormal event that leads to an error or failure in IT systems, compromising the quality of IT services (Gupta *et al.*, 2008; TSO, 2011; Ghrab *et al.*, 2016). So, the goal of the IM process is to restore IT services to a normal operational status in the minimum time possible with the least impact on the business operations (Gupta *et al.*, 2008; TSO, 2011; Ghrab *et al.*, 2016).

The value that this process brings to organisations includes the reduction of costs caused by incidents, a low downtime of IT services, the ability to align IT with BOs and to identify potential improvements to the IT services, which causes the IM process to be highly visible to organisations (TSO, 2011). Due to this high visibility, the IM process is often one of the first processes to be implemented in ITSM initiatives, as it is possible to measure its immediate effects (Gupta *et al.*, 2008; TSO, 2011; Valiente *et al.*, 2012).

Figure 5 shows the workflow proposed by ITIL for the IM process (TSO, 2011). This workflow suggests the activities that should be conducted for the processing and resolution of incidents, suggesting also the structuring of the IM process in different functional levels (TSO, 2011).

Considering that the IM process is one of the most implemented ITSM processes and also that ITIL is the most adopted ITSM framework by organisations (Gupta *et al.*, 2008; Coelho and Cunha, 2009; TSO, 2011; de Sousa Pereira and Mira da Silva, 2012; Valiente *et al.*, 2012; Ghrab *et al.*, 2016), this research will focus its efforts on understanding how this specific process can be improved through a BPM approach.

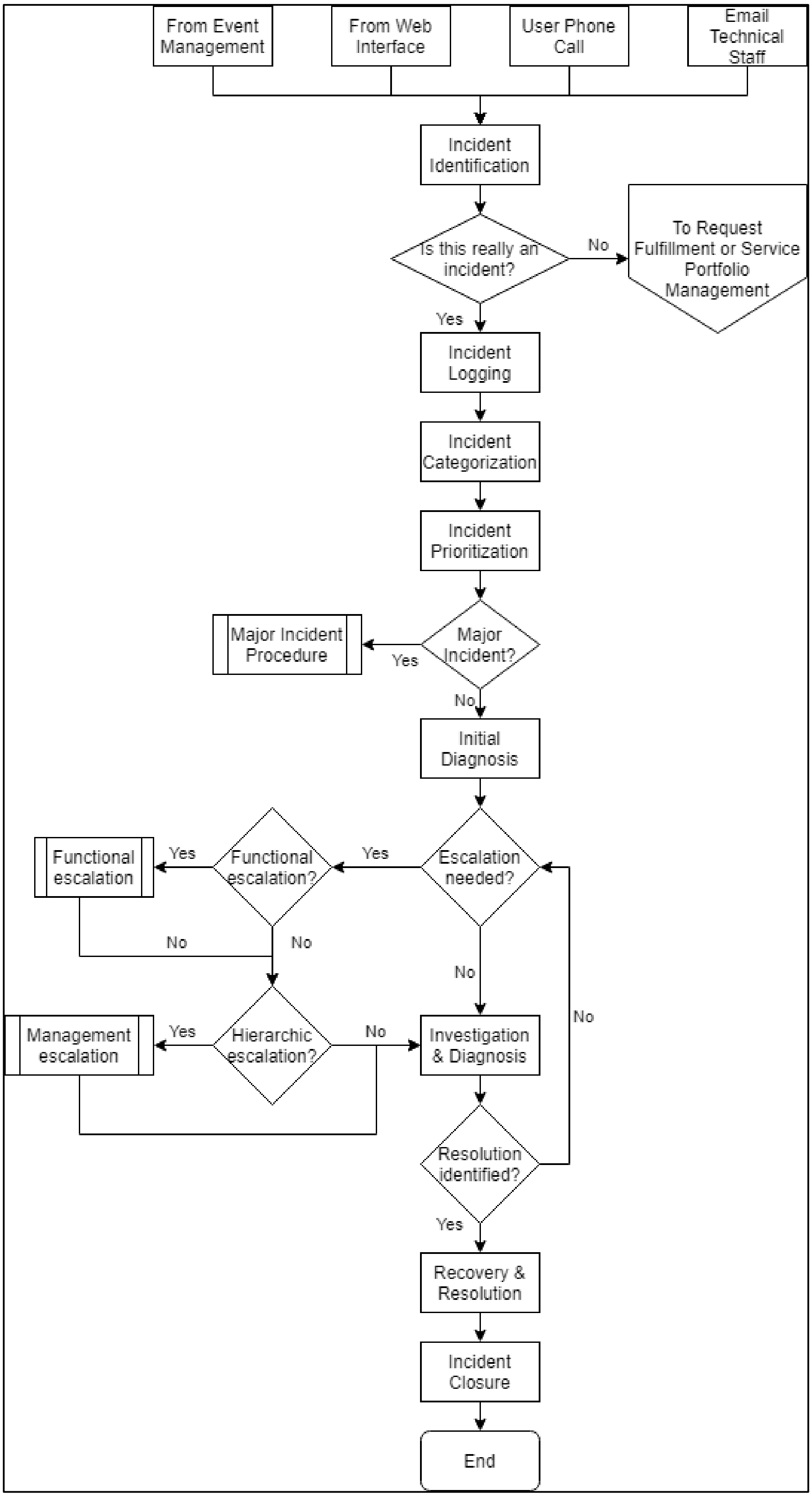

Figure 5 - Incident management process workflow, according with TSO (2011)

2.5.Related work

Galup *et al.* (2009: 125) state "because ITSM is process-focused, it shares a common theme with the process improvement movement (such as, TQM, Six Sigma, Business Process Management, and CMMI)". This section presents the literature review performed to collect existing related work on the improvement of IM process through BPM.

The related work found can be divided in two categories: improvement of the IM process and BP improvement through BPM. Table 5 presents the examples found of work developed on the improvement of the IM process.

Authors	Publication	Improvement method
Ghrab *et al.* (2016)	3rd International Conference on Artificial Intelligence and Pattern Recognition	Automation through constraint programming
Goby *et al.* (2016)	24th European Conference on Information Systems	Automation through business intelligence
Trinkenreich *et al.* (2015)	27th International Conference on Software Engineering and Knowledge Engineering	Automation through business intelligence
Salah *et al.* (2015)	Journal of Network and Systems Management	Incident correlation model
Bezerra *et al.* (2014)	9th International Conference on the Quality of Information and Communications Technology	Optimization through the reuse of experiences and natural language processing techniques
Bartolini *et al.* (2008)	19th IFIP/IEEE International Workshop on Distributed Systems	Optimization through discrete event simulator
Gupta *et al.* (2008)	5th IEEE International Conference on Autonomic Computing	Automation through incident correlation

Table 5 - Related work on the improvement of the IM process

The related work found for the improvement of the IM process revealed that most of the work developed is technology-oriented, with different methods and techniques being applied for technological improvement solutions. Automation and incident correlation are the most common improvement methods found.

Table 6 presents examples of works developed on BP improvement through BPM.

Authors	**Publication**	**Area**
Sanka Laar and Seymour (2017)	13th European Conference on Management, Leadership & Governance	Small and medium enterprises
Rebuge and Ferreira (2012)	Journal of Information Systems	Healthcare services
Netjes *et al.* (2010)	Workshops of 7th International Conference on Business Process Management	Healthcare services
Becker *et al.* (2007)	13th Americas Conference on Information Systems	Healthcare services
Küng and Hagen (2007)	Business Process Management Journal	Banking services
Hertz *et al.* (2001)	Supply Chain Management: An International Journal	Automotive industry
Ferretti and Schiavone (2016)	Business Process Management Journal	Operations in seaports
Rinaldi *et al.* (2015)	Business Process Management Journal	Public administration
Haddad *et al.* (2016)	Business Process Management Journal	Non-profit organisations

Table 6 - Related work on the BP improvement through BPM

Several more related works were found concerning BP improvement through BPM, being the most common example located in healthcare services.

Although several examples were found in each of the two categories mentioned, there was not a single work found concerning the improvement of IM process through a BPM approach, the topic of this research. Two examples were found that slightly approached this topic:

- The work of Mahy *et al.* (2016), published in the 3rd International Conference on Systems of Collaboration, that only modelled the IM process.
- The work of Bezerra *et al.* (2014), published in the 9th International Conference on the Quality of Information and Communications Technology, that also only modelled the IM process.

The review of related work in the literature did not provided a single reference on the topic approached by this research, which leads to the conclusion that this topic is not explored.

3. Research Methodology

This chapter describes the research methodology followed in this research, presenting also the unit of analysis selected and the plan for the collection of evidence.

3.1.Exploratory Case Study

As the previous chapter concludes, studies found concerning the application of BPM in IT processes are scarce. So, it justifies the classification of this research as exploratory in its nature. Exploratory analysis is one of three purposes for conducting a research, where there are none or few prior works presented on the subject studied (Zainal, 2007; Yin, 2009). Plus, the same authors also argue that case study is the traditional methodology for this kind of research.

The definition of case study given by Yin (2009: 18) is that it "is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident".

Runeson and Höst (2009) argue that the case study methodology has exploration as primary objective, to which Zainal (2007: 1) adds that the nature of case studies is to "explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions, and their relationships". Thus, this research follows the case study methodology proposed by Yin (2009).

Following Yin (2009) recommendations, a research question is formulated, in Table 7, to fulfil the purpose of this study.

ID	Research question
RQ 1	What are the BPM redesign heuristics that best suit IM process improvement?

Table 7 - Research question for the case study

This question will guide the author in the research for a common ground between BPM and a ITSM process that has not been much explored.

3.2. Case Study Design

Table 8 presents the methodology proposed by Yin (2009) for the conduction of the case study research. Although the author defines these stages as part of a logical case study process, he also argues that this process is iterative and has a certain degree of flexibility, allowing repetitions and parallelisms in its execution.

The case study research will take place between September 4th 2017, and July 4th 2018, being the unit of analysis a single team. Therefore, according with Yin (2009), this research follows a single case study design.

Theory is essential for the design and conduction of a case study (Yin, 2009). Thus, a revision of the literature concerning the main topics implicit in this study is developed in the Chapter 2, providing solid theoretical fundaments for the remaining exploratory research.

To assure the quality of the case study results, the four validity tests of Yin (2009) are pursued throughout the research. The validity of the case study will be analysed in Chapter 6.

Stages	**Description**	**Chapters & Sections**
Plan	Identify case study as the adopted methodology and define research questions	1.2 Problem and Objectives 3.1 Exploratory Case Study
Design	Identify the specific case study design and establish its logic and quality procedures	3.2 Case Study Design 3.3 Unit of Analysis
Prepare	Define the protocols and develop the skills to collect case study evidence	3.4 Prepare to Collect Evidence
Collect	Follow the protocols and collect evidence from different sources, building and maintaining a chain of evidence	4. Conduction of the Case Study
Analyse	Conduct the analysis and interpretation of the collected evidence	4. Conduction of the Case Study
Share	Develop conclusions related to data analysis results and compose a case study reporting	4.4 Summary and Recommendations 4.5 Discussion

Table 8 - Case study stages, adapted from Yin (2009)

Being the objective of this research to understand how BPM can improve the IM process, the Dumas *et al.* (2013) lifecycle proposal will be applied in Chapter 4. Therefore, the sections in that chapter are organized according with the performed lifecycle phases. The *Collect* and *Analyse* stages of the Yin (2009) case study methodology will be executed hand-in-hand within each one of those phases, included as subsections, which is allowed by the stated degree of flexibility existing in this methodology. This approach for the conduction of the case study, as presented in Table 9, is chosen because it is the most appropriate for a process-oriented analysis and redesign, and it is a recent and broader methodology that encompasses several methods and tools of different BP traditions, as seen in the literature review. Being a case study with an already defined objective and unit of analysis, in which the IM process is the case of interest, the *Process Identification* is not performed, since it is not required. Due to limitation imposed by the organisation, the Dumas *et al.* (2013) lifecycle will be executed only until the *Process Redesign* phase, being the *Process Implementation* and the *Process Monitoring and Controlling* phases not possible to be performed. However, this does not prevent the conduction of the case study nor the achievement of the objectives presented.

Chapter	**Sections**	**Subsections**
4. Conduction of the Case Study	4.1 Process discovery	4.1.1 Collection of Evidence 4.1.2 Analysis of Evidence
	4.2 Process analysis	4.2.1 Collection of Evidence 4.2.2 Analysis of Evidence
	4.3 Process redesign	4.3.1 Collection of Evidence 4.3.2 Analysis of Evidence

Table 9 - Structure for the conduction of the case study

To support the conduction of the case study, a specific BPM system will be utilized as tool for modelling, analysis and simulation purposes. The language employed for modelling is the *Business Process Model and Notation 2.0*, as proposed by Dumas *et al.* (2013), as it is a recent and broad language that combines other modelling best practices, which makes it easier to interpret and understand.

3.3. Unit of Analysis

The unit of analysis of this case study will consist in a team that belongs to a multinational company in the markets of electrification, digitalization and automation, which is present in at least 190 countries and employs directly more than 350.000 people. The team was formed in 2014 and is composed by 17 members, being characterized in Table 10.

ID	ITIL experience	Time (in years)		Function
		IT experience	With IM team	
I1	Yes	19	3	Team leader
I2	Yes	16	3	Support expert
I3	No	0,16	0,16	Support expert
I4	No	5	2	Support expert
I5	Yes	7	3	IT specialist
I6	Yes	23	2	Support agent
I7	Yes	22	3	Support expert
I8	No	3	0,16	Support expert
I9	Yes	22	3	IT specialist
I10	Yes	5	2	IT specialist
I11	Yes	13	2	Support expert
I12	Yes	4	2	Support expert
I13	Yes	25	3	Support expert
I14	Yes	14	3	Support expert
I15	Yes	9	1	Support expert
I16	No	0,25	0,25	Support agent
I17	Yes	18	3	IT specialist
	Average	12,1	2,1	

Table 10 - Team members description

The team is based in Lisbon, Portugal, integrated in a IT support service to the whole Human Resources (HR) department of the company, being the owner of a local IM process. With this process, the organisation provides an IT support service that receives and processes all incidents reported by the users of the HR’s IT services, which are the customers of the process.

This team is chosen as the unit of analysis for this case study because it is the owner of an IM process, the selected ITSM process for research. Being the goal of the team and of its IM process to provide a fast service, time is considered as the main performance dimension. Thus, time shall be the driving performance dimension for the improvement proposals in this research.

3.4.Prepare to Collect Evidence

A plan for collection of evidence was defined following Yin (2009) recommendations. In order to achieve the validity of the analysis that will be performed and avoid the weaknesses inherent to each source of evidence, it is desirable to collect evidence from difference sources. For this case study, four different sources of evidence are expected to be made available by the organisation, as presented in Table 11.

Sources of evidence	Description
Documentation	Internal documentation and private web content about the organisation, the IT support service, the team and the IM process
Archival records	Data records and data reports generated by the daily operation of the IM process
Interviews	Open and focused interviews, with all the team members
Focus groups	Structured focus groups, with all the team members

Table 11 - Expected sources of evidence

Being an IT-nature process, observation and physical artefacts are not expected to be available as sources of evidence. Adding to the enounced sources, it is also expected that informal sources, such as punctual conversations, may occur with team members.

Figure 6 depicts the chronogram planned for the collection of evidence in the conduction of the case study.

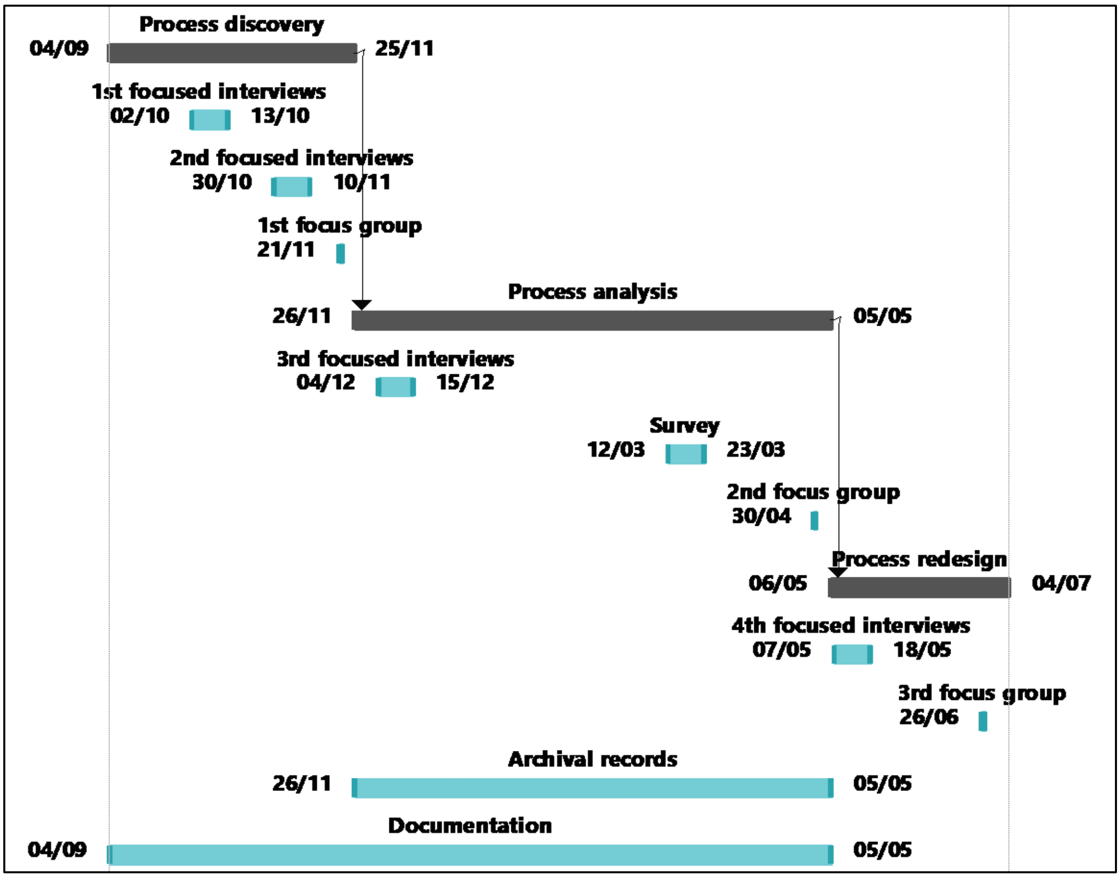

Figure 6 - Planned chronogram for evidence collection

The plan for collection of evidence is designed according with the different objectives of each BPM lifecycle phase (Dumas *et al.*, 2013), and also taking into account that the performance dimension to improve in this research is time.

3.4.1. Process Discovery

This phase comprises a collection of evidence aiming to document the process in its current state (Dumas *et al.*, 2013). Therefore, the methods employed must focus on collecting evidence related to the current functioning, structure and workflow of the IM process and of the support service, in order to deliver the documentation of the as-is model as output of this phase.

Being the team the owner of the analysed IM process, it is vital to collect evidence with its team members regarding the execution of the process.

To do this, two rounds of interviews will take place:

- A 1st round of interviews, with all the team members individually from October 2nd 2017 to October 13th 2017, to have an end-to-end insight of the IM process, as seen by its owners and performers. The pretended result is to have an initial draft of as-is model.
- A 2nd round of interviews with all the team members individually from October 30th 2017 to November 10th 2017, to detail and correct the initial as-is draft of the IM process. The expected result is an improved, more complete and accurate draft of as-is model.

Any documentation concerning the characterization of the IM process or of the support service will be collected for analysis, with the objective of being used for comparing with the results of the interviews and improve the draft of the as-is model.

Once having the final draft of the as-is model, a 1st focus group will be convened with all the team members collectively, on November 21st 2017, to correct any existing flaws or imprecisions and gather a consensus on the model to approve it as the final version of the as-is model, thus ending the *Process Discovery* phase.

3.4.2. Process Analysis

For this phase, evidence collection must be the most extensive as possible to allow a complete identification and exhaustive analysis of the issues existing in the as-is process (Dumas *et al.*, 2013). Therefore, both qualitative and quantitative evidence must be collected. Existing issues must be identified with the team members, but also identified and confirmed through data and records generated by the daily operation of the process.

In order to have an initial perception of what may be the issues affecting the IM process, a 3rd round of interviews will be scheduled with all the team members individually from December 4th 2017 to December 15th 2017, to collect and list the existing issues, as felt by the team members. The expected outcome is a collection of issues that will provide a starting point for the *Process Analysis*.

To validate the identified issues in the 3rd round of interviews or elicit any new issues, yet unidentified, archival and service records of the IM system generated by the daily operation will be collected. With this, it is expected to have the data required to:

a) Characterize the demand of the IM process.
b) Perform a time analysis to current performance of the IM process;
c) Assess the compliance of the IM process with the existing KPIs and SLAs.

The following data are expected to be available:

- Demand volumes, necessary to characterize the demand of the IM process.
- Processing volumes and rates, to characterize the IM process flows, and essential to quantify and configure the as-is model for the time analysis.
- Processing times, to have a measure of the time required to handle and solve incidents in the IM process, which is necessary to perform the time analysis to the as-is model.
- KPIs and SLAs compliance rates, to understand if the IM process is meeting its operational and quality targets.

The time analysis will be performed recurring to a simulation tool existing in the BPM system supporting this research. This analysis will seek to assess the time performance of the IM process in its current state and to quantify the existing issues affecting it.

To complete, documentation will be collected to verify if there are any already identified and documented issues by the team.

Concluding this phase, a 2nd focus group will be convened on April 30th 2018, with all the team members collectively, to gather a consensus and approve the final list of issues, which will be the basis for redesign and improvement of the IM process in the next phase.

3.4.3. Process Redesign

Process Redesign is focused on working and deciding on improvement options, being these based on the evidence collected in the previous phases (Dumas *et al.*, 2013). Thus, collection of evidence is not so relevant or necessary in this phase. Despite this, in order to justify and sustain the decisions regarding redesign and improvement options inherent to this phase, two moments of data collection are planned.

Qualitative suggestions from people working with the IM process are always welcome and may provide more specialized and customized solutions. Thus, to start this phase, a 4th round of interviews will take place with all the team members individually, from May 7th 2018 to May 18th 2018, to collect redesign and improvement proposals, being the expected outcome a list of improvement proposals.

To close this phase, a 3rd focus group will be scheduled on June 26th 2018, with all the team members collectively, to gather a consensus on the improvements options and, based on those options and possible redesigns, decide the final to-be model.

4. Conduction of the Case Study

This chapter consists in the practical conduction of the case study, by following the established design in the previous chapter. The chapter has three sections dedicated to the performed BPM lifecycle phases and two last stages dedicated to summary, managerial recommendations and discussion of results.

4.1.Process Discovery

The goal of *Process Discovery* is to document the current state of the process, by producing an as-is model (Dumas *et al.*, 2013). For this, a set of steps were defined, as shown in Figure 7.

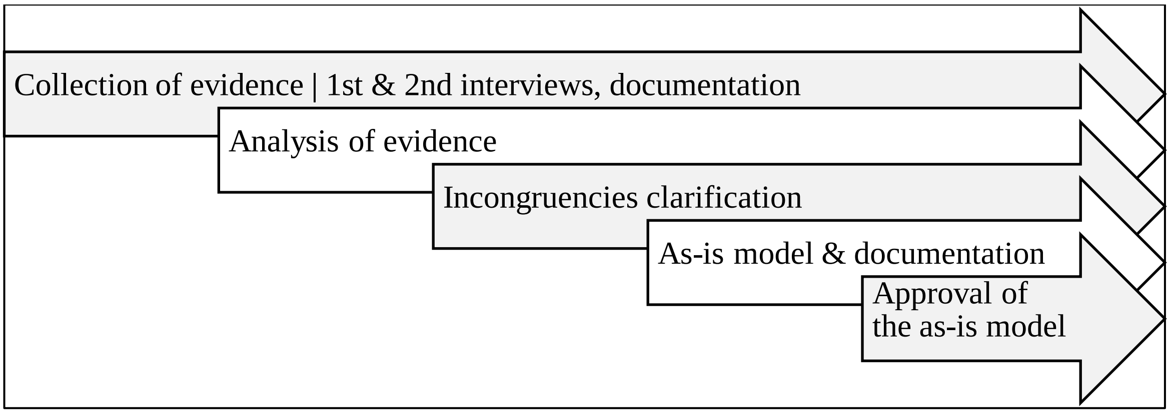

Figure 7 - *Process Discovery* steps

The first step consisted in the collection of the evidence required, through the conduction of the two rounds of interviews and gathering of documentation. The analysis of the evidence was performed in parallel with its collection. This analysis provided the desired information for this phase and allowed to clear the incongruencies detected in the collection of evidence. The IM process was then documented in its current state, through an as-is model and respective description. Lastly, the 1st focus group was convened to approve the documentation.

With the documentation of the IM process in its current state approved, the objective defined by Dumas *et al.* (2013) for this phase was achieved. These *Process Discovery* steps are accomplished in the next subsections.

4.1.1. Collection of Evidence

Collection of evidence in this phase occurred according with the established plan. Table 12 provides the details of the employment of the planned methods.

Method	Date / Period	Approximate duration	Participants	Annexe
1st interviews	October 2nd to October 13th	45 minutes each	All team members, individually	1
2nd interviews	October 30th to November 10th	45 minutes each	All team members, individually	2
Documentation	-	-	-	-
1st focus group	November 21st	1-hour	All the team members, collectively	-

Table 12 - Details of evidence collection in *Process Discovery*

The 1st round of interviews followed a script directed to the mapping of the process. The interviewees were asked to map the IM process, from end-to-end, detailing the activities performed, the participants involved, the decisions and exceptions along the process.

The 2nd round of interviews was conducted based on the results of the previous round of interviews. This time, the team members were faced with the initial draft of the as-is model and requested to validate it: to spot and correct inaccuracies, and to address incongruencies and clarify them. They were also asked to detail even more the model with relevant artefacts and information inherent to the IM process.

Documentation was collected, being available administrative documents about the support service, descriptions of the participants in the IM process and respective roles, as well as a depiction of the workflow adopted.

To have an approved as-is model, the 1st focus group was convened. The team was asked to collectively analyse the final as-is model, discuss its validity and point any required adjustments.

These methods of evidence collection were employed because they enable a thorough *Process Discovery*, having as output the documentation of the as-is model, which is the basis for the analysis of the IM process and its issues.

4.1.2. Analysis of Collected Evidence

Table 13 resumes the outputs of each method of evidence collection.

Method	Output
1st interviews	A collection of different mappings of the IM process, drawn by each team member
2nd interviews	A list of corrections and details to be made to the draft of the as-is model
Documentation	Information about the support service, descriptions of the participants in the IM process and respective functions, as well as a depiction of the workflow adopted
1st focus group	Approval of the as-is model, by all the team members

Table 13 - Outputs of the collection of evidence in *Process Discovery*

4.1.2.1. Analysis of evidence

The 1st round of interviews produced several mappings of the IM process drawn by the interviewees. These mappings were analysed and compared between them. Although some minor incongruencies were identified and marked for further clarification, it was possible to combine the mappings and produce a draft of the as-is model.

The 2nd round of interviews provided a set of adjustments and detailing to be made to the draft, as indicated by the interviewees. Some of the detected incongruencies were addressed and corrected. The draft was detailed, which made it more informative and understandable, reflecting the various features of the IM process. The draft of the as-is model was improved, becoming more accurate and true to the reality.

Following the interviews, the collected documentation was analysed and compared with the resulting draft of the interviews. This comparison allowed to clear the remaining incongruencies concerning the IM process. Documentation analysis also provided detailed descriptions of the participants and roles existing in the support service.

4.1.2.2. Incongruencies clarification

In the two rounds of interviews conducted, four incongruencies were detected, concerning the mapping of the IM process.

Incongruency A, depicted in Table 14, had its source in the 1st round of interviews, and concerned what of activity the *Incident Prioritization* in the 1st support level is: a user activity, performed by a team member (scenario 1), or a script activity, automatically performed the IM system (scenario 2).

<table>
<tr><th colspan="2">Incongruency A</th></tr>
<tr><th>Scenario 1</th><th>Scenario 2</th></tr>
<tr><td>
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</td></tr>
</table>

Table 14 - Incongruency A

The 2nd round of interviews cleared this incongruency, by defining *Incident Prioritization* has a script activity performed automatically by the IM system (scenario 2).

Incongruency B, shown in Table 15, had its source in the 1st round of interviews, and concerned existence of a gateway for the triage of incident validity in the 1st support level (scenario 1) or not (scenario 2).

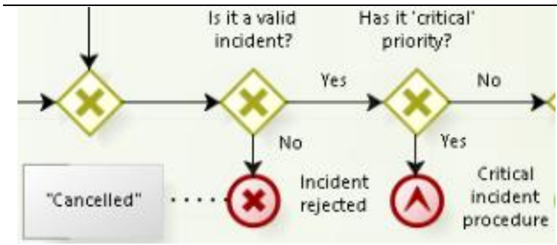
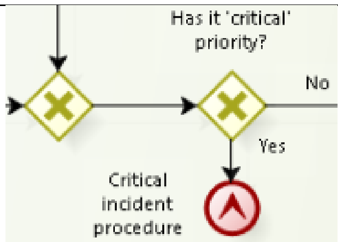
<table>
<tr><th colspan="2">Incongruency B</th></tr>
<tr><th>Scenario 1</th><th>Scenario 2</th></tr>
<tr><td>
</td><td>
</td></tr>
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Table 15 - Incongruency B

The documentation analysis solved this incongruency, by revealing that there was no gateway for the triage of incident validity in the 1st support level (scenario 2).

Incongruency C, presented in Table 16, also had its source in the 1st round of interviews, and concerned the position of a gateway for the triage of critical priority incidents in the 1st support level: if before the *Incident Categorization* activity (scenario 1) or after (scenario 2).

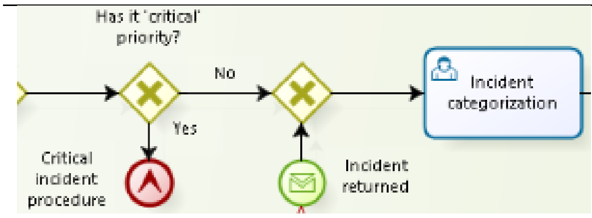
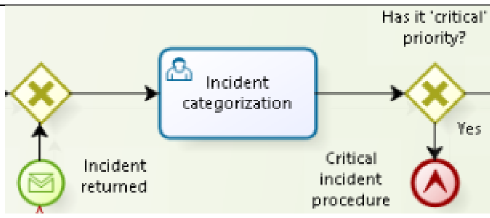
<table>
<tr><th colspan="2">Incongruency C</th></tr>
<tr><th>Scenario 1</th><th>Scenario 2</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Table 16 - Incongruency C

The 2nd round of interviews cleared this incongruency, by setting the position of the gateway before *Incident Categorization* activity (scenario 1).

Incongruency 4, presented in Table 17, was detected in the 2nd round of interviews, and concerned the period of working days required by the IM system for closing an incident: if 14 working days (scenario 1) or 7 working days (scenario 2).

<table>
<tr><th colspan="2">Incongruency D</th></tr>
<tr><th>Scenario 1</th><th>Scenario 2</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Table 17 - Incongruency D

The documentation solved this incongruency, by revealing 14 working days as the time period required by the IM system for closing an incident (scenario 1).

With all the incongruencies cleared, the final documentation of the IM process was produced, including the final draft of the as-is model.

4.1.2.3. As-is model & documentation

There are three main identified participants in the IM process:

- The customers, which are the users who report incidents to the support service.
- The support service, composed by the three support levels (SL) that perform the IM process itself, thus being the focus of this research.
- The IT suppliers, which are external to the support service and are the providers the IT services used by the organisation.

The support service is composed by three SLs that have different roles and teams involved, as presented in Table 18.

Support level	**Description & responsibilities**	**Staff**
1st SL	*Support agents* that perform the initial reception, triage and forwarding of incidents to the 2nd SL, the so called dispatching activities	2
2nd SL	*Support experts* that perform a technical diagnosis and resolution of the incidents, being also responsible to contact the customer and to always close incidents. If unable to find the solution for the incidents, it must forward it for the 3rd SL	10
3rd SL	*IT specialists* that perform an extensive investigation and resolution, being the last resort of the support service to solve the incidents. If unable, it must request for the intervention of the respective IT supplier. With the resolution performed, the 3rd SL must return the incident to the 2nd SL for closure	4 (in the team)

Table 18 - Support levels in the support service

Of the three SL presented in Table 18, the team fully incorporates the 1st SL with 2 support agents, and the 2nd SL with 10 support experts. However, the 3rd SL is partially represented in the team, with only 4 IT specialists. The 3rd SL is composed by several IT specialists from various IT development teams in the organisation, that are called to participate in the IM process whenever required, being the quantity of staff involved in this SL unknown. This structure of the support service is designed to handle and solve the incidents according with their complexity and severity, and with the level of expertise and specialization required, being one of goals of the team to retain and solve as much incidents as possible in the 2nd SL, avoiding a high workload for the 3rd SL.

The IM process starts whenever a customer reports an incident to the 1st SL, either through the email (*Incident reported*) or through call (*Call arrival*). From here, the IM process is mainly grounded in the workflow defined by ITIL, being its activities and gateways easily recognized in the as-is model. These activities are performed with the support of a single IM system, which is used for the storage and management of all incidents, through the logging and update of incidents in tickets with all the respective information and actions performed. The activities are described in Table 19.

Activities	**Description**
Answer call (subprocess)	Answer the customer call to report an incident, including the user activities of incident identification, logging and prioritization, as shown in Annexe 3
Incident logging	The IM system automatically creates a ticket for the incident reported by the customer
Incident prioritization	The IM system automatically prioritizes the ticket, usually to a standard priority that can be changed further ahead
Incident identification	Identify the IT service impacted and the type of incident
Incident categorization	Classify the incident based on the previous identification, defining the incident scope
Initial diagnosis	Analysis the received incident, to assess its scope, validity and nature, being a more specialized in the 3rd SL than in the 2nd SL
Investigation & diagnosis	Investigate the incident to find its root-cause and to determine the possible resolution. If required, change the standard priority
Resolution & recovery	Solve the incident and restore the normal IT service, after finding the root-cause of the issue
Incident closure	Contact the customer to notify him that a resolution has been performed and asking for feedback
Incident reanalysis	Reanalyse the reopened incident and the new information reported by the customer

Table 19 - Activities of the IM process

There are two rework situations in the middle of the IM process:

- Whenever there is an *incident returned* from the 2^{nd} SL to the 1^{st} SL, due to mistake of the 1^{st} SL.
- Whenever there is a *reopening request* from the customer to the 2^{nd} SL, after an incident is labelled as resolved.

The IM process finishes in the *Incident solved & service restored*, the main end event of the process in the 2^{nd} SL, with the incident is solved and the ticket closed. However, two alternative end events may occur:

- *Incident rejected*, when the 2^{nd} SL determines that there is no valid nature in the received incident that justifies the deployment of the IM process and cancels the respective ticket.
- *Critical incident procedure*, a special procedure designed to deal with incidents that have a perceived critical priority or critical nature. These procedures are different and customized according with the different IT services.

The documentation of the IM process reveals that, despite being adapted to the organisation, it is mainly grounded on the ITIL standard and that most of the recommendations proposed by the standard are followed.

Figure 8 presents the final draft of the as-is model.

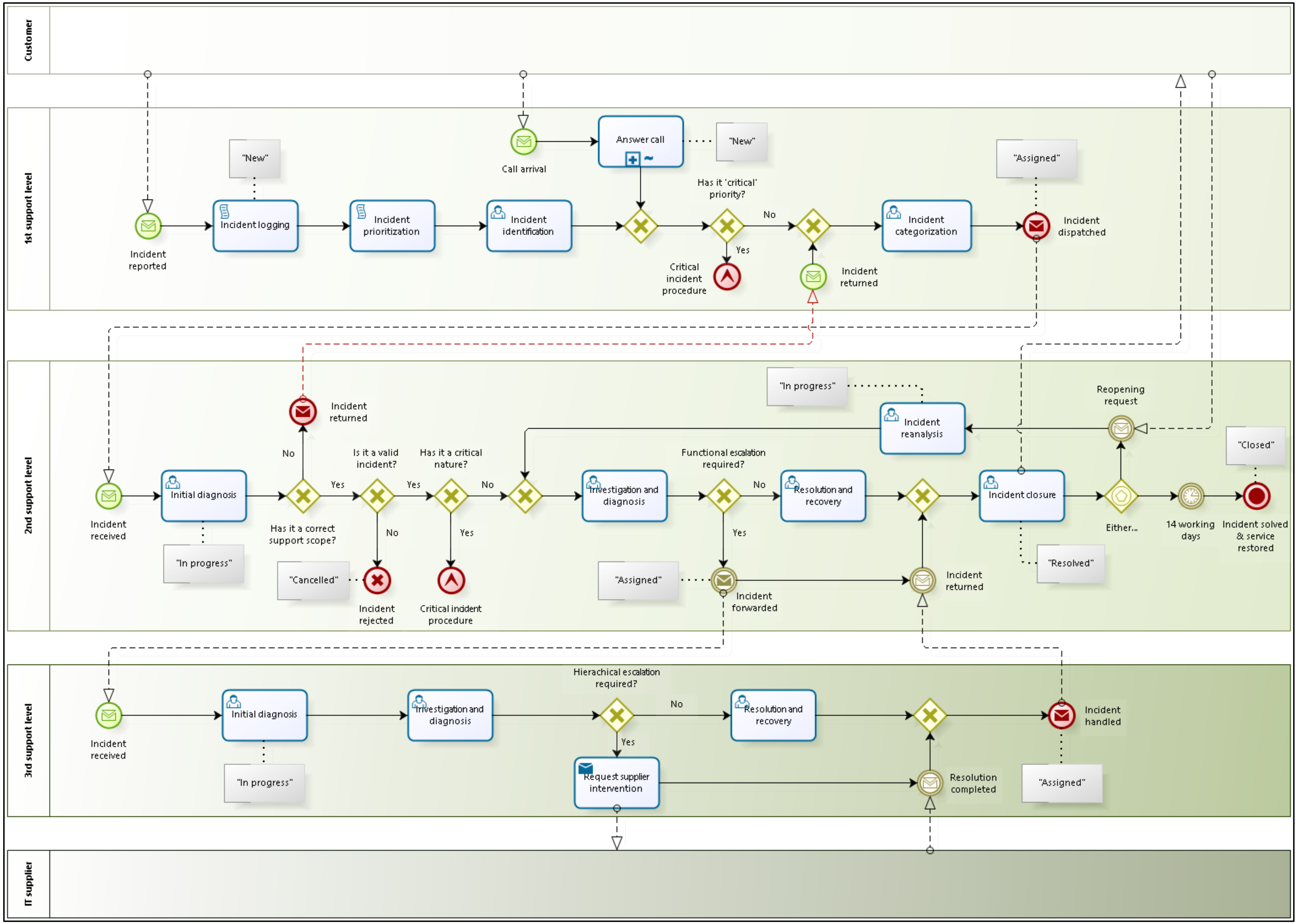


Figure 8 - As-is model

4.1.2.4. Approval of the as-is model

The final documentation of the IM process was submitted for approval in the 1st focus group. This 1st focus group, convened with all the team members, validated the documentation, without any opposition, not being required any adjustments or corrections to the as-is model.

With the 1st focus group finished, the *Process Discovery* phase was completed.

4.2. Process Analysis

In *Process Analysis*, the issues affecting the process in its current state are identified and quantified using a performance dimension, being the output a structured collection of issues (Dumas *et al.*, 2013). Considering time as the main driver for this research, the *Process Analysis* was focused on unravelling the existing issues affecting the time performance of the IM process.

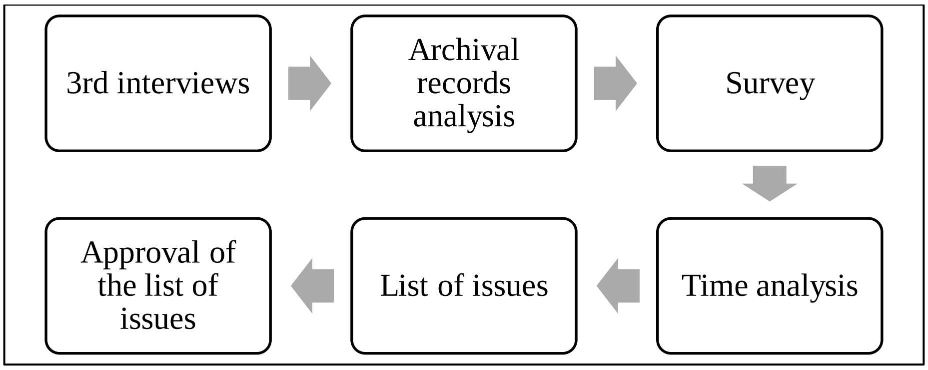


Figure 9 - *Process Analysis* steps

As depicted in Figure 9, the steps taken in the conduction of this *Process Analysis*, were:

1. The conduction of the 3rd round of interviews, which collected the issues as reported by the team members. These issues were compiled and described in an initial list, providing hints on the problems that should be addressed and analysed.
2. An analysis to the archival records to characterize the IM process and to quantify the issues reported in the 3rd round of interviews. This was achieved by:
   - Conducting a Pareto analysis to the IM process demand.
   - Extracting processing volumes and rates, essential not only to characterize and quantify the IM process flows and issues, but also to conduct the time analysis.
   - Performing a compliance analysis to the existing KPIs and SLAs.
3. The conduction of a survey, due to the lack of data concerning processing times in the archival records, to collect time estimates with the team members for the activities of the IM process, required for the time analysis.

4. A time analysis, through the simulation of the quantified as-is model in the BPM system, to assess the time performance of the IM process and quantify the issues identified in the 3rd round of interviews. This analysis also aimed to reveal and quantify any yet unidentified issues.
5. The elaboration of the final list of issues, with all the identified and quantified issues along the *Process Analysis*.
6. The conduction of a 2nd focus group to debate the final list of issues and approve it.

With the final list of issues approved, the goal established by (Dumas *et al.*, 2013) for this phase was considered accomplished. The *Process Analysis* steps are explained in the next subsections.

4.2.1. Collection of Evidence

Collection of evidence in this phase followed the established plan. However, due to some limitations, additional methods of evidence collection had to be employed, as further ahead presented. Table 20 details the employed methods in this phase.

Method	Date / Period	Approximate duration	Participants	Annexe
3rd interviews	December 4th to December 15th	45 minutes each	All team members, individually	4
Archival records	-	-	-	-
Survey	March 12th to March 23rd	30 minutes each	All team members, individually	5
Documentation analysis	-	-	-	-
2nd focus group	April 30th	1-hour	All team members, collectively	-

Table 20 - Details of evidence collection in *Process Analysis*

The 3rd round of interviews, in order to produce an initial list of issues, was focused on collecting the accounts and perspectives of the team members about the IM process. The as-is model was shown to the interviewees, who were asked to pinpoint and describe the issues affecting the IM process, namely time-consuming activities, bottlenecks and constraints, and the major challenges and difficulties felt in the daily operation.

The collection of archival and service records was carried out to further prove the existence of the listed issues in the previous interviews, and to unravel unidentified ones. This resulted in the collection of 6385 incidents from the IM system database, concerning the period between October 1st 2017 and December 31st 2017, which provided most of the desired data: demand volumes, processing volumes and rates, KPIs and SLAs compliance rates. However, due to limitations regarding some IM system features, it was not possible to have the data concerning the required processing times, which in turn limited the execution of the analysis to the time performance of the IM process.

To work around this problem, considering the impossibility of performing direct observation due to the nature of the IM process, a survey with all the team members was conducted, in order to have time estimates for the activities of the IM process (see Table 20). The survey presented the as-is model to the interviewees and requested them, based on their functions, to provide with time estimates for the duration of each activity. Depending on the activities, the parameters asked varied:

- For more demanding and specialized activities, it was requested a minimum, a most-likely and a maximum duration time estimate.
- For less demanding and superficial activities it was requested a minimum and a maximum duration time estimate.

This survey made possible to conduct the time analysis, essential to assess the time performance of the IM process and to quantify the existing issues affecting it.

Although documentation was collected and analysed, no relevant reporting on identified issues affecting the IM process was found.

The closing 2nd focus group took place to present and approve the final list of identified and quantified issues. The issues were presented, indicated in the as-is model and described. The team members were then encouraged to debate on the issues, suggest further analysis if required, and approve the final list.

Although some limitations appeared, motivating the use of unplanned methods, the methods applied enabled a complete *Process Analysis*, where the final output was an approved list of identified and quantified issues, which is the main foundation for the *Process Redesign* effort.

4.2.2. Analysis of Collected Evidence

Table 21 presents the outputs of each evidence collection method employed.

Method	Output
3rd interviews	An initial list of issues affecting the IM process, as identified and described by the team members
Archival records	Demand volumes, processing volumes and rates, and KPIs & SLAs compliance rates of the IM process
Survey	Collection of time estimates for the activities in the IM process, which enabled to perform its time analysis
Documentation	None
2nd focus group	Approval of the final list of issues, by all the team members

Table 21 - Outputs of the collection of evidence in *Process Analysis*

4.2.2.1. 3rd round of interviews

In the 3rd round of interviews, the team members reported and described the main problems affecting the IM process and challenges to the daily operation. These various issues were compiled and listed, as presented in Table 22.

ID	Reported issues
A	3 interviewees (I6, I8 and I16) reported that answering calls in the 1st SL to receive incidents is a too much time-consuming activity, which takes time that can be applied in the remainder dispatching activities
B	10 interviewees (I1, I2, I4, I7, I11, I12, I13, I14, I15 and I17) mentioned that sometimes the dispatching performed by the 1st SL is done wrongly, which leads to a waste of time and effort by the 2nd SL on incidents with incorrect scope
C	9 interviewees (I1, I2, I4, I5, I7, I8, I12, I16 and I17) implied that the dispatching activities of the 1st SL are time-consuming and prone to errors, being referred also as essential targets for analysis and improvement
D	All the interviewees indicated that the IM system utilized by the support service is outdated, with time-consuming features, low automation degree and lacking key reporting tools

Table 22 - Issues reported by the team members

Being time the driving dimension of this research, it is clear, through the identification of the issues A, B and C, that the 1st SL must be a focal point of further analysis regarding the its time performance and how it affects the overall IM process. Issue D suggests that some of the features in the IM system are inadequate to the daily operation and can affect the IM process time performance. Despite this, issue D is not related to a measurable activity, which limits the conduction of a time analysis on it. However, this issue may be reflected in the duration of the activities of the IM process. Also, the fact of not being measurable does not mean that improvement suggestions can not be proposed.

4.2.2.2. Archival records analysis

The analysis of the archival records was performed on the 6385 incidents collected from the IM system, which concerned the processed volume from October 1st 2017 and December 31st 2017. The IM process provides support to a total of 46 IT services. Performing a simple Pareto analysis, it was found that 9 IT services (~20% of the IT services) corresponded to approximately 87% of the whole demand, as shown in Table 23.

IT services	Volume (q)	Weight rate (%)
A	1790	28.03%
B	1064	16.66%
C	554	8.68%
D	528	8.27%
E	500	7.83%
F	344	5.39%
G	294	4.60%
H	259	4.06%
I	219	3.43%
9	5552	86.95%

Table 23 - Pareto analysis of the IM process demand

If the next most demanding IT service is considered for the Pareto analysis, it is verified that 10 IT services are accountable for 90.02% of the whole demand. This reveals that there is a great inequality in the distribution of the demand per IT service, probably due to the nature of the various IT services. The demand is polarized to a distinguished set of IT services to which the IM process is more requested for.

It was found that, out of the 6385 incidents collected, 360 incidents were reported through calls, while the remaining 6025 incidents were reported through email. Based on this, and considering that from October 1st, 2017, to December 31st, 2017, there were a total 58 working days, the arrival rates of the starting events were calculated in minutes (m), as presented in Table 24.

Starting events	Volume	Rate	Arrival rate (m)
Incident reported	6025	94.36%	13.862
Call arrival	360	5.64%	232.00
	6385	100%	

Table 24 - Arrival rates of the IM process

Table 24 reveals that the most frequent way for customers to contact the support service is through email, being calls a small rate in the processed volume. These conclusions are relevant for the quantification and analysis of issues A and C.

Rates concerning the handling of incidents between each participant – *incident returned (from the 2nd SL to the 1st SL)*, *incident forwarded (from the 2nd SL to the 3rd SL)* and *supplier intervention requested* – were obtained through archival records concerning the self-solving quotas of each SL of the support service. Although there were no volumes associated with these rates, considering that the processed volume was 6385 incidents, such quantities can be estimated. Table 25 shows those rates (%) and the respective estimated volumes (q).

Events/activities	Rate (%)	Estimated volume (q)
Incident returned (from the 2nd SL to the 1st SL)	12%	766
Incident forwarded (from the 2nd SL to the 3rd SL)	34%	2171
Supplier intervention requested (*)	5%	109

Table 25 - Estimated quantities for handling rates

In the case of *supplier intervention requested* (*) the rate refers to the volume that arrived to the 3rd SL and had to be forwarded to the IT supplier. Therefore, the calculation of the respective quantity is made with the estimated volume of the 3rd SL (2171 incidents) and not with the overall processed volume (6385 incidents). The rate and estimated volume for *incident returned* (from the 2nd SL to the 1st SL) are relevant for the analysis of issues B and C, since it reflects the impact of the 1st SL and of dispatching errors in the IM process.

Also important to know are the opposite volumes (q) and rates (%) for those handling rates, as Table 26 presents.

Opposite events/activities	**Opposite rate (%)**	**Estimated volume (q)**
No *incident returned* (from the 2nd SL to the 1st SL)	88%	5619
No *incident forwarded* (from the 2nd SL to the 3rd SL)	66%	4214
No *supplier intervention requested* (*)	95%	2062

Table 26 - Estimated quantities for the opposite handling rates

The values in Table 26 show that 5619 incidents were correctly dispatched by the 1st SL, that 4214 incidents were solved entirely by the 2nd SL, and that 2062 incidents in the 3rd SL did not require the intervention of an IT supplier.

The processing volumes (q) and rates (%) for the remainder events were also provided by the archival records, as presented in Table 27.

Events	**Volume (q)**	**Rate (%)**
Critical incident procedure (overall)	8	0.13%
Incident rejected	99	1.55%
Reopening request	191	2.99%

Table 27 - Processing rates in the incident management process

All these volumes and rates enabled to characterize some of the flows of the IM process:

- The most probable path, also the desired one by the support service, consists in an incident arriving through email, being correctly dispatched from the 1st SL, being solved entirely by the 2nd SL and not having a reopening request.
- The second most probable path consists in an incident arriving through email, being correctly dispatched from the 1st SL, solved by the 3rd SL, closed by the 2nd SL, without a reopening request.
- The least probable paths concern the incidents that finish in *critical incident procedure* and in *incident rejected*.

The analysis to the KPIs and SLAs compliance rates allowed to assess if the IM process was meeting its objectives. The KPIs and SLAs used by the team were analysed:

- The team has as KPI the self-solving quota for the 2nd SL, since the 2nd SL is fully incorporated in the team. The target established for this KPI defines 60% as the minimum rate for self-solving quota in the 2nd SL. As seen above in Table 26, the team is meeting this objective by having reported 66% rate of self-solving quota in the 2nd SL (the opposite of the 34% of incidents forwarded to the 3rd SL).
- The team also uses the rate of reopening requests as KPI. The target established for this KPI sets 5% as the maximum rate allowance. As presented above in Table 27, the team is meeting this target by having only a 2.99% rate of reopening requests.
- The team has time effort defined as KPI for time performance. This KPI measures the time of effective work for processing incidents in each SL, thus concerning the processing times. However, it was discovered that the IM system was not recording this parameter, which meant that there were no processing times available. It also meant that the team had no perspective or control on what the time performance of the IM process was, which is equal to say that there were no insights on how the work was being performed. The lack of processing times in the archival records limited the conduction of the planned time analysis. This limitation was also relevant for issue D, by being related with the obsolescence of the IM system.
- The SLAs for this IM process are time limits defined for the resolution of incidents, which vary depending on the priority and classification of the incidents. Analysing the SLAs compliance rates, it was found that no single incident of the collected 6385 incidents exceeded the imposed the time limits, which allows to conclude that the IM process is assuring the quality of the service it provides.

4.2.2.3. Time estimates survey

The existence of processing times records was necessary to perform the planned time analysis. To overcome the inexistence of such records, a survey was conducted with all the team members to collect estimates for the time required to accomplish each user activities of the IM process, as described in previous section. The output of this survey consisted in processing time estimates, in minutes (m), for each activity, as shown in Tables 28, 29 and 30.

1st support level time estimates		
Activities	**Dimension**	**Time (m)**
Answer call	Maximum	45
	Most Likely	16
	Minimum	10
Incident identification	Maximum	8
	Minimum	2
Incident categorization	Maximum	5
	Minimum	1

Table 28 - Time estimates for the 1st support level activities

2nd support level time estimates		
Activities	**Dimension**	**Time (m)**
Initial diagnosis	Maximum	18
	Minimum	5
Investigation and diagnosis	Maximum	145
	Most Likely	16
	Minimum	6
Resolution and recovery	Maximum	559
	Most Likely	18
	Minimum	7
Incident closure	Maximum	11
	Minimum	3
Incident reanalysis	Maximum	20
	Minimum	8

Table 29 - Time estimates for the 2nd support level activities

3rd support level time estimates		
Activities	**Dimension**	**Time (m)**
Initial diagnosis	Maximum	23
	Minimum	5
Investigation and diagnosis	Maximum	1000
	Most Likely	42
	Minimum	4
Resolution and recovery	Maximum	1020
	Most Likely	50
	Minimum	7
Request supplier intervention	Maximum	5
	Minimum	1

Table 30 - Time estimates for the 3rd support level activities

For the script activities of *incident logging* and *incident prioritization*, which are automatically performed by the IM system, no estimates were requested, since they do not require effort from the 1st SL to be accomplished. So, these activities are considered to have null processing times. With the time estimates for the IM process activities collected, it became possible to quantify and configure the as-is model, in order to perform the time analysis.

4.2.2.4. Time analysis

The time analysis was performed through the simulation tool on the BPM system used to support this research. With the as-is model quantified and configured with the data previously collected, the simulation of the IM process in its current state was run with 50 replications, to assure the stability and reliability of the results.

The outputs of this time analysis were the average, maximum and minimum times required for processing incidents in each SL and also for the execution of each activity of the IM process. This analysis allowed to understand the overall processing time required by the support service to perform the IM process and solve incidents.

Table 31 exhibits the average processing time, in minutes (m) and hours (h), in each SL.

Pool	**Average processing time**	
	(m)	**(h)**
1st support level	9.45	0.16
2nd support level	202.69	3.38
3rd support level	707.77	11.80

Table 31 - Average processing time for each support level

This demonstrates that incidents usually take a combined 3.54 hours in 1st SL and 2nd SL. However, the 34% of incidents that are forwarded to the 3rd SL require in average almost 12 hours of processing. Although these values provide an insight of the processing times required for each SL, they are averaged values, which means they do not reflect the reality of different, more extreme processing times. These processing times may vary depending on the incident nature and on the various paths it can follow in the IM process. Therefore, the processing time for each incident is always different. Table 32 shows the average time required, in minutes (m) and hours (h), for processing incidents in the two most common paths.

Paths	**Average processing time**	
	(m)	**(h)**
Most probable	276.06	4.60
Second most probable	803.02	13.38

Table 32 - Average processing time in the two most probable paths

The values in Table 32 demonstrate a big difference between the two most probable paths. The most probable path requires almost 3 times less time than the second most probable path. Again, these are averaged values, which means that they do not reflect more extreme processing times required for both paths.

The time analysis also enabled to address and quantify some of the issues identified in the 3rd round of focused interviews.

To quantify issue A, an analysis was performed to determine the average time spent per call and the total time spent on calls, which are presented, in minutes (m) and hours (h) in Table 33.

Issue A: Time spent with calls		
Impact to the 1st support level		
Volume	(q)	360
Average time spent per call	(m)	23.65
Total time spent in calls	(m)	8504.81
	(h)	141.75

Table 33 - Issue A analysis

These results revealed that the 1st SL spent a total of 141.75 hours (approximately 6 days) answering calls to receive incidents. Considering that calls only represent 5.64% of the whole processed volume, this proves that answering calls is a time-consuming activity.

The analysis to quantify issue B aimed at revealing the time that 1st SL and 2nd employed in dealing with dispatching errors. Table 34 shows the results in minutes (m) and hours (h).

Issue B: Time spent with dispatching errors				
Impact		In the 1st support level	In the 2nd support level	Total
Volume	(q)	766 dispatching errors		
Average time spent per dispatching error	(m)	3.00	11.50	14.50
Total time spent with dispatching errors	(m)	2296.97	8806.56	11103.54
	(h)	38.28	146.78	185.06

Table 34 - Issue B analysis

This analysis discovered that the 2nd SL spent 146.78 hours dealing with dispatching errors, while the 1st SL spent 38.28 hours, a total combined of 185.06 hours. This means that each of the 10 support experts in the 2nd SL dedicated 14.68 hours to deal with errors incoming from the 1st SL, and that each of the 2 support agents in the 1st SL had to rework 19.14 hours to correct those categorization mistakes.

Dispatching errors are clearly a waste of time in the IM process, not only because they require rework and time spending but also because they are not supposed to happen.

Issue C was addressed by extracting the average, maximum and minimum processing time for the 1st SL and its activities, which are detailed, in minutes (m), in Table 35.

Issue C: Time spent with 1st support level activities			
Activities/pool	Average time (m)	Maximum time (m)	Minimum time (m)
Answer call	23.65	43.38	10.68
Incident identification	5.00	8.00	2.00
Incident categorization	3.00	5.00	1.00
1st support level	9.45	47.03	1.00

Table 35 - Issue C analysis

The minimum processing time in 1st SL is 1 minute, which is related to the dispatching errors that return to the 1st SL for rework and correction. The average processing time in the 1st SL is 9.45 minutes, which is long for a set of activities that should be performed swiftly, almost automatically. For the worst-case scenario, the results show that the maximum processing time may be 47.03 minutes, which is almost 5 times more than the average processing time. The 1st SL activities should be performed quickly but are not. This is due mainly to error and slowness of the HR, but also due to calls, proven once again as time-consuming.

While analysing issue B, another related issue was perceived and unravelled: the time spent by the 1st SL and the 2nd SL with incidents rejected. Table 36 presents the new identified issue E, in minutes (m) and hours (h).

Issue E: Time spent with incidents rejected				
Impact		In the 1st support level	In the 2nd support level	Total
Volume	(q)	99 incidents rejected		
Average time spent per incident rejected	(m)	3.00	11.50	14.50
Total time spent with incident rejected	(m)	296.87	1138.19	1435.05
	(h)	4.95	18.97	23.92

Table 36 - Issue E analysis

Analysis of issue E revealed that a combined total of 23.92 hours (nearly one day) were spent with incidents that were eventually rejected, which is high for a very low volume event. Although the rejection of invalid incidents is natural to the IM process, in this case, it implies the waste of an average of 14.50 minutes until the incident is rejected. This processing time is unnecessarily high to a triage that could imply less time waste.

The time analysis quantified issues A, B and C, and also allowed to identify and quantify issue E, describing the impact of these issues in the IM process time performance.

4.2.2.5. List of issues

The main results of each *Process Analysis* steps are indicated in Table 37.

Steps	**Results**
3rd interviews	The identification and description of 4 issues (A, B, C and D) that affect the time performance of the IM process, as reported by the interviewees
Archival records analysis	Allowed to characterize the demand and assess on the compliance of the IM process. Provided insights on the IM process, including processing rates, which are essential to perform the time analysis
Survey	Provided estimates for the processing times of all activities in the IM process, which is required to perform the time analysis
Time analysis	Revealed the time performance of the IM process and quantified issues A, B and C, allowing also to identify and quantify issue E, revealing the impact of these issues in the IM process.

Table 37 - Results of the *Process Analysis* steps

Table 38 shows the contributions of each step for the understanding of the five identified issues.

Contributions	**3rd interviews**	**Archival records analysis**	**Survey**	**Time analysis**
Qualitative insights	Issues A, B, C, D	Issues A, B, C, D	-	Issues A, B, C, E
Quantitative insights	-	Issues A, B, C	Issues A, B, C	Issues A, B, C, E

Table 38 - Contributions of the *Process Analysis* methods for the 5 issues

With all the issues gathered, the final list of issues was elaborated, as presented in Table 39.

ID	Issues	Short conclusion
A	Calls are too much time-consuming	141.75 hours were spent on answering calls in the 1st SL, which represents only 5.64% of the processed volume
B	Dispatching errors are time-consuming	185.06 hours spent along the 1st SL and 2nd SL to correct errors that should not happen
C	1st SL activities are time-consuming	Has a high average processing time of 9.45 minutes, with a worst-case scenario of 47.03 minutes
D	IM system is obsolete	Lacks KPIs parameters that difficult the management of the IM process, and has old features that are no longer required
E	Invalid incidents are time-consuming	23.92 hours were spent to deal with incidents that were rejected

Table 39 - Final list of issues

4.2.2.6. Approval of the list of issues

The final list of issues was submitted for debate and approval in the 2nd focus group. The 2nd focus group, which gathered all the team members again, debated the five identified issues and their impacts in the IM process. The final list was approved in consensus, with no vote against. Remarks must be made on the reactions of some team members that did not expected such results concerning the quantified issues. Also, suggestions were made to study automation as a possible solution for the issues.

This 2nd focus group marked the conclusion of *Process Analysis*.

4.3. Process Redesign

Process Redesign consists in identifying and analysing changes to the process that address the issues previously identified, in order to improve the process performance, being the output of this phase a to-be model (Dumas *et al.*, 2013). To achieve this, several steps were taken, as depicted in Figure 10.

The first step was the conduction of the 4th round of interviews, which collected improvement proposals suggested by the team members and provided hints on how to redesign the IM process.

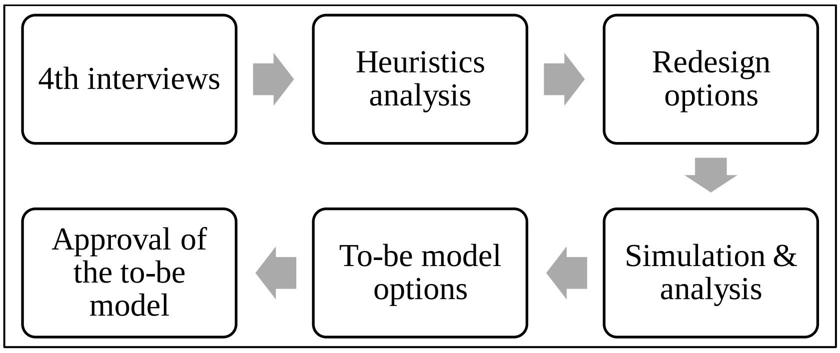


Figure 10 - *Process Redesign* steps

Secondly, the redesign heuristics proposed in the framework of Dumas *et al.* (2013) were analysed, to identify and select the most adjusted redesign heuristics for the improvement of the IM process. The criteria followed to select the heuristics consisted in:

1. Reject all the redesign heuristics that had a neutral or negative effect in the time performance dimension, according with Dumas *et al.* (2013).
2. Select the redesign heuristics best suited to address the existing issues of the IM process and the improvement proposals, considering also the compliance with the ITIL standard.

With the heuristics identified, different redesign options for the IM process were produced by employing and combining those heuristics. Each redesign option was then simulated in the BPM system, to measure the respective impact in the IM process time performance. The results of all the different redesign options were compared. The redesign options that presented the best time performance improvements were selected as possible to-be models and presented in the 3rd focus group for debate. The 3rd focus group was convened to debate the best redesign options and identify one as the to-be model for a new, improved IM process.

With the to-be model identified, the *Process Redesign* goal defined by Dumas *et al.* (2013) was reached. These *Process Redesign* steps are disclosed in the following subsections.

4.3.1. Collection of Evidence

The established plan for evidence collection was followed in this phase. However, in this phase, due to organisational change, team member I17 was no longer part of the team. Therefore, it did not participate in the evidence collection moments of this phase involving the team members. Table 40 presents the details of the employed methods.

Method	Date / Period	Approximate duration	Participants	Annexe
4th interviews	May 7th to May 18th	30 minutes each	All team members, individually, except team member I17	6
3rd focus group	June 26th	1-hour	All team members, collectively, except team member I17	-

Table 40 - Details of evidence collection in *Process Redesign*

The 4th round of interviews followed a script aimed at its goal of gathering redesign and improvement proposals suggested by the team. The as-is model and the list of issues from the previous phases were presented to the team members, which were given time to think and requested to suggest, though not forced, any proposals for redesign and improvement.

To close this phase, after the analysis of the possible redesign options, a final 3rd focus group was convened to decide on the final to-be model. All redesign options, including the ideal redesign option, were presented, along with the issues that they would solve. The team members were then asked to debate on each redesign option and to choose which one is the most suitable for implementation, presenting the reasons why. This allowed to choose and approve the best suited to-be model for this IM process.

Despite being a more analysis-oriented phase, the moments of evidence collection gave sustenance and reason to the analysis realized and to the decisions made regarding the redesign options and the final to-be model. IT also answered the research question of this case study.

4.3.2. Analysis of Collected Evidence

Table 41 describes the outputs of two moments of evidence collection occurred in this phase

Method	Output
4th interviews	A list of redesign and improvement proposals, suggested by the team members
3rd focus group	Discussion of the redesign options and approval of the final to-be model, by all the team members

Table 41 - Outputs of the collection of evidence in *Process Redesign*

4.3.2.1. 4th round of interviews

In the 4th round of interviews, the team members suggested redesign and improvement proposals, based on the issued identified in *Process Analysis*. Table 42 lists and describes all the proposals made.

ID	Improvement proposal	Issue addressed
P1	6 interviewees (I1, I2, I6, I8, I2 and I16) suggested to end calls in the 1st SL, establishing email as the only way to receive incidents.	Issues A, C
P2	11 interviewees (I1, I2, I4, I5, I7, I8, I11, I12, I13, I14 and I15) suggested to automate all the activities of the 1st SL, by integrating them in the IM system, implying also the end of calls as an entry point and as an activity.	Issues A, B, C
P3	All the interviewees mentioned that the IM system should be updated or changed to a more recent version that includes time-saving features and automation tools, being the latter suggested as a complement of *P2*.	Issues A, B, C, D

Table 42 - Improvement proposals collected

Only a total of three improvement proposals were produced, with neither addressing issue E. These proposals were considered for the selection of the best suited redesign heuristics.

4.3.2.2. Heuristics analysis

Of the 29 redesign heuristics listed by Dumas *et al.* (2013), 8 heuristics were initially cast out due to having neutral or negative effects in the time performance. This reduced the number of possible redesign heuristics to 21, all with positive effects on the time performance.

To these 21 heuristics, the analysis sought to identify which ones best corresponded to the identified issues and to the improvement proposals, based on their nature. Issues A, B, C and E were clearly operational issues, concerning activities and flows of the IM process, while issue D had a technological nature. As for improvement proposals, *P1* offered an operational solution to the operational issues A and C. However, *P2* and *P3* suggested technological solutions for issues A, B, C and D. With this the analysis was narrowed to three categories of redesign heuristics: BP operation heuristics, BP behaviour heuristics and technology heuristics.

To these three categories of redesign heuristics, the analysis aimed at selecting the ones that best suited the improvement of the time performance of the IM process, while still meeting the ITIL standard. For redesign heuristics were selected, as detailed in Table 43.

ID	Redesign heuristic	Targeted elements of the current IM process	Issue addressed	Proposal addressed
H1	Activity elimination	*Call arrival* & *answer calls*	Issues A, C	P1
H2	Resequencing	*Initial diagnosis* (in the 2nd SL) and its following gateways	Issues B, E	-
H3	Activity automation	All user activities in the 1st SL	Issues A, B, C, D, E	P2, P3
H4	Integral technology	IM system	Issues A, B, C, D, E	P2, P3

Table 43 - Identified heuristics for *Process Redesign*

These four heuristics were selected because they addressed not only the identified issues in the IM process and the improvement proposals, but also because they respect the ITIL recommendations. The expected effect of each heuristic in the time performance of the IM process is described in Table 44.

ID	Expected effect in the IM process time performance
H1	Reduction of the average processing time for the 1st SL
H2	Reduction of the average processing time for the 2nd SL.
H3	Elimination of all time spent in the 1st SL activities
H4	Indirect: elimination of all time spent in the 1st SL activities

Table 44 - Expected effects of the selected heuristics

The premise to employ these heuristics is to combine them:

- *H2* should be combined with *H1*, otherwise the solo employment of *H2* will increase an already high average processing time for the 1st SL, since calls would still be performed.
- *H3* must be employed with the *H4*. Despite the latter not having a direct measurable impact in the time performance, it enables for *H3* to be employed. Thus, as shown previously, the impact of *H3* is the indirect impact of the *H4*.
- *H3* must also be employed with *H1*, or else there will not be a single-entry point of incidents, which is required for centralizing the incoming flow of incidents in one single 1st SL path and automate of the respective activities.

Concluding, the combination of these four redesign heuristics is essential to obtain the best time performance improvement for the IM process.

4.3.2.3. Redesign options modelling

Based on the identified heuristics and the conditions for their employment, four different redesign options for the IM process were produced, as detailed in Table 45.

ID	Heuristic employed	Issue affected	Corresponding proposal	Annexe
R1	H1	A, C	P1	7
R2	H1, H2	A, B, C, E	-	8
R3	H1, H3, H4	A, B, C, D	P2, P3	9
R4	H1, H2, H3, H4	A, B, C, D, E	-	10

Table 45 - Redesign options produced

Option *R1* is the solo employment of *H1*, proposing the elimination of the time-consuming calls in the 1st SL and centralizes emails as the single-entry point for incidents in the IM process. Option *R2*, adding to *H1*, proposes the transfer of the *Initial diagnosis* activity from the 2nd SL to the 1st SL. Option *R3*, adding to *H1*, proposes the automation of the all the user activities in the 1st SL (*incident identification, incident categorization*) by upgrading the IM system. Option R4, adding to H1, combines the automation of all the user activities in the 1st SL through the upgrading of the IM system with the transfer of the *Initial diagnosis* activity from the 2nd SL to the 1st SL. Two outcomes, transversal to all the redesign options, are expected:

- Changes in the processing times for 1st SL and 2nd SL.
- No changes in the processing time for the 3rd SL, since neither identified issue or redesign options changes affects it.

4.3.2.4. Redesign options simulation

The four redesign options were configured for simulation in the BPM system, to measure the time performance of each. The configuration and quantification of each redesign option was based on the data used in the *Process Analysis*.

All the redesign options imply the elimination of calls and centralization of emails as the single-entry point of the IM process. This means that, with only one starting event, the volume that corresponded to calls (360 incidents) shifted to that entry point.

Therefore, the whole volume of 6385 incidents arrived at the IM process by email. Considering this, the new arrival rate for the new starting event was calculated, in minutes (m), as presented in Table 46.

Starting event	Volume (q)	Rate (%)	Arrival rate (m)
Incident reported	6035	100%	13.081

Table 46 - Arrival rate for the four redesign options

The redesign options R3 and R4 require the automation of the user activities *incident identification* and *incident categorization* in 1st SL. This meant that these two activities would be performed by the IM system, no longer requiring effort for their accomplishment, as already happens with *incident logging* and *incident prioritization*. Therefore, the processing time considered for *incident identification* and *incident categorization*, in the options R3 and R4, was null minutes.

Options R2, R3 and R4, by addressing issue B, have as consequence the end of dispatching errors. Therefore, the rate and volume concerning *incident returned* (from the 2nd SL to the 1st SL) were removed in the configuring of these options.

Apart from these nuances in the redesign options, which are due to the changes proposed by each one, the remainder configurations were equal to the ones of *Process Analysis*.

4.3.2.5. Redesign options analysis

For each redesign option, an analysis was performed to assess the impact of each one in the time performance of the IM process and on the issues each one addressed.

Option *R1* resulted in the reduction of the average processing time for the 1st SL, as shown in Table 47, in minutes (m) and hours (h).

Impact in the 1st SL	Average processing time	
	(m)	(h)
Current state	9.45	0.16
Option R1	8.41	0.14
Difference	1.03	0.02

Table 47 - Impact of R1 implementation

With the employment of H1, issue A is eliminated, which also impacts issue C, resulting in a 10.9% decrease of processing time in the 1st SL when compared with the IM process in its current state. For the worst-case scenario in 1st SL, the results of R1 reveal a decrease to 12.93 minutes. However, the remainder of the issues still persisted (issue B and issue C), since there was no change in the 2nd SL.

Table 48 presents, in minutes (m) and hours (h), the results of the simulation of option *R2*.

	Average processing time					
Impact	**Current state**		**Option R2**		**Difference**	
	(m)	**(h)**	**(m)**	**(h)**	**(m)**	**(h)**
1st support level	9.45	0.16	19.50	0.32	10.05	0.16
2nd support level	202.69	3.38	178.17	2.97	24.52	0.41

Table 48 - Impact of R2 implementation

Although *R2* solved issues A, it aggravated issue C by adding 10.05 minutes to the average processing time in the 1st SL, which means that the time saved by eliminating calls was not enough to compensate for performing the *initial diagnosis*. For the worst-case scenario in 1st SL, the results of R2 show a decrease to 30.41 minutes. However, by solving issues B and E, the average processing time for the 2nd SL decreased by 24.52 minutes, a reduction of 12.1% when compared with the current time performance.

Option *R3* produced more significant results, as Table 49 presents in minutes (m) and hours (h).

	Average processing time					
Impact	**Current state**		**Option R3**		**Difference**	
	(m)	**(h)**	**(m)**	**(h)**	**(m)**	**(h)**
1st support level	9.45	0.16	0	0	9.45	0.16
2nd support level	202.69	3.38	180.98	3.02	21.71	0.36

Table 49 - Impact of R3 implementation

With the employment of *H1*, *H3* and *H4*, the option *R3* eliminated the processing time for the 1st SL, which solves issues A, B, C and D, and also eliminates the worst-case scenario.

Without dispatching errors, the 2nd SL had it processing time reduced to an average 180.98 minutes, a break of 10.7% compared to the current state of the IM process. However, in this redesign option, there still was waste of time with invalid incidents (issue E).

The results of option *R4*, are presented in Table 50, in minutes (m) and hours (h).

	Average processing time					
Impact	**Current state**		**Option R4**		**Difference**	
	(m)	**(h)**	**(m)**	**(h)**	**(m)**	**(h)**
1st support level	9.45	0.16	11.5	0.19	2.05	0.03
2nd support level	202.69	3.38	178.17	2.97	24.52	0.41

Table 50 - Impact of R4 implementation

By employing all the selected redesign heuristics, *R4* solved issue A, B, D and E. The average processing time for 2nd SL was reduced to 178.17 minutes, a reduction of 12.1% compared to the current time performance. For the worst-case scenario in 1st SL, the results of R4 show a reduction to 30.41 minutes. However, by deploying all the redesign heuristics, issue C was slightly aggravated, with the processing time for 1st SL increasing to an average 11.5 minutes, which represents a difference of 2.05 minutes per incident.

As expected, all the redesign options changed the processing times either for 1st SL and for 2nd SL, and neither altered the processing time for 3rd SL.

4.3.2.6. To-be model options

Table 51 compares the impact of the four redesign options, in minutes (m) and hours (h).

	Average processing time							
Impact	**Option R1**		**Option R2**		**Option R3**		**Option R4**	
	(m)	**(h)**	**(m)**	**(m)**	**(m)**	**(h)**	**(m)**	**(h)**
1st support level	8.41	0.14	19.50	0.32	0	0	11.50	0.19
2nd support level	202.69	3.38	178.17	2.97	180.98	3.02	178.17	2.97
3rd support level	707.77	11.80	707.77	11.80	707.77	11.80	707.77	11.80

Table 51 - Comparison of the four redesign options

With the results of the several redesign options analysed, it was clear that *R3* and *R4* were the redesign options which presented the best time performance improvement.

Table 52 presents a detailed comparison between these two redesign options, in minutes (m) and hours (h).

Impact	Average processing time					
	Option R3		Option R4		Difference	
	(m)	(h)	(m)	(h)	(m)	(h)
1st support level	0	0	11.50	0.19	11.50	0.19
2nd support level	180.98	3.02	178.17	2.97	2.81	0.05
3rd support level	707.77	11.80	707.77	11.80	-	-

Table 52 - Redesign options comparison

The greatest difference between the two options is the average processing time for the 1st SL, which is 11.50 minutes. While in R3 there is no time spent with 1st SL activities, resulting from the automation of the dispatching activities, in R4 the processing time is 11.50 minutes, which is higher than the current time performance. Concerning 2nd SL, the difference between the two options is smaller, consisting only in an average 2.81 minutes per incident. Once again, all these values are averaged, each hides the reality of possible more extreme, lower or higher, processing times. The two redesign options, *R3* and *R4*, and the respective results were submitted for debate and approval in the 3rd focus group.

4.3.2.7. Approval of the to-be model

The 3rd focus group gathered all the team members available (I17 was no longer part of the team) to debate the redesign options *R3* and *R4* and its results. The redesign option chosen and approved by the team members was *R3*. This choice was made by all the team members in consensus, which agreed that *R3* was the redesign option that met the issues reported in the 3rd round of interviews and the improvement proposals made in the 4th round of interviews. *R4* was rejected due to the higher processing time it demands for the 1st SL, the main source of issues. The team members preferred to keep the initial diagnosis in the 2nd SL and deal with invalid incidents, instead of raising the processing time of 1st SL and receiving only valid, real work incidents in the 2nd SL. Also, management rules from the organisation required that the *initial diagnosis* to remain in the 2nd SL, due to an update of the IM system that was planned to occur, has a step for the improvement of the IM process. The final approved to-be model for the IM process is depicted below in Figure 11.

The 3rd focus group was the finishing step of *Process Redesign*.

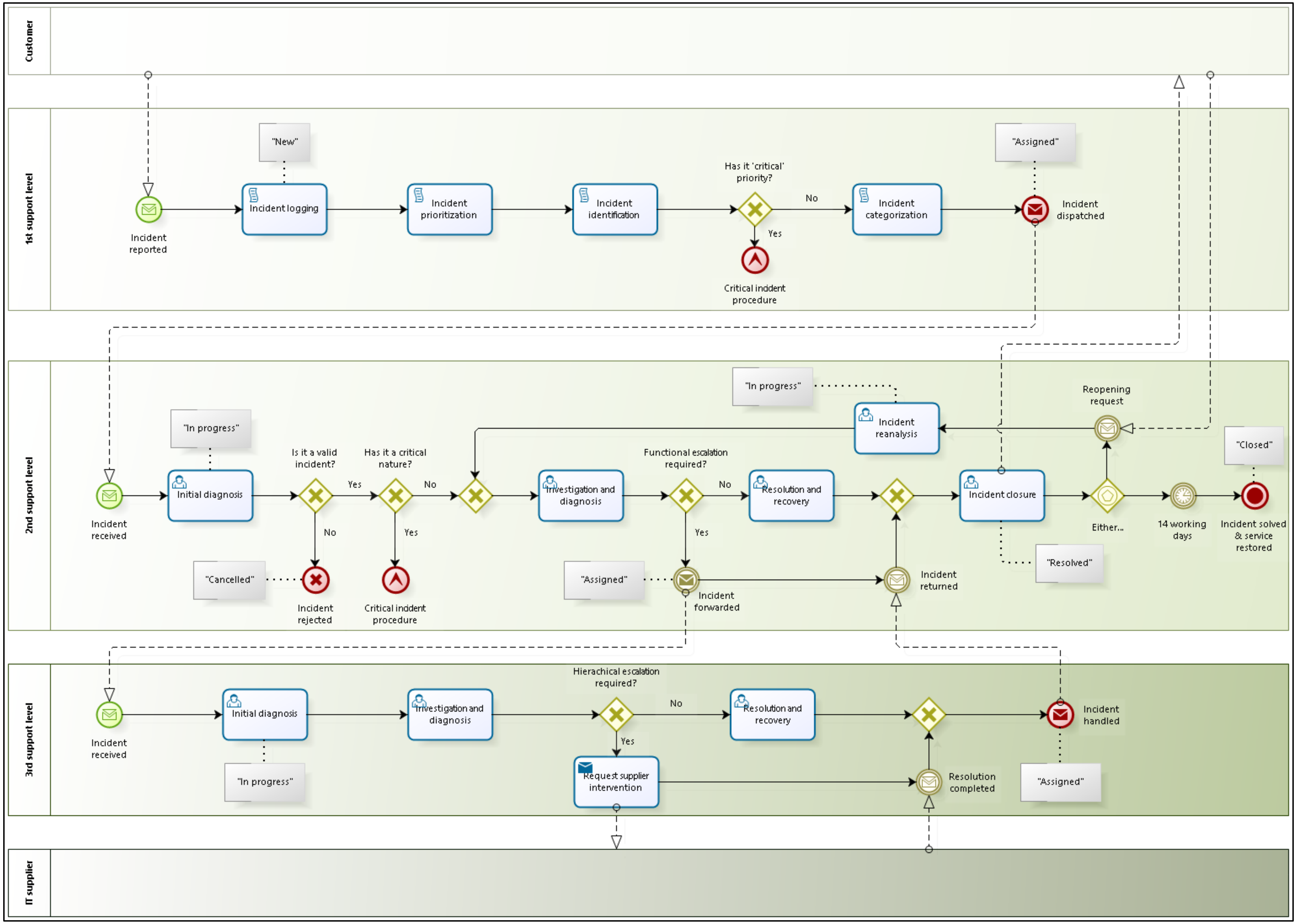


Figure 11 - To-be model

4.4. Summary and Recommendations

The conduction of the case study revealed how the analysed IM process is shaped, what is its current performance and how that performance can be improved through the employment of the BPM methodology and redesign heuristics.

The initial phase of the case study, *Process Discovery*, provided both a visual and a documented understanding of how the IM process is performed and who are the participants involved. It was discovered that the analysed IM process is a standardized process, mainly based on the ITIL standard. The IM process not only follows the ITIL workflow, but also most of the recommendations and rules proposed by ITIL for the management of incidents' lifecycle are adopted by the organisation's support service. The results and conclusions of this initial phase, namely the as-is model, were the basis for the analysis performed in the ensuing phase.

The second phase of the case study, *Process Analysis*, allowed to assess, characterize and quantify the IM process in its current state, and to reveal and measure the issues affecting its time performance. A list of five identified and quantified issues affecting the IM process current time performance was produced and was assessed and approved by the team members. Of those five issues, four had an operational nature, while one had a technological nature, being the issues mainly related to the 1st SL. These identified issues were targeted as improvement opportunities for the final phase.

Process Redesign, the last phase in the conduction of the case study, analysed how the issues identified in *Process Analysis* could be resolved and the IM process improved, through the identification and employment of BPM heuristics, which consists in researching goal of the case study. Four redesign heuristics (activity elimination, resequencing, activity automation and integral technology) were identified has best suited for employment in the IM process to overcome its issues and improve its time performance. Based in the selected heuristics, four different redesign options were modelled and simulated in the BPM system. Option *R3* was chosen by the team as the to-be version of the IM process, mainly because it addressed the issues reported by the team members in the 3rd round of interviews and reflected the improvement proposals suggested in the 4th round of interviews. It was also chosen due to management reasons, which had a planned upgrade of the used IM system that was starting to happen. Thus, the applied redesign heuristics for improvement of the IM process were activity elimination, activity automation and integral technology.

Comparing the as-is with the to-be model, the employment of activity elimination, activity automation and integral technology enabled to address and solve the issues identified during *Process Analysis*. The elimination of calls as entry point in the IM process allowed to remove a time-consuming activity and streamlined the arrival of incidents. This in turn enabled the full automation of the 1st SL activities, by upgrading the IM system. The measured result was the elimination of the time spent by the 1st SL and the decrease of 10.7% in the average processing time required by the 2nd SL, when compared with the current state of the IM process. Thus, the IM process become faster, which was the desired outcome.

As managerial recommendations, this case study reveals that the upgrading of the IM system is a good option and required for the automation of activities to be possible. The automation of activities solves the waste of time with dispatching activities and with dispatching errors, existing in the current situation. However, it is fundamental to eliminate calls and establish emails as the single-entry point of incidents, not only because it saves time, but also because it allows the automation of activities to achieve its full effect. With the automation of all the activities of the 1st SL, there is no need for HR in this SL. These team members can be trained to perform 2nd SL role, increasing its installed capacity. The establishment of KPIs to measure effort and processing times allows to control the time performance of the IM process and to discover and approach potential issues more easily. The implementation of such parameters is recommended while updating the IM system.

4.5. Discussion

This case study shows that, as Hammer (2010) states, a good process can always be improved. Although the analysed IM process was complying with its operational and quality targets, there was still room for improvement of the time performance. The identified and selected redesign heuristics – activity automation, activity elimination and integral technology – proved to be the best suited to be employed for the improvement of the analysed IM process, while respecting the ITIL guidelines.

As seen in Chapter 2, to the best of our knowledge, there is no related work found applying a BPM approach for the improvement of the IM process specifically.

In the related work found concerning the improvement of the IM process, seen in Table 5, researches study and propose solutions for the improvement and optimization of the

IM process, being automation a frequently explored path. This further sustains the results of this case study on indicating activity automation and integral technology as best suited redesign heuristics. Different techniques and methods are presented for automating IM process, as the work developed by Ghrab *et al.* (2016), Goby *et al.* (2016), Trinkenreich *et al.* (2015) and Gupta *et al.* (2008) demonstrate. This may be due to the ease existent for the automation of certain activities in the IM process, especially the less analytical and time-consuming ones. Such is the case in this research, as the activities performed by the 1st SL are proposed for automation. Other solutions for improvement are presented as well in the works developed by Salah *et al.* (2015), Bezerra *et al.* (2014) and Bartolini *et al.* (2008). However, these solutions are IT-oriented, looking at improvement as a technical challenge and focusing on specific features and activities of the IM process, not considering the whole processual perspective. Contrary to this, the BPM approach applied in this research allows organisations to have an integrated perspective of the IM process, understanding the relations between the different activities and participants, and providing an end-to-end view of how a given improvement can affect the performance the IM process.

In the related work found concerning BP improvement through BPM, seen in Table 6, no cases were found of application on any IT processes. The works of Mahy *et al.* (2016) and Bezerra *et al.* (2014) do model the IM process, but their purpose was not BP improvement. This leaves this research as an exploratory case, adding to the body of knowledge in this area.

5. Conclusions

BPM is a broad discipline that offers methodologies and tools for the control and improvement of BP. By using BPM, managers can thoroughly analyse BP and discover improvement opportunities, which is increasingly requested in the organisational environment.

This research explored how the IM process can be improved through a BPM approach, a relationship that has not yet been much investigated by the scientific community. For this goal, a case study methodology was followed. The conducted case study followed the recommendations suggested by Yin (2009) for the validation of the research, thus assuring the quality of the results obtained, as Table 53 describes.

Test	Description	Chapter
Construct validity	Multiple sources of evidence are used, and triangulation of data is also performed	3. Research Methodology 4. Conduction of the Case Study
Internal validity	Causal relationship is assured, by producing explanations and conclusions through the analysis and linking of the collected evidence	4. Conduction of the Case Study
External validity	A literature review is performed to define the domain to which the study's findings can be generalized. The results of the research are compared with the related work found	2. Literature Review & Theoretical Background 5. Discussion
Reliability	The procedures of the case study are documented and Yin (2009) recommendations were followed	4. Collection of Evidence

Table 53 - Validity tests to Yin (2009) case study methodology

The goal of the case study conducted was achieved with the presentation of the BPM redesign heuristics that best suit the analysed IM process. This means that the objective of the research was also achieved, by showing that the IM process can be improved through a BPM approach.

The main conclusions of this research are that the best suited redesign heuristics for the improvement of the analysed IM process are activity elimination, activity automation and integral technology. IT managers and organisations should consider these as a way to achieve a better performance for the IM process.

This research contributes to reduce the gap existent between BPM and ITSM processes. There is a clear relation between both areas, due to their process-oriented nature, but there is very few research developed in this specific area.

Although the research fulfilled its objectives, it faced some limitations. First, the main one, this research itself is limited to this organisation, to this case study, which means that results obtained may not be valid for other cases. However, as seen in Chapter 2, and also concluded in the case study, this kind of process is highly adopted by organisations and also is heavily standardized, being ITIL the most adapted standard. This means that, although this is a case study limited to the chosen unit of analysis, its results may be similarly adopted for other cases. The limitations found in the collection of evidence, concerning the archival records, did not allowed a more solid, in-depth analysis to the IM process, which could have revealed more issues.

For future researches on the topic, BPM is a management approach that can help to understand and improve IT processes. Researchers and managers can start looking at IT processes as common industrial operations that can be improved to assure the best service provided. This relationship can be more explored, in larger scopes, for example, the analysis and improvement of all processes in a support service. As mentioned, there is a large gap to close in this area. Still, it is advised the study and knowledge of BPM analytical tools and of ITSM frameworks to perform this kind of research.

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Annexes

Annexe 1 – 1st round of interviews template

<u>*Process Discovery* | 1ª ronda de entrevistas</u>

Introdução

"Este questionário é realizado no âmbito de um projeto de modelação e otimização do processo de *incident management*. Tem como único objetivo o levantamento das atividades e fluxos do processo, para um primeira fase de mapeamento. O que se pretende do entrevistado é que responda às perguntas e desenhe um mapa processual do processo de *incident management*, estando sempre à vontade para não responder se assim o preferir."

Questões fechadas

a) Quais são as suas funções enquanto participante no processo de *incident management*?

b) Que outras funções e outros participantes existem no processo de *incident management*?

c) Com base na sua função, que tarefas é que desempenha e quais as suas responsabilidades no processo de *incident management*?

d) Onde é que começam e onde é que acabam as suas responsabilidades no processo de *incident management*?

Questão aberta

e) Tendo em conta as suas respostas anteriores, mapeie o processo de *incident management.*

Annexe 2 – 2nd round of interviews template

Process Discovery | 2ª ronda de entrevistas

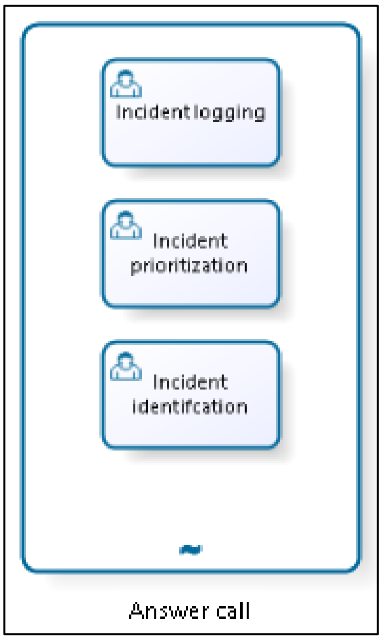
Introdução

"Este questionário é realizado no âmbito de um projeto de modelação e otimização do processo de *incident management*. Tem como objetivo o ajuste e detalhe do primeiro rascunho do modelo do processo de *incident management*. O que se pretende do entrevistado é que avalie o primeiro rascunho e indique correções, sugira ajustes e melhorias, e que indique detalhes e características importantes do processo de *incident management*, estando sempre à vontade para não responder se assim o preferir."

Questões abertas

a) Indique no rascunho os erros e omissões que encontrou e em seguida corrija-os. Descreva tanto os erros e omissões como as correções, e justifique.
b) Indique no rascunho as melhorias ou alterações que faria, e em seguida descreva-as e justifique.
c) Indique no rascunho os detalhes e características operacionais e processuais que deveriam ser representadas, e em seguida descreva-as e justifique.

Annexe 3 - *Answer call* subprocess



Annexe 4 – 3rd round of interviews template

***Process Analysis* | 3ª ronda de entrevistas**

Introdução

"Este questionário é realizado no âmbito de um projeto de modelação e otimização do processo de *incident management*. Tem como objetivo o levantamento de problemáticas afectivas ao desempenho de tempo do processo de *incident management*. O que se pretende do entrevistado é que reflita sobre a situação o processo de *incident management*, e que indique e descreva os problemas que afetam a operação diária do mesmo e o seu desempenho de tempo, estando sempre à vontade para não responder se assim o preferir."

Questões fechadas

a) Quais são os problemas existentes no processo de *incident management* que afetam o desempenho de tempo do mesmo?
b) Que atividades, limitações e outras situações levam ao desperdício de tempo no processo de *incident management*?
c) Quais as atividades, limitações e outras situações no processo de *incident management* que afetam o desempenho das suas funções e que lhe "roubam" tempo?

Questão aberta

d) Com base nas suas respostas anteriores, localize no modelo as-is do processo de *incident management*, as problemáticas indicadas.

Annexe 5 – Time estimates survey

***Process Analysis* | Questionário de estimativa de tempos**

Introdução

"Este questionário é realizado no âmbito de um projeto de modelação e otimização do processo de *incident management*. Tem como objetivo o levantamento de estimativas de tempos para as adtividades do processo de *incident management*. O que se pretende do entrevistado é que reflita sobre as suas tarefas no processo de *incident management*, e que indique estimativas de tempo para as diversas actividades que desempenha, estando sempre à vontade para não responder se assim o preferir."

Questionário

Com base nas suas funções, indique estimativas de tempo para as actividades que desempenha no processo de *incident management*. Por favor, responda apenas para a sua função: 1ª linha de suporte (*support agent*), 2ª linha de suporte (*support expert*) ou 3ª linha de suporte (*IT specialist*).

1ª linha de suporte | *Support agent*		
Actividade	**Duração**	**Estimativa de tempo (minutos ou horas)**
Answer call	Máxima Mais provável Mínima	
Incident identification	Máxima Mínima	
Incident categorization	Máxima Mínima	

2ª linha de suporte | *Support expert*		
Actividade	**Duração**	**Estimativa de tempo (minutos ou horas)**
Initial diagnosis	Máxima Mínima	
Investigation and diagnosis	Máxima Mais provável Mínima	
Resolution and recovery	Máxima Mais provável Mínima	
Incident closure	Máxima Mínima	
Incident reanalysis	Máxima Mínima	

3ª linha de suporte | *IT specialist*		
Actividade	**Duração**	**Estimativa de tempo (minutos ou horas)**
Initial diagnosis	Máxima Mínima	
Investigation and diagnosis	Máxima Mais provável Mínima	
Resolution and recovery	Máxima Mais provável Mínima	
Request supplier intervention	Máxima Mínima	

Annexe 6 – 4th round of interviews template

Process Redesign **| 4ª ronda de entrevistas**

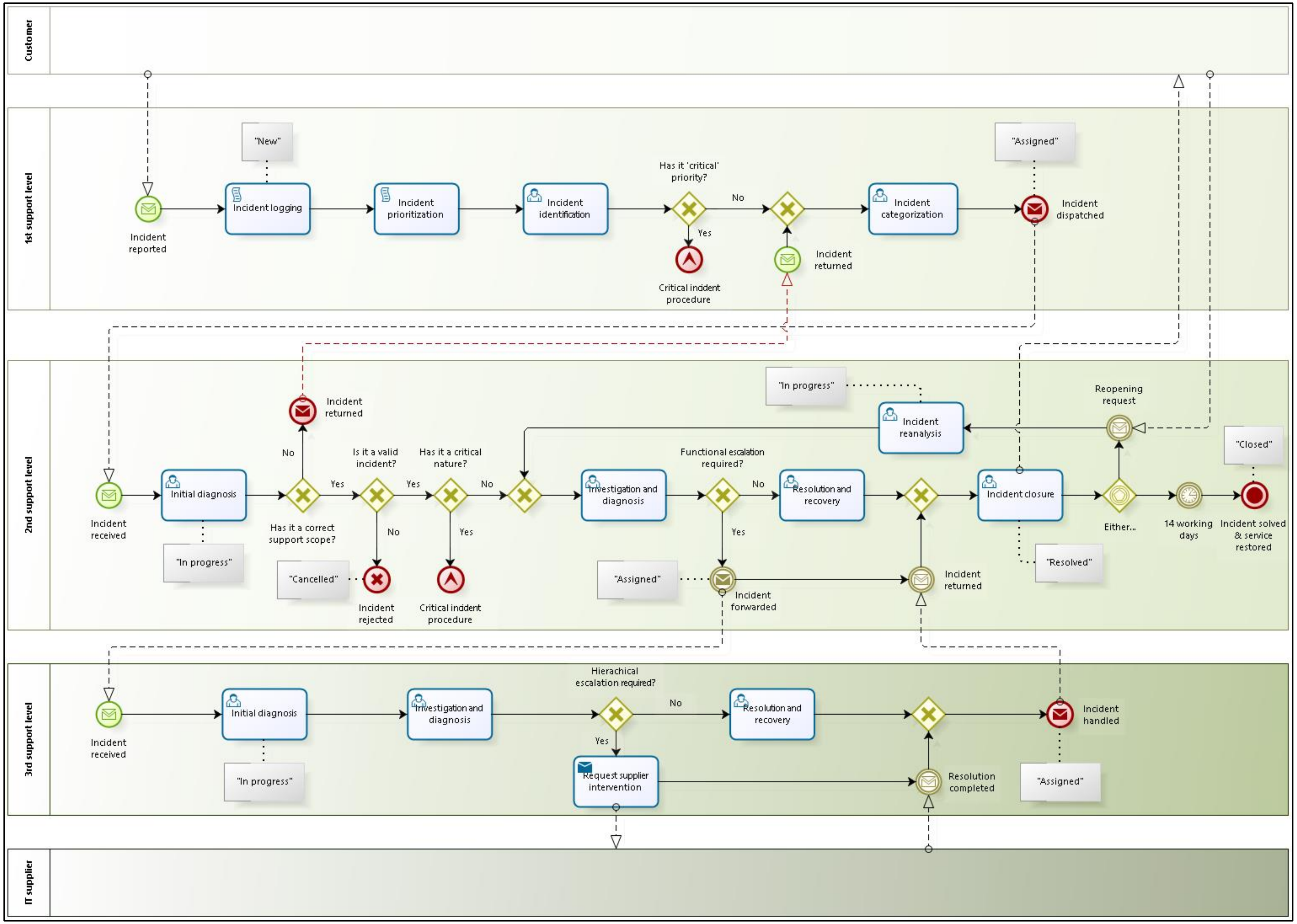
Introdução

"Este questionário é realizado no âmbito de um projeto de modelação e otimização do processo de *incident management*. Tem como objetivo o levantamento de sugestões e propostas de melhoria para o processo de *incident management*. O que se pretende do entrevistado é que reflita sobre as problemáticas identificadas no processo de *incident management*, e sugira acções de melhoria ao processo para combater essas problemáticas, estando sempre à vontade para não responder se assim o preferir."

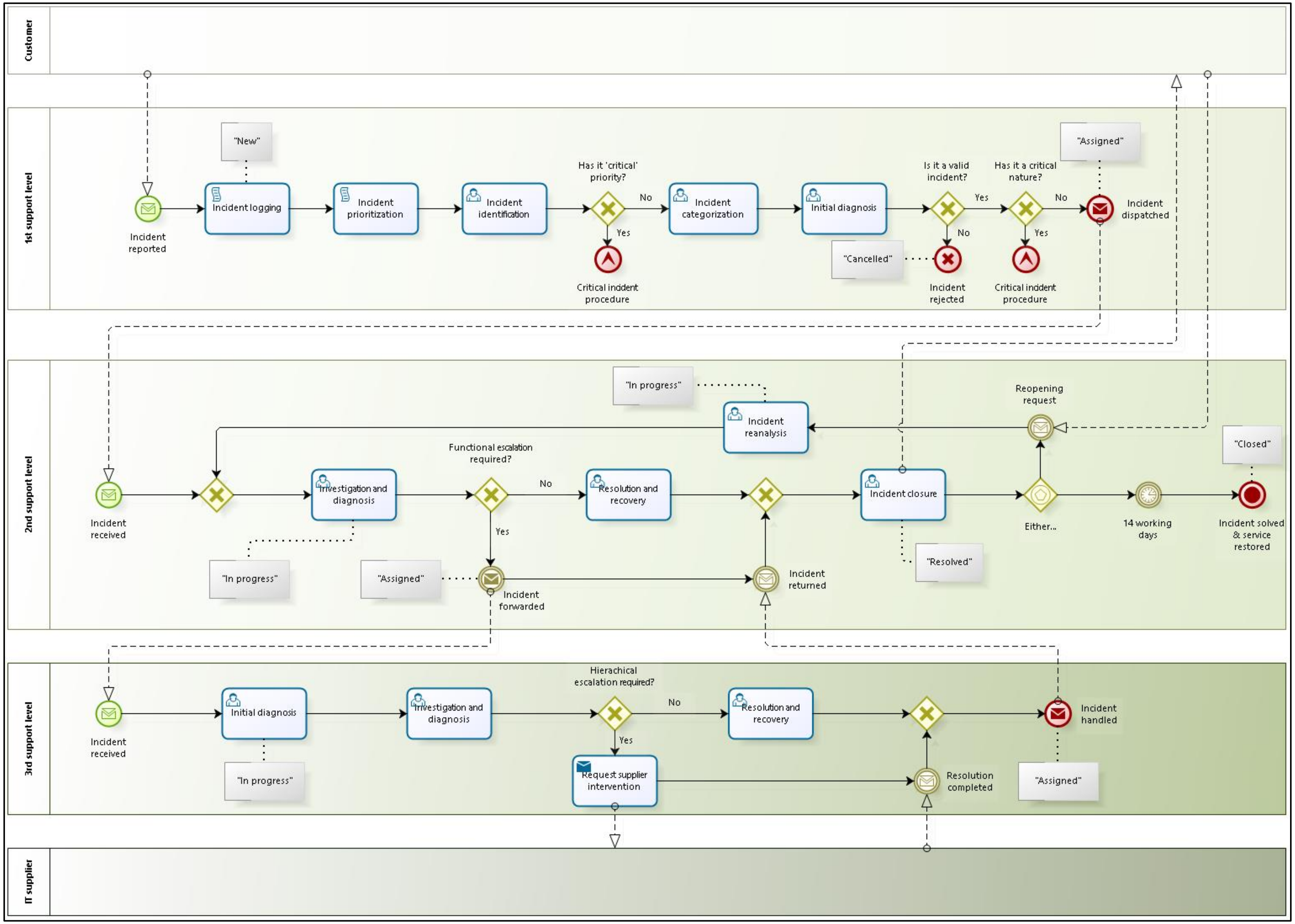
Questões abertas

a) Indique e descreva possíveis soluções para a problemática A - *answer calls*, na 1ª linha de suporte. Justifique.
b) Indique e descreva possíveis soluções para a problemática B - *dispatching errors*, na 1ª linha de suporte e na 2ª linha de suporte. Justifique.
c) Indique e descreva possíveis soluções para a problemática C - *1st support level activities*, na 1ª linha de suporte. Justifique.
d) Indique e descreva possíveis soluções para a problemática D - *obsolete IM system*, em todo o processo de *incident management*. Justifique.
e) Indique e descreva possíveis soluções para a problemática E - *invalid incidents*, na 1ª linha de suporte e na 2ª linha de suporte. Justifique.

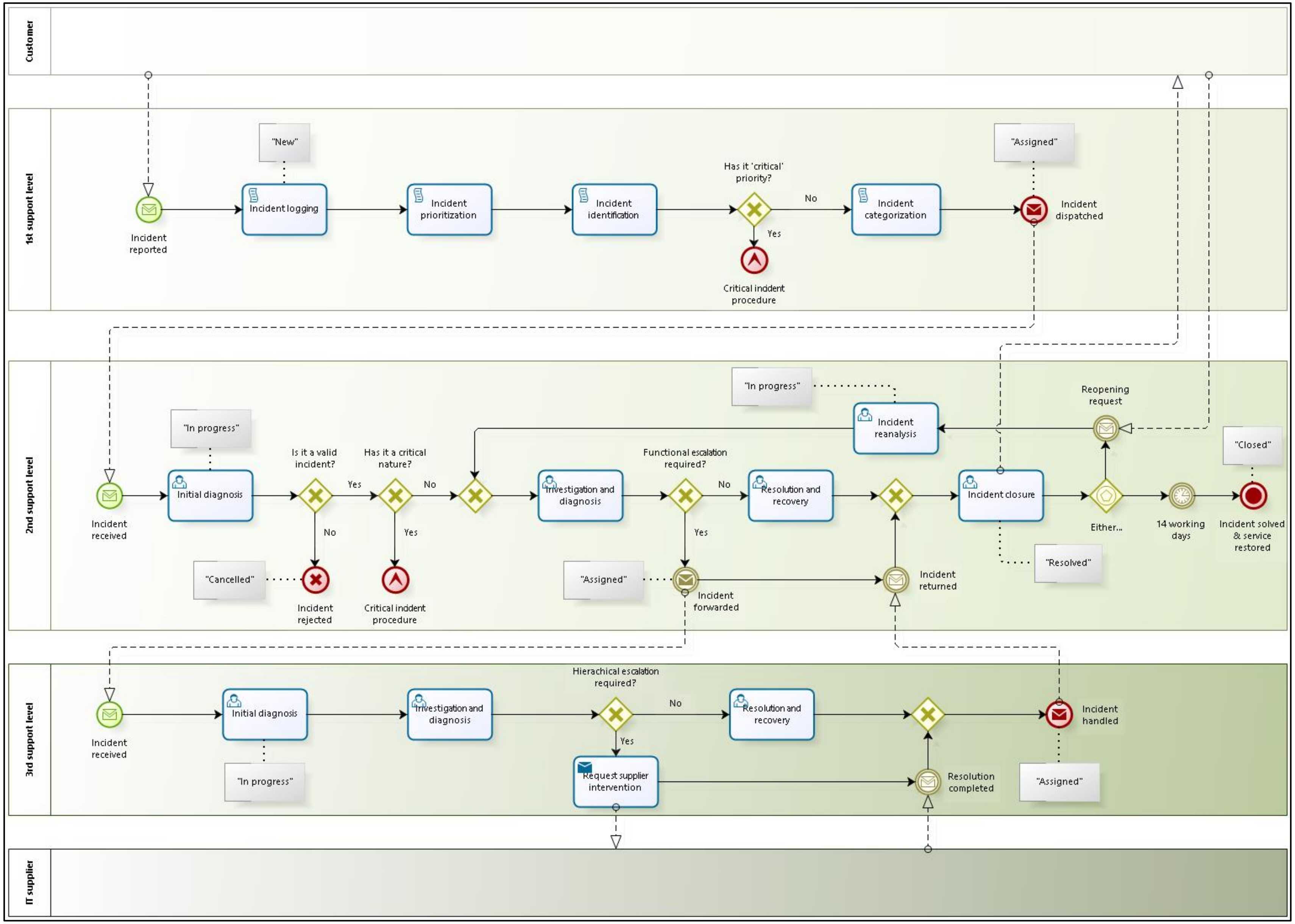
Annexe 7 – Redesign option 1



Annexe 8 – Redesign option 2



Annexe 9 – Redesign option 3



Annexe 10 – Redesign option 4