IUL School of Technology and Architecture

Department of Information Science and Technology

DASHBOARD DESIGN APPLIED TO THE ITIL®V3 PROBLEM MANAGEMENT PROCESS: A CASE STUDY AT ISCTE-IUL

Tiago Miguel Henriques Martinho

A Dissertation presented in partial fulfillment of the Requirements for the Degree of Master in Computer Engineering

Specialization in Information Systems and Knowledge Management

Supervisor:

PhD, Elsa Alexandra Cabral da Rocha Cardoso, Assistant Professor
ISCTE – University Institute of Lisbon,

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ISCTE IUL
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In memory of Manuel Francisco Martinho (1934 – 2010) and António Miguel Henriques (1940 – 2013), for giving me education and values of life that allowed me to grow and face life and all its challenges with seriousness, humility and dedication.

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Abstract

ISCTE-IUL is a Portuguese higher education institute that is oriented to the ITIL®V3 adoption for the Information Technology (IT) Services, in order to improve the management practices in accordance with best practices recommended and to achieve the ISO/IEC 20000 certification.

Dissertations have been related with the ITIL processes implementation, having already implemented the Asset Management, Incident Management, Request Fulfillment and the Change Management processes. The scope of this dissertation is the implementation of the Problem Management process that will fills the gap in the problem root-cause investigation.

The Problem Management process defines the activities required to control the flow of problems and ensure the correct recording, evaluation, investigation and solution implementation. This dissertation describes the evaluation of the current problem management process at ISCTE-IUL and the transition to a new process developed according to the best practices and modeled with the Business Process Modeling Notation (BPMN).

As recommended by ITIL, the processes must be monitored and measured using appropriate metrics. In line with this, was defined the second phase of the dissertation, the process measurement. In this phase are designed and built Service Operation Dashboards covering the Incident Management, Request Fulfillment and Problem Management processes. This measurement is performed through Microsoft Excel, analyzing the data extracted from the EasyVista, an ITSM platform. The goal is to analyze the data and provide reliable information to enable the decision-making based on facts, identifying trends and the levels of effectiveness and efficiency.

Key words: ITIL®V3, Problem Management, Information Technology Services Management, Dashboards, ISCTE-IUL

ACM classification: K.6 Management of Computing and Information Systems

Resumo

O ISCTE-IUL é um instituto superior de educação Português, orientado à adoção do ITIL®V3 nos seus serviços das Tecnologias da Informação (TI). Melhorando assim as práticas de gestão, de acordo com as melhores práticas recomendadas e atingir a certificação ISO/IEC 20000.

Dissertações relacionadas com a implementação dos processos de ITIL têm surgido, estando atualmente implementados os processos de Gestão de Ativos de Serviço, Gestão de Incidentes, Satisfação de Pedidos e Gestão de Alterações. O âmbito desta dissertação é a implementação do processo de Gestão de Problemas que irá preencher a lacuna na investigação da causa-raiz dos problemas.

O processo de Gestão de Problemas define as atividades necessárias para controlar o fluxo de problemas e assegurar o correto registo, avaliação, investigação e implementação da solução. Nesta dissertação é descrita a avaliação ao estado atual do processo presente no ISCTE-IUL e a sua transição para o novo processo, desenvolvido de acordo com as melhores práticas e modelado com a *Business Process Modeling Notation (BPMN)*.

Segundo recomendações do ITIL, os processos devem ser avaliados utilizando métricas apropriadas. Foi assim definida a segunda fase da dissertação, contemplando a medição dos processos. Foram desenhados e construídos *Dashboards* da Operação do Serviço, abrangendo os processos de Gestão de Incidentes, Satisfação de Pedidos e Gestão de Problemas. Esta medição é executada através da ferramenta Microsoft Excel, analisando os dados extraídos do EasyVista, uma plataforma de Gestão de Serviços das TI (ITSM).O objetivo é analisar os dados e fornecer informação fidedigna, permitindo a tomada de decisão baseada em factos, identificando tendências e os níveis de eficácia e eficiência.

Palavras-chave: ITIL®V3, Gestão de Problemas, Gestão de Serviços de TI, Dashboards, ISCTE-IUL

Classificação: ACM: K.6 Management of Computing and Information Systems.

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Abbreviations

BPMN – Business Process Modeling Notation

HEI – Higher Education Institutions

ISCTE-IUL – ISCTE-University Institute of Lisbon (from the Portuguese ISCTE-Instituto Universitário de Lisboa)

ISO – International Organization for Standardization

IT – Information Technology

ITIL® - Information Technology Infrastructure Library®

ITSM – Information Technology Service Management

KEDB – Known Error Database

NAU – User Support Center (from the Portuguese Núcleo de Apoio ao Utilizador)

OGC – Office of Government Commerce

OTRS – Open-Source Ticket Request System

KPI – Key Performance Indicator

RFC – Request For Change

SLA – Service Level Agreement

1 Introduction

This dissertation focuses on the theme of Information Technology Service Management (ITSM), more specifically, on the use of the Information Technology Infrastructure Library® (ITIL®) Problem Management process. The subjects under study comprise the ITIL® framework (version 3) and the design of effective dashboards. Dashboards will be developed to enable the understanding of metrics to support the monitoring and the decision making regarding the Service Operation processes in the context of the Information Technology (IT) services of the ISCTE – Lisbon University Institute (ISCTE-IUL), a public Higher Education Institution in Lisbon, Portugal.

A problem is an obstacle, impediment, difficultly, any question or matter involving doubt or uncertainly, or any situation that requires a resolution. Therefore, a problem leads to a challenge consisting of many actions in the direction of achieving positive results, resulting in an acceptable solution. The repetition of similar challenges and problems leads to theories and methods, which allows us to create innovation (D'Ambrósio).

In an increasingly computerized and competitive society it is essential to have efficient methods to solve problems, resulting in less downtime, less disruption to business critical systems, higher productivity of business and IT staff, reduced expenditure on workarounds and reduction in cost of resolving repeated incidents.

In ITSM, problem management is the process responsible for managing the lifecycle of problems. The main objectives of this process are: (1) to prevent problems and resulting incidents from happening, (2) to eliminate recurring incidents and (3) to minimize the impact of incidents that cannot be prevented. This process includes activities such as root-cause analysis to determine and resolve the cause of incidents, proactive attitude to detect and prevent future problems and incidents, and a Known Error repository to improve diagnosis and resolution if further incidents occur (OGC 2007).

1.1 Research Context

The dissertation follows on from previous studies, done at ISCTE-IUL by Master's degree students in partnership with faculty and members of the IT Services, based on the implementation of ITIL®v3 best practices in Higher Education Institutions. The purpose of implementing ITIL®v3 best practices at ISCTE-IUL is to improve the effectiveness and efficiency of ITSM processes, with the goal of achieving an international certification of quality ISO/IEC 20000:2011.

In the previous studies, the following ITIL®v3 processes were addressed: Service Asset and Configuration Management (Martins 2010), Incident Management and Request Fulfillment (Ferreira 2011), and the Change Management (Barroso 2011). These processes were modeled, implemented and are currently in use by EasyVista, the ITSM tool adopted at ISCTE-IUL. This dissertation focuses on the next most important process to be implemented according to the Director of ISCTE-IUL's IT Services – the Problem Management process.

The Problem Management process incorporates the activities needed to diagnose the root causes of incidents to determine which resolution can solve the problem. This process takes responsibility for ensuring that the resolution is implemented through the appropriate control procedures, especially using the Change Management and Release Management processes. The information about problems and appropriate solutions will be maintained using tools such as the Known Error Database and an efficient communication with the Knowledge Management process, leading to a reduction in number and impact of incidents in the institution over time.

Incident and Problem Management share similar features and functionality, although they are separate processes. These processes are closely related and will normally use the same tools and use similar categorization, ensuring effective communication when dealing with related incidents and problems.

1.2 Motivation

Problems and incidents are major threats for any institution, with negative impacts, affecting the correct functioning of IT Services. Therefore, in order to mitigate these risks, the implementation of ITSM best practices in an organization is most valuable. The implementation of a problem management process is very important for ISCTE-IUL because it enables (OGC 2007):

- The inquiring and understanding of the root causes of incidents;
- An increase in IT service availability and quality;
- A greater control and monitoring of the problems reported;
- The recording of information about resolutions;
- The use of recorded information to speed up the resolution time and identification of permanent solutions, reducing the number and resolution time of incidents;
- A lesser downtime and lesser disruption to business critical systems;
- A higher availability of IT services;
- A higher satisfaction and productivity of the business and the IT staff;
- A reduced expenditure on workarounds or fixes that do not work; and
- A reduction in the cost of resolving repeated incidents.

These improvements not only create value to the business but are also a step forward towards the achievement of the international certification ISO/IEC 20000:2011, which would increase the reputation of the IT Services and ISCTE-IUL in general. With this work it is expectable that the IT Service staff will acquire more knowledge and experience in ITIL®v3 best practices, which in turn may result in a better acceptance for new practices (i.e., an improvement in resistance to change).

Top management needs to take decisions based on facts and numbers, so it is essential to extract quantitative results from the implemented processes. The ITSM tool currently in use by the institution, EasyVista, has some deficiencies in this field. The purpose of developing the dashboards is to overcome the gaps of the ITSM tool by providing key performance indicators achieved by investigation

and analytics capabilities to support more efficiently the decision-making process regarding the aspects of Service Operation processes.

Finally, this dissertation is purposely written in English to facilitate the dissemination of results, which may be useful to other national and international Higher Education Institutions that wish to implement the ITIL®v3 best practices.

1.3 Research Questions

This dissertation emerges from the need to have a mechanism to inquire, monitoring and gathering information about problems and root causes of incidents. ISCTE-IUL does not have that mechanism and problems are treated in a reactive way. Currently, the old system called Gralha providing a service to store errors and known issues, as well as requests for product improvements and services, is no longer in use. Each record in the Gralha system documented the lifecycle of a single problem, services or features request (Borges 2009).

Mismanagement can lead to the inability to link Incident and Problem management, making it more difficult to inquire the root causes of problems and therefore leading to increasing delays in the investigation of problems. With these delays, more incidents can happen, increasing the negative impact on the institution. Making sure that business impact is well understood by the IT staff working on problem resolution is essential for the acceptance of Problem Management process.

The Problem Management implementation will allow the IT staff to improve the problem investigation and diagnosis, find a workaround, raising a known error record, problem resolution, problem closure and major problems review. The investigation should be conducted to try to diagnose the root cause of the problem. In some cases it may possible to find a workaround to the incidents caused by the problem, as a temporary way of overcoming the difficulties. As soon as the diagnosis is complete, and particularly where a workaround has been found, a Known Error Record must be raised and placed in the Known Error Database, which allow IT staff to identify further incidents or problems and restore the service more quickly. Ideally, as soon as a solution has been found, it should be applied to resolve the problem, but if any change in functionality is required this will require a Request for Change in the Change Management process to be raised and approved before the resolution can be applied. When any change has been completed, successfully reviewed and the resolution has been applied, the Problem Record should be formally closed, ensuring that the record contains a full historical description of all events. According to the organization's priority system, every major problem should be reviewed to learn any lessons for the future, specifically, those related to things correctly done, those things that were done wrong, what could be better in the future, how to prevent recurrence, whether there has been any third-party responsibility and whether follow-up actions are needed (OGC 2007).

The main problem addressed by this dissertation is the inefficient and reactive problem management process currently in place at the IT Services of ISCTE-IUL, specifically:

- The imprecise association of an incident to a problem, the temporary workarounds that are often mismanaged, and the lack of an efficient review of the implemented solutions;
- The lack of an efficient and updated system to record all the information about problems and known errors, that increases the time spent in inquires;
- The poorly defined problem management process does not have a strong communication with the change management process, which may cause adverse effects, such as mismanaged changes;
- The generic information provided by the ITSM tool does not cover all the necessary requirements to support the decision-making of the IT Services Director and managers.

The following research questions are then formulated:

- Is it possible to adapt the best practices of ITIL®v3 Problem Management Process to the IT services of ISCTE-IUL?
- Is it possible to extract sufficient information from the ITSM tool implemented at ISCTE-IUL (EasyVista) to build service operation dashboards?
- Can these service operation dashboards be considered useful to support the decision-making and justify the allocation of resources and costs regarding the service operation processes?

1.4 Objectives

EasyVista is the ITSM tool adopted by the IT Services of ISCTE-IUL and the following processes are already implemented: the Service Asset and Configuration Management process, the Incident Management Process, the Request Fulfillment process and the Change Management process. This tool provides generic information about the functioning of these processes, but it is unable to fulfill the requirements of the IT Services managers, as it cannot provide detailed metrics to support decisions. For that reason, dashboards will be designed and created to compile metrics for the implemented processes, providing more flexibility in the management and understanding of the metrics, quantifying all information to support the decision-making based on facts.

This dissertation aims to implement the problem management process based on ITIL®v3 for the IT Services of ISCTE-IUL, to improve the problem investigation and diagnosis, record known errors and to monitor the implemented solutions.

This research work encompasses the analysis, design, implementation and monitoring of the ITIL®v3 Problem Management process, according to the proposed best practices. Standard methods and procedures will be defined for the effective and efficient treatment of problems, i.e., ensuring that problems will be detected, logged, categorized, prioritized, investigated and diagnosed, if possible find a workaround, raise a known error record, apply a solution, formally close the problem record and review major problems.

Another focus of work is the creation of Service Operation dashboards to display the most important information that IT Staff and management need to perform their functions, shown in a way that allows

them to monitor the current situation of the IT processes. The design and creation of dashboards will be done applying good practices, consolidating and arranging the most important information providing an efficiently and effectively communication. The indicators from reports will be compared with the defined targets to conclude how far objectives have been met, and which aspects of the process can be improved.

1.5 Research Method

The research method used in this dissertation is Design Science Research (Peffers et al. 2007-8), based on the problem-solving paradigm with the intention of creating new and innovate artifacts. Design Science Research requires the creation of an innovative, purposeful artifact for a special problem domain. This artifact must be evaluated in order to ensure its validity (Hevner et al. 2004).

The design science research process model (Peffers et al. 2007-8) comprises six activities, as displayed in Figure 1. These are: (1) identify problem and motivate, (2) define objectives of a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication.

The artifacts produced are the model of the problem management process for the IT Services of ISCTE-IUL according to the ITIL®v3 and the dashboards for the analysis of the already implemented Service Operation processes (Incident Management, Problem Management and Request Fulfillment).

The first and second activities of the design science research process model have already been described in this introductory chapter. The third and fourth activities will be developed in the third chapter of this dissertation, where the process will be designed and customized. The evaluation, fifth activity, will be handled in the fourth chapter, where will be designed and developed dashboards to evaluate the process. Finally, the sixth activity will be addressed in the fifth chapter, with the closing of the dissertation, final considerations and future work.

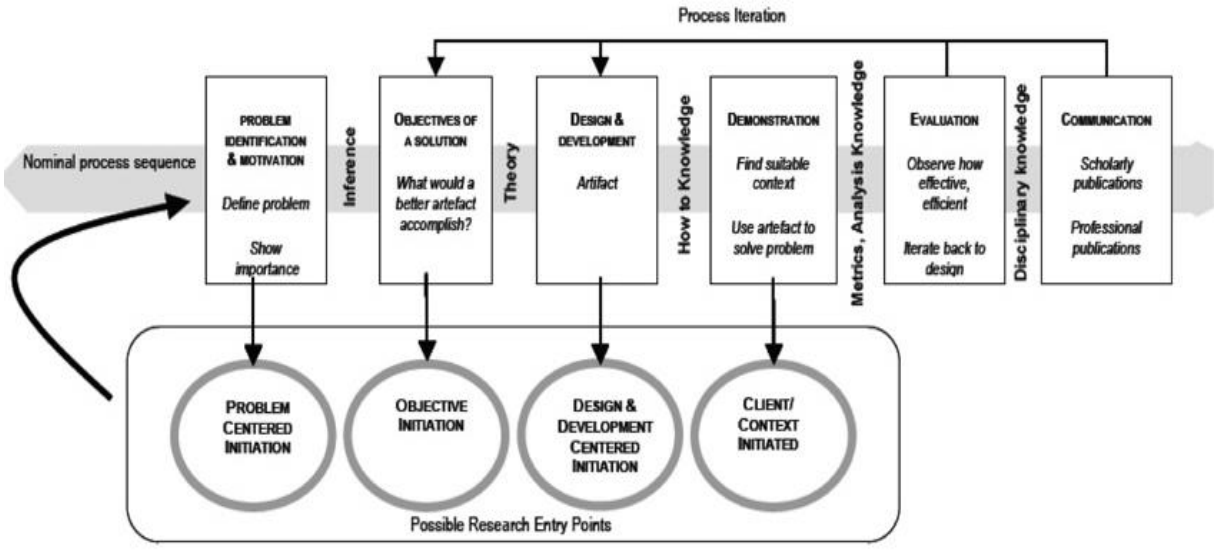

Figure 1 - Design Science Research Process Model (Peffers et al. 2007-8)

2 State of the Art

The thematic was released at the introductory chapter, as well as the research questions and the objectives of the dissertation. In this second chapter will be researched some important subjects, regarding what will be developed, in order to understand the actual panorama of the concepts, the different points of view, its evolution over time, how and why it is used, the impact that it may be in this project, what can be learned and what can be leveraged.

2.1 IT Governance

There are some IT Governance frameworks, each with their specifics, strengths and weaknesses, focus and purpose. ITIL is a major framework and it is focus on IT service management.

Corporate Governance is comprised by processes, policies, laws, customs and management practices that support the management of an organization, involving the relationship between the stakeholders in such a way that guide them to achieve the goals of the organization efficiently and effectively.

IT Governance is a subset discipline of Corporate Governance, with emphasis on the information technology systems and all the questions regarding this subject, as the risks that this area is exposed and the controls that mitigates those risks. It comprises the processes that ensure the effective and efficient use of IT services and the measurement of the benefits to business.

Some objectives associated to IT Governance are:

- Effectiveness;
- Efficiency;
- Integrity;
- Availability;
- Reliability;
- Confidentiality.

The IT Governance ensures that the activities and functions are aligned with the strategy of the organization, enabling and supporting the objectives and priorities of the organization. However it is important to understand that there is no single IT Governance model that is optimal, i.e. there is not only one correct method and no one-size-fit-all. The hey IT decisions, roles and responsibilities of the stakeholders, governance structures, processes and policies will be differ from company to company. The governance preparation needs to be flexible to adapt to companies and its constant changes (IT Governance Institute 2003).

In the Figure 2 is shown a structure of Governance.

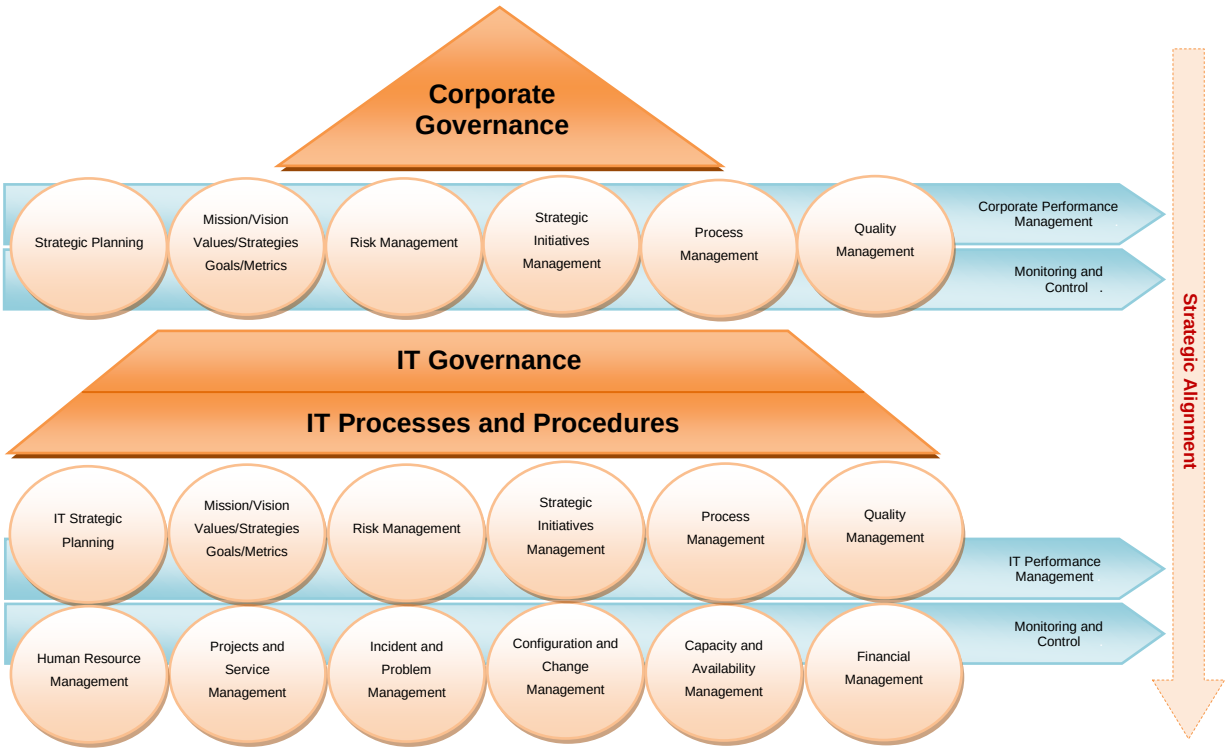

Figure 2 - Governance Framework (adapted from Softsearch 2013)

In the business domain it is important to understand how IT is used to enable and operate the business. On the other hand, in the IT domain it is important to understand how IT is managed and delivered.

The strategic alignment between the Corporate Governance and IT Governance allows having in the companies or institutions a reliable IT service supplying the ongoing business operations effectively and efficiently, not affecting the users and the normal course of the operations.

The ITIL Problem Management process appears in the level of IT processes and procedures where the interface with operational IT is done, and problems are handled with investigation and resolution, stabilizing the normal levels of the IT services, decreasing the disruption of essential services to the business and preventing recurrent incidents.

2.2 ITIL®v3

The Information Technology Infrastructure Library (ITIL) is a public framework that describes good practices for IT Service Management, and focuses on aligning IT Services with the needs of business, continual measurement and improvement of the quality of IT service delivered to the business and customer (Cartlige at al. 2007).

The ITIL methodology is about 20 years old and it is a direct approach to the identification, planning, delivery and support of IT services to the business (Arraj 2010).

The project was born under the necessity to utilize consistent practices in the service lifecycle, leading to organizational effectiveness and efficiency, recognized by the UKs Office of Governance Commerce. ITIL is in constant reformulation due to the technology advances in informatics, to the advent of new business needs and to the emergence of new practices with better results. In the Figure 3 below, is shown the level of maturity implemented in the business, according to the practices, attitudes and mentality put in place.

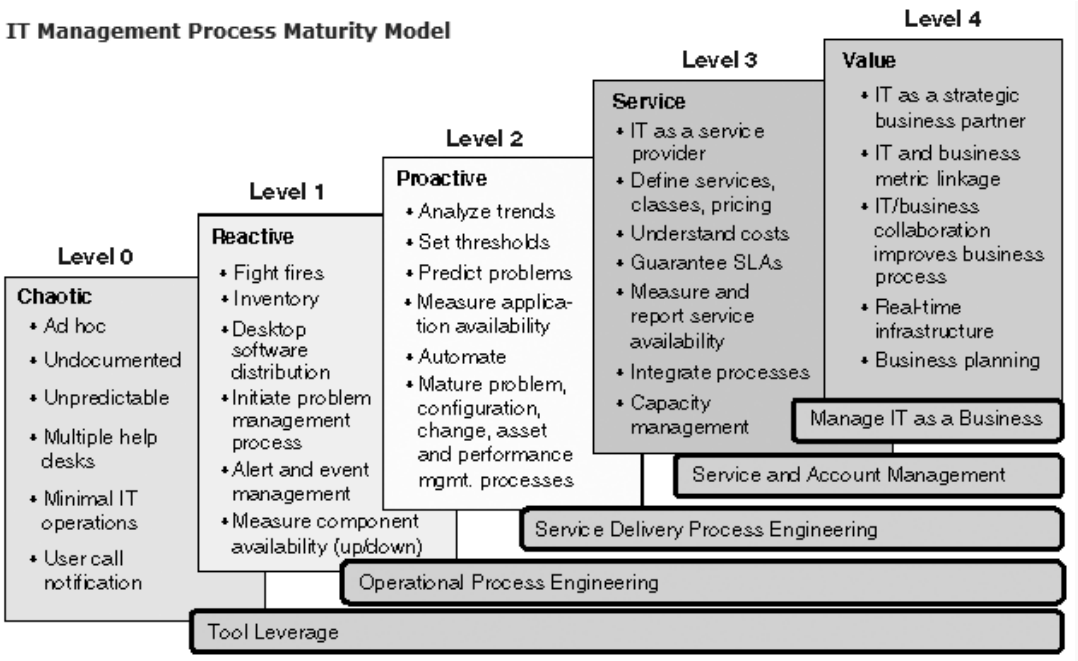

Figure 3 - Gartner Capability Maturity Model (2009)

The compilation of good practices describes procedures, tasks and checklists advisable to an organization for establishing a minimum level of competence. So, an organization can establish a baseline from which it can plan, implement and measure. It is used to demonstrate compliance and to measure improvement.

ITIL is focused on how must be services and processes of IT, with special attention on the delivery of services and support, considering the technical aspects of monitoring the process. Those manual books present and explain the practices that are more beneficial for IT services with the main objectives of provide managing standards to managers to obtain more value using the IT. The framework is non-proprietary, not being restricted by any organization or technology and is not prescriptive, because it is passive of adoption and implementation by any organization.

2.3 Advantages

The advantages of ITIL focus on the provision of guidelines for the use of the best practices for IT. Some authors have identified several advantages and it is possible to enumerate:

- IT services align with business strategy allow to achieve more objectives;
- Know IT costs ensuring a better financial plan;
- IT services are more reliable and available, increasing the business productivity, efficiency and effectiveness;
- Improved resource management and reduced rework;
- Users and customers more satisfied with IT (OGC 2007);
- Improved availability, reliability and security of IT Services;
- Increased IT project delivery efficiencies;
- Reduced cost of IT infrastructure and applications;
- Decreased levels of rework and elimination of redundant activities;
- Justify cost of service quality;
- More effective third-party relationship and contracts (Wells at al. 2005);
- Standard terminologies to unify and facilitate the communication with clients;
- Difference between management and practice shortened because managers can utilize the ITIL books to ensure that Service Management is performed according with the best practices;
- International Standards to motivate the Service Management improvement;
- Team certification with the foundation and managers levels. The first used to certificate staff with general knowledge of the processes and ITIL terminology. The second to certificate staff with thorough knowledge of ITIL and the capacity to implement and manage ITIL processes (Jesus 2006).

These advantages means that the organization can ensure to clients the utility, perceived by the clients in the performance of their tasks, and the guarantee, derived from the positive effect of being available when needed, with sufficient capacity and reliably in terms of continuity and security (Nunes 2011).

2.4 Publications and Service Lifecycle

Actually, known as ITIL®v3, is composed by five core publications: Service Strategy, Service Design, Service Transition, Service Operation and Continual Service Improvement. Each of which covers and ITSM lifecycle stage and provides a guidance following the ISO/IEC 20000 standard specification, assumed as International Service Management Standard for IT Service Management.

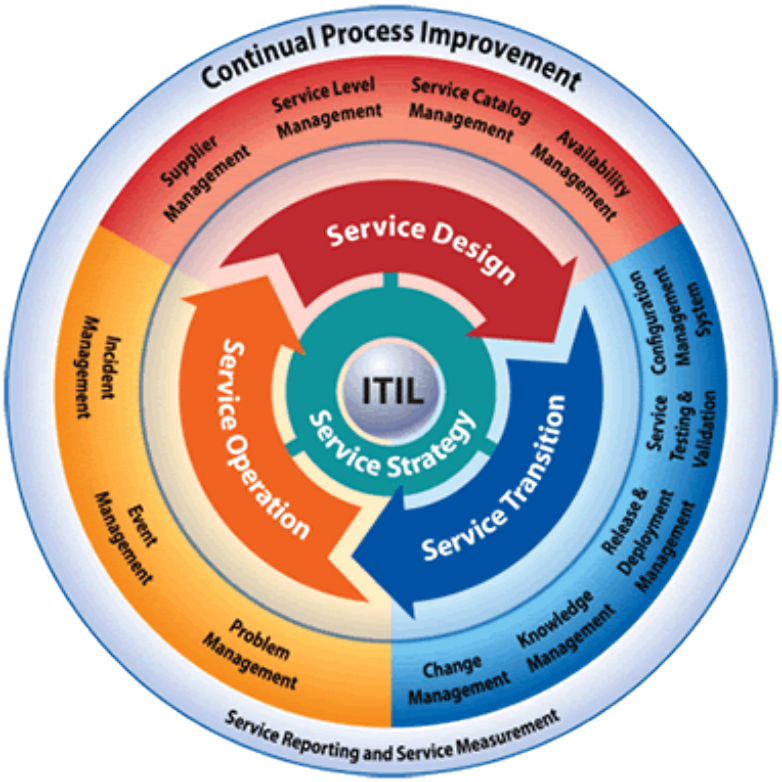

Figure 4 - ITIL Service Lifecycle (S4B Consulting 2009)

The Lifecycle begins with Service Strategy. At this point is essential understand who the IT customer are, the services required to satisfy the customers' needs and the IT capabilities required to develop and execute these offerings efficiently. To be successful, the services provided must deliver sufficient value, as expected by the customer (OGC 2007).

Service Design ensures that services and service management processes are designed and developed effectively to cover customer expectations. Strategic objectives are converted into portfolio of services and service assets, and are established plans to create and modify services and processes allowing it to increase or maintain value to customer. Service management systems and necessary tools to monitor and support services and process efficiency and effectiveness must be considered (OGC 2007).

In the Service Transition, the design is built, tested and moved into production, transitioning new and changed services into operations. Guidelines are provided to ensure that the requirements defined in Service Strategy and encoded in Service Design are effectively performed in Service Operation. This assurance process is done while the risks of failure and disruption are controlled (OGC 2007).

It's in the Service Operation that services are provided daily to customers and users. This stage of lifecycle incorporates practices of Service Operation and guidance on achieving effectiveness and efficiency in the delivery and support of services, ensuring the value for the customer and the organization. Managing service disruptions by a quickly restoring from incidents, determine the root

cause of problems and detect trends of issues, treatment of end users daily request and managing service access (OGC 2007).

Continual Service Improvement is transversal to all lifecycle stages and it provides mechanisms to measure and improve the service levels, leading the organizations to learn and realize improvements in service quality, operational efficiency and business continuity (OGC 2007).In the Figure 5 below is shown the cycle of continual service improvement with the actions and formal documents that should be taken.

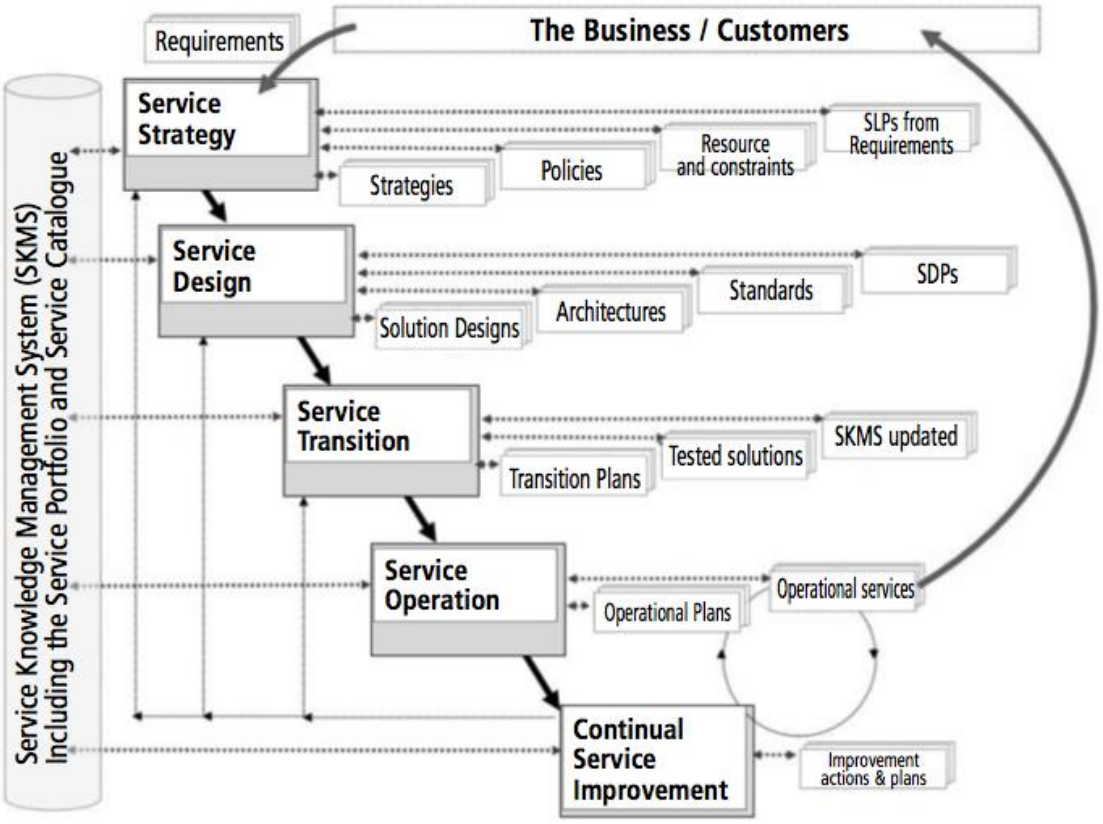

Figure 5 - Key links, imputs and outputs of the service lifecycle stages (Cartlige et al. 2007)

2.5 ITIL Processes

Each core ITIL publication concerns to a stage in the service lifecycle and group key processes required in that stage. The Figure 6 below illustrates how the processes are grouped.

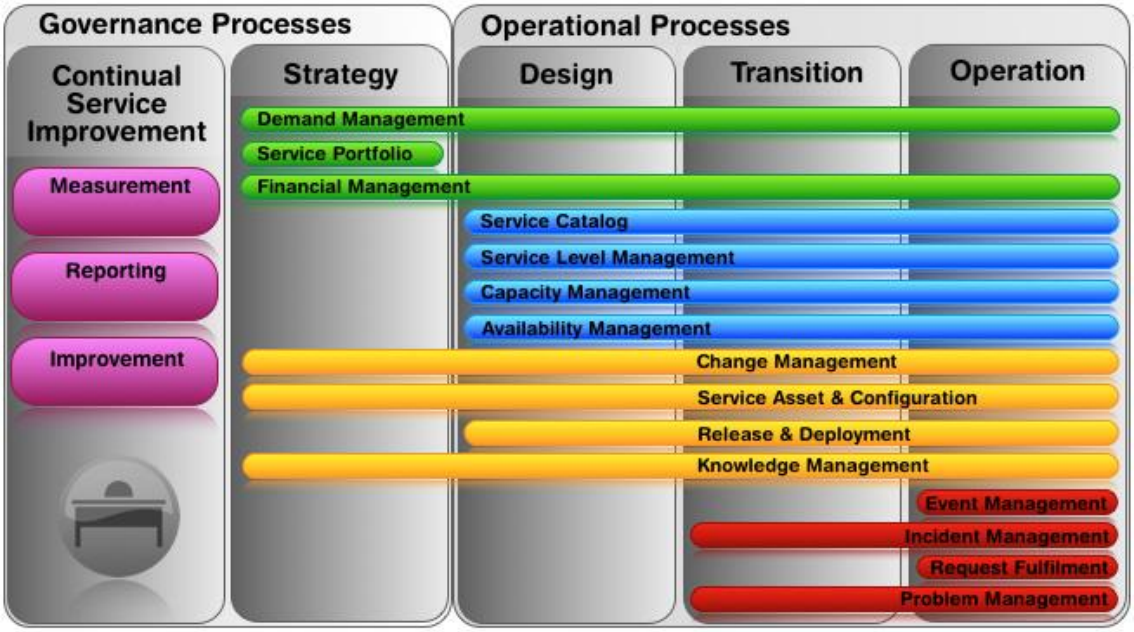

Figure 6 - Processes Lifecycle (Livetime 2010)

2.6 International usage of ITIL

The itSMF (2010) elaborated a global survey about the experience of management services and the results reveal that the ITIL is the most widely used ITSM, corresponding approximately to 70% of the respondents. The questionnaire was filled by organizations in different countries and industries. According to this survey, the Incident Management and the Change Management are the most implemented processes by the organizations that had response.

Hornbill (2009) aims to explore the levels of adoption of ITIL in the labor market and the reasons for such adoption, with an international study. The study included all types of organizations of private and public sectors. The level of maturity of the ITIL registered by Hornbill indicates that 32% of respondents claim to have high levels of maturity of the framework, 55% is in the middle and lower level of maturity and 13% of the participants this is the first experience with ITIL.

The quality of service and the customer satisfaction are the main factors for the implementation of ITIL, as seen in the Figure 7. However, after implementation, one of the main benefits actually achieved relates to the use of standard processes. This benefit becomes more important in the view of customer satisfaction because it is one of the advantages effectively achieved and understood within organizations.

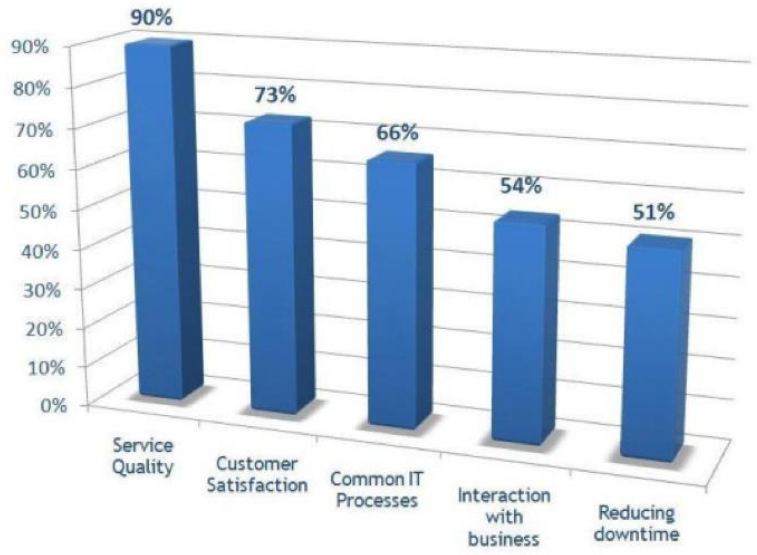

Figure 7 - Motivations to ITIL adoption (Hornbill 2009)

The Service Operation stage of the lifecycle is the mostly implemented in organizations. This fact can be explained taking into account that the Incident Management and Change Management processes are the most implemented. This investment can be based on the fact that are these processes that run daily in the organization and are the ones most visible to customers and users.

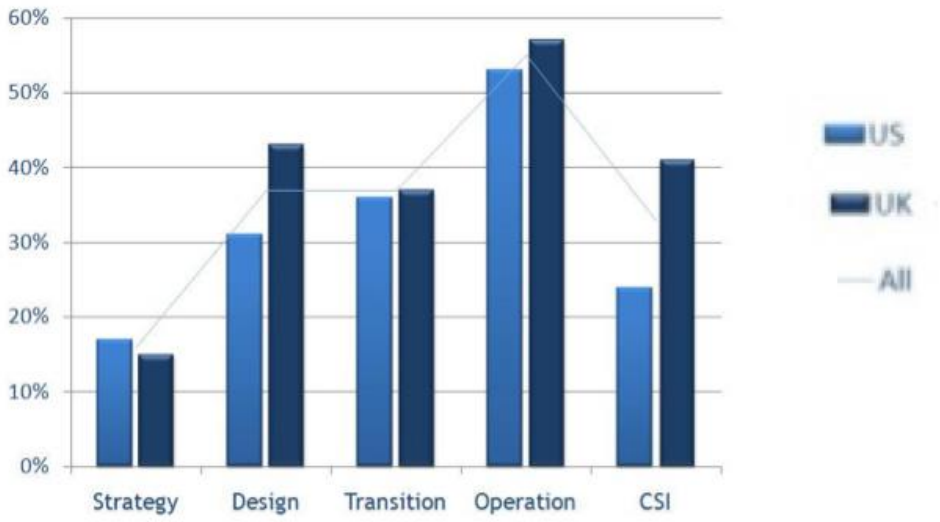

Figure 8 - ITIL processes implemented by lifecycle stage (Hornbill 2009)

Regarding the university environmental, the Universities and Colleges Information Systems Association (UCISA) documented the experience of thirteen Higher Education Institutions from UK in the implementation of ITIL. The Figure 9 below shows the average maturity of the processes implemented in organizations, according to the maturity scale used:

0 – Unplanned; 1 – Planned; 2 – Partially implemented/Emerging; 3 – Implemented/To be evolved.

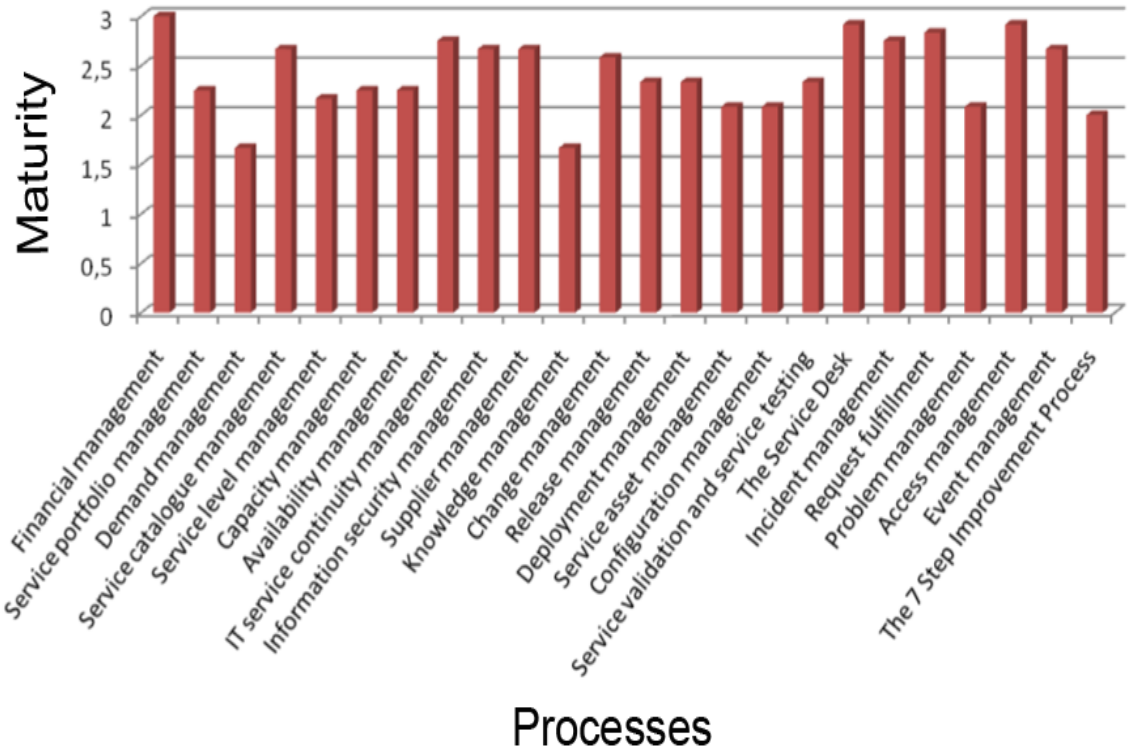

Figure 9 - Average maturity of the ITIL processes in British Universities (Adapted from Martins 2011)

Currently in the TI services of ISCTE-IUL, the ITIL®v3 best practices are being implemented. The Service Asset and Configuration Management (Martins 2010), Incident Management, Request Fulfillment (Ferreira 2011) and Change Management (Barroso 2011) processes are implemented. It is still too early to assess the real benefits of the implementation and the volume of data is not very big, which make it difficult to compare metrics with the purposed aims.

2.7 ITIL usage at ISCTE-IUL

The ITIL adoption at the ISCTE started in September of 2008 fostered by the work of two faculties from the Information Science and Technology Department. It began as research works conducted in curricular units, which subsequently evolved into dissertations. This research work aimed to apply the best practices in IT service management in the higher education sector (and at ISCTE-IUL in particularly), to build and share knowledge in this field.

Currently, four processes are already implemented:

- Service Asset and Configuration Management (Martins 2010);
- Incident Management (Ferreira 2011);
- Request Fulfillment (Ferreira 2011);
- Change Management (Barroso 2011).

These processes entered the service operation stage only in January 2012. Therefore, there is still very little information available. The Figure 10 and Figure 11 display the generic information regarding incidents and requests for changes generated by the ITSM tool EasyVista.

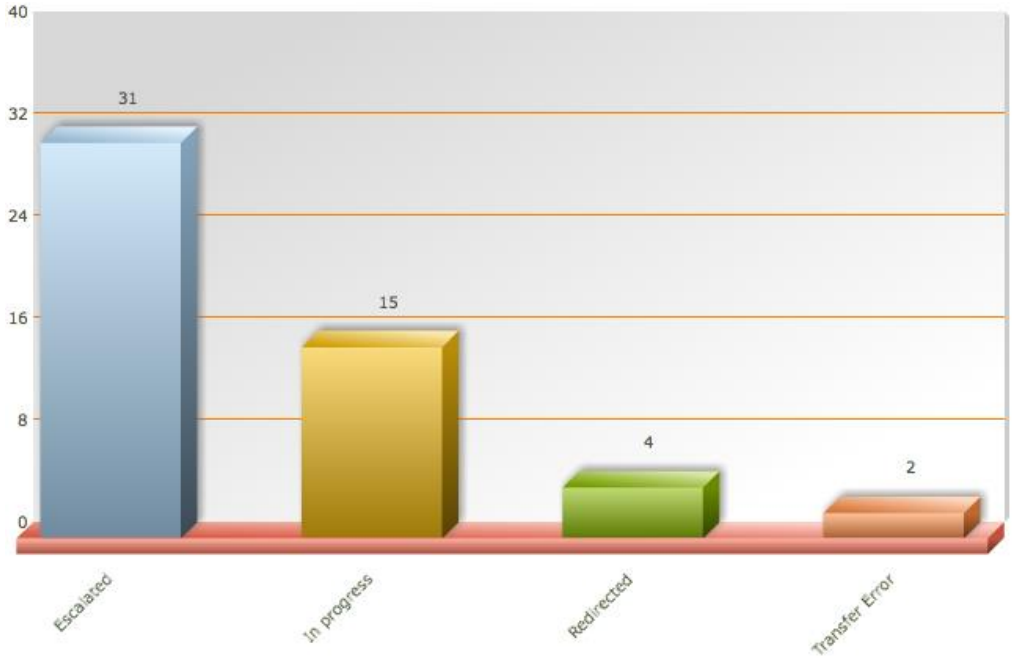

Figure 10 - Incidents registered in the Incident Management Process (EasyVista 2012)

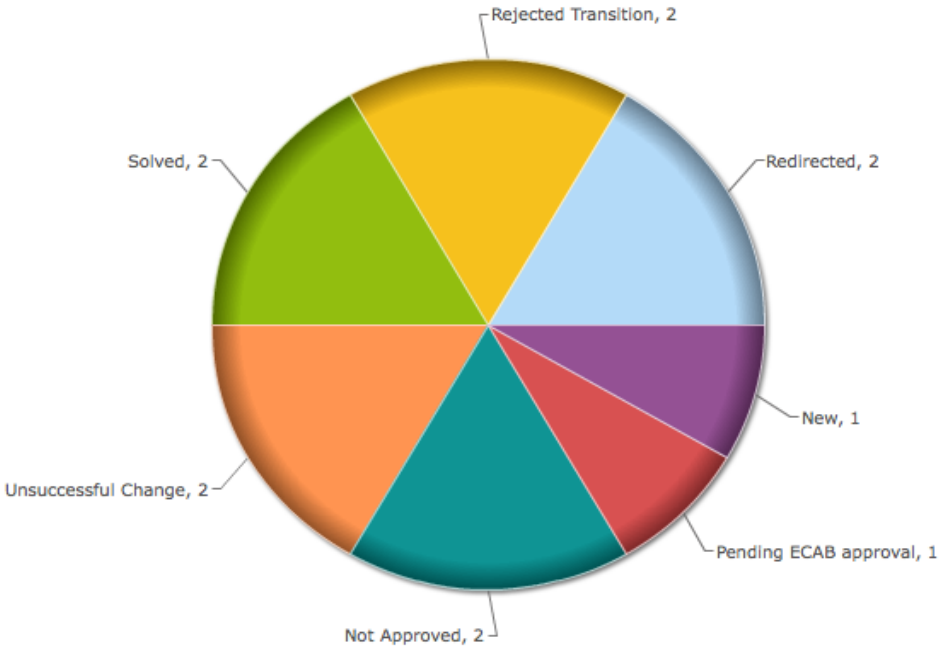

Figure 11 - Requests to the Change Management Process (EasyVista 2012)

2.7.1 Service Asset and Configuration Management

An organization only can be fully efficient if it manages its assets, which are vital to the business. ITIL Service Asset and Configuration Management process aims to maintain information about Configuration Items required to deliver an IT service, including their relationships (OGC 2007).

The Configuration Management process has some main activities such as:

- **Configuration Identification** where are defined and maintained the structure of the Configuration Management System (CMS), allowing it to hold important information about Configuration Items (CI), such as attributes describing CI types, their sub-components and relationships;
- **Configuration Control** where are ensured that CI's are only added or modified with the required authorization, and if that modifications are properly recorded in the CMS;
- **Configuration Verification and Audit** to perform regular checks and ensure that the information contained in the CMS is correct, reliable and is an exact representation of the CIs actually installed on the organization.

This process permits:

- Better planning of changes;
- Changes and releases to be assumed, planned and delivered successfully;
- Evaluate the impact and causes of incidents and problems;
- Impact assessment of proposed modifications;
- Identify the costs for a service.

2.7.2 Incident Management

When occurs an unplanned interruption to an IT service, a reduction in IT service quality or a fail in a configuration item, we are facing an incident. This incident results in a repair or a request for change to remove the incorrect event.

The purpose of incident management is to restore the normal operations as quickly as possible to minimize the adverse effect of the incident on the business operations, certifying the quality and availability of the service. So, this process take care of all incidents, like failures, questions or queries that can be reported by users (contacting the Service Desk), technical staff or automatically detected and reported by event monitoring tools. An incident management tool is essential to register and manage the incidents information.

The incidents are categorized to allow identify who will attend the occurrence and to permit trend analysis. The incidents are too prioritized, according to urgency and the adverse impact on the business. If the support team can't solve the incident, this must be scaled to a technical support with appropriate knowledge. After investigation and diagnosis, the resolution must be tested, and the user satisfaction must be ensured before close the incident.

Incident Management is frequently the first process to be implemented in Information Technology Service Management because it's extremely visible to the business, so it's easy to demonstrate its value. The impact of the process in creating business value is visible as (i) the capacity to detect and resolve incidents reduce the downtime, which means the availability of the service, (ii) understand what constitutes an incident and contact with the activities of business operational staff permit identify potential improvements and (iii) during the treatment of incidents, the Service Desk can identify additional service or training requirements (OGC 2007).

The main activities of Incident Management are:

- Incident identification
  All components should be monitored to detect early potential failures, minimizing the impact on the business. Ideally, incidents must be solved before they have an impact on users.

- Incident logging
  All incidents must be registered with maximum detail to provide a credible source of information for other processes, audit, service optimization and planning. It's important to have all relevant information to improve the assistance, so all information relating to the nature of the incident must be logged to maintain a historical documentation.

- Incident categorization
  To help forward the request to the correct resolution groups, should be developed a categorization scheme to the incident adapted to do organization and specify the categorization activities to the incident.

- Incident prioritization
  Normally determined by taking account both the urgency of the incident and the level of impact it is causing. Other factors are the number of services affected, the level of financial losses or effect on business reputation. It is important define and document a table of priorities and resolution times. Should be identified the priorities to the VIP clients. The priorities to the incidents with resolutions delayed must be dynamically recalculated.

- Initial diagnosis
  Must be created the necessary conditions to identify a solution, fix and close the incident in the first contact with the user. At this moment the known errors information can be very useful to allow an earlier and accurate diagnosis, decreasing the impact on the business and increasing the users' satisfaction with the efficiency of the TI services.

- Incident escalation
  Rules to hierarchical scaling to technics and users should be defined and documented to improve the service organization and management. Tools to help automatize the scaling must be used in accordance with SLA (Service Level Agreement) and OLA (Operational Level Agreement).

- Investigation and diagnosis

All investigation and diagnosis activities and results should be recorded to improve the methodology approach to the incident resolution and reinforce the knowledge base.

- Resolution and recovery
  When a potential resolution has been identified, this should be applied and tested. All activities should be documented. After solve the incident, the resolving group should pass it back to the Service Desk for closer action.

- Incident closure
  The Service Desk is responsible for the incident closure activities such as evaluate the success and the user satisfaction level. Therefore is provided information, ideas and suggestions for service improvement plan. It helps to create the knowledge base, ensuring that details of the incidents and its resolution are documented and updated.

2.7.3 Request Fulfillment

A service request includes many types of demands from users. Many are small changes like an information request or advice, a request to a standard change or a request for an IT service access.

The objectives of the Request Fulfillment are (i) to provide a way for users to request and receive catalogued services, (ii) to deliver these services, (iii) provide information to users and costumers about the availability of services and necessary procedures to access them and (iv) help users with general information to clarify questions, comments or complaints.

All requests should be registered and followed during its life cycle. The Request Fulfilment may have financial implications for the organization, so it's necessary approval before providing the service.

Request Fulfillment produces value to business, because it provides quick and effective access to standard services, which means that users can improve their productivity or the quality of business services and products. This process reduces the bureaucracy involved in requesting and receiving access to services, and centralizing fulfillment increases the level of control over these services and also helps to reduce the cost of support.

The Service Desk, acting as first-line support, may complete some simple requests, while others will have to be forwarded. Most requests will have some form of financial implications, so the cost of fulfillment the request must first be established (OGC 2007).

The Service Request will contain information about:

- What service is being requested
- Who requested and authorized the service
- Which process will be used to fulfill the request
- To whom it was assigned to and what action was taken
- The date and time when the request was logged as well as the date and time off all action taken

- Closure details

2.7.4 Change Management

Change Management is a Service Transition process and has the objective to ensure that standardized methods and procedures are used for handling all changes to control IT infrastructure with efficiency, minimizing the number and impact of incidents related to the change and maintain the proper balance between the need for change and the potential negative impact of changes.

In the TI infrastructure can happen two types of changes. The reactive changes take place in response to problems or externally requirements. On the other hand, the proactive changes take place from seeking improved efficiency and effectiveness.

This process is composed by the raising and recording of changes, assessing the impact, cost, benefit and risk of proposed changes, change approval, managing change implementation, monitoring and reporting on implementation, reviewing and closing change requests. (OGC 2007)

The change management, in an operational level, will improve the availability, performance and response times of TI services provided by the organization. (Barroso 2011)

This process permits:

- Improved alignment of TI services to business requirements;
- Better communication of changes to business and staff;
- Improved risk assessment;
- Reduced negative impact of change;
- Less disruption and higher quality services;
- Improvement on Problem and Availability Management.

The next process to be designed and implemented according to the best practices described in ITIL is the Problem Management Process.

2.7.5 Problem Management

Problem Management process incorporates the activities needed to diagnose the root cause of incidents to determine which resolution can solve the problem. This process takes responsibility of ensuring that the resolution is implemented through the appropriate control procedures, especially Change Management and Release Management. The information about problems and appropriate solutions will be maintained using tools such as the Known Error Database and an efficient communication with Knowledge Management, leading to a reduction in the number and the impact of incidents in the institution over the time.

The problem management implementation will allow IT staff to improve the problem investigation and diagnosis, find a workaround, raising a known error record, problem resolution, problem closure and major problems review. The investigation should be conducted to try to diagnose the root cause of the

problem. In some cases it may possible to find a workaround to the incidents caused by the problem, as a temporary way of overcoming the difficulties. As soon as the diagnosis is complete, and particularly where a workaround has been found, a Known Error Record must be raised and placed in the Known Error Database, which allow IT staff to identify further incidents or problems and restore the service more quickly. Ideally, as soon as a solution has been found, it should be applied to resolve the problem, but if any change in functionality is required this will require a Request for Change in the Change Management process to be raised and approved before the resolution can be applied. When any change has been completed, successfully reviewed and the resolution has been applied, the Problem Record should be formally closed, ensuring that the record contains a full historical description of all events. According to the organization's priority system, every major problem should be reviewed to learn any lessons for the future, specifically, those that things were done correctly, those things that were done wrong, what could be better in the future, how to prevent recurrence, whether there has been any third-party responsibility and whether follow-up actions are needed (OGC 2007).

The implementation of a problem management process is highly important for ISCTE-IUL because:

- Inquire and understand root causes of incidents.
- Ensure that IT service availability and quality are increased.
- Greater control and monitoring of the problems reported.
- Record information about resolutions.
- Use recorded information to speed up the resolution time and identify permanent solutions, reducing the number and resolution time of incidents.
- Less downtime and less disruption to business critical systems.
- Higher availability of IT services
- Higher satisfaction and productivity of business and IT staff
- Reduced expenditure on workaround or fixes that do not work
- Reduction in cost of resolving repeated incidents

As proposed by the OGC, the metrics that should be extracted to measure the performance, effectiveness and efficiency of the problem management are:

- The number of problems recorded in the period;
- The percent of problems resolved within SLA targets;
- The number and percent of problems that exceeded their target resolution time;
- The backlog of outstanding and the trend;
- The average cost of handling a problem;
- The number of major problems;
- The percent of major problem reviews successfully performed;
- The number of Known Errors added to the KEDB;
- The percentage accuracy of the KEDB;
- The percentage of major problems reviews completed successfully and on time.

The metrics should have a grain defined to category, impact, severity, urgency and priority levels and compared with previous periods. (OGC 2007)

2.8 Dashboards

Dashboards have become a useful business tool during the last years because it can display the most important information in a way that allows people to monitor and quickly perceive what's going on in an instance. In this way, dashboard is a powerful medium of communication, but it requires deep attention in the design, with objectivity and simplicity, creating a user-friendly dashboard, taking advantage of the technology, design, science and communication (Few, 2006).

2.8.1 Requirements and benefits

The dashboard must communicates clearly and immediately, and must be seen in a historical context to understand how and why they've come about, providing a unique and powerful means to present information. According to this, the success of a dashboard depends considerably on the design implementation, where it is essential to communicate efficiently and effectively.
It is essential to find the reasons that make you believe your dashboard will be useful. Then arise three important questions (Juice, 2009):

- (i) Who is the audience?
- (ii) What value will the dashboard add?
- (iii) What type of dashboard am I creating?

These are essential questions to start defining the real scope and importance of the dashboards. Detailing this questions, we have (i) the importance to know what decisions our audience are making and what questions do they need to answer, (ii) what type of value and what areas of the business are affected by our dashboard enriched by consolidated and arranged information, and (iii) define the scope, business role, time horizon, customization, level of detail and point of view.
It is really important too group data logically, make the data relevant to the audience, present only the important and agreed metrics and define the periodicity that the data need to be refreshed.
The best dashboards should be compliant with some requirements, namely:

- Lots of important data;
- Few color;
- Smart graphs;
- User-friendly design;
- Time overview.

The expected benefits of a success dashboard are:

- Visual presentation of performance measures;
- Ability to identify and correct negative trends;
- Measure efficiencies and inefficiencies;

- Align strategies and organizational objectives;
- Save time using a unique report.

The Figure 12 shows a resume of the alignment flow.

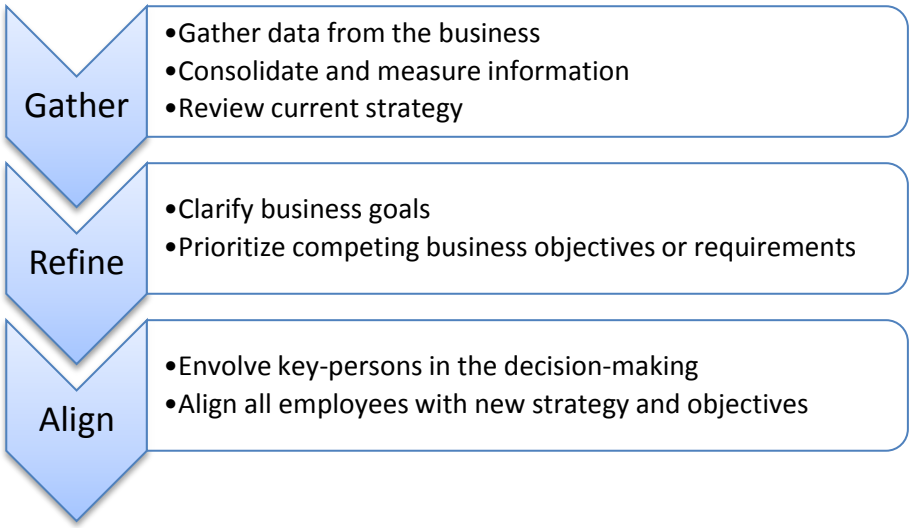

Figure 12 - Dashboards alignment flow

2.9 Dashboards and ITIL

According to ITIL, it is recommended that the processes must be monitored and measured. According to that, it is essential to have an applicational infrastructure to support the processes, ensuring the correct flow of activities and recording the information, functioning as a data repository that will be the basis of the data which will be treated, analyzed and converted into useful information.

The ITIL service management tool implemented locally, EasyVista, is ITIL compliance, allows parameterize the processes and record the associated data. However it provides generic information about the functioning of the processes, that can't response to the coordinator requirements and provide detailed metrics to support the decision-making.

Therefore, the aim of this second phase of the dissertation is the creation of a Service Operation report, composed by dashboards, where each dashboard evaluates a process. The processes in scope are the Incident Management, Request Fulfillment and the new Problem Management. This phase requires a research work, interviews, conversations and observations to gather and compile a list of possible metrics that will be discussed with key-persons, to achieve a final selection of key metrics that will be integrated in each dashboard of process. The indicators from the report will be compared with the defined targets to conclude how far objectives are being met and which aspects of the process can be improved.

The dashboards will provide analytical capabilities that transmit clearly and immediately the most important information, consolidated and arranged, in a historical context, providing a strong meaning to the information presented.

3 Implementation of the Problem Management Process at ISCTE-IUL

In this chapter, and taking into account the study made in the previous chapters, will be documented the implementation of the problem management process at ISCTE-IUL, as well as the understanding of the institution and the IT Services, the ITIL oriented tool that will support the process and made a proposal of roles and responsibilities that should be analyzed and adjusted to the reality of the department, among other related things.

3.1 Description of the Institution

ISCTE – University Institute of Lisbon is a public university established in 1972. Pursuing teaching, research and community activities, it plays a major role in educating qualified specialists and personnel, whose cultural, scientific and technical skills enable them to contribute to sustainable development both at the nation and the global level. The strategic objectives of ISCTE-IUL are: innovation, quality, internationalization and development of an entrepreneurial culture.

With approximately 8500 students enrolled in undergraduate (52%) and postgraduate (48%) programs, 450 teachers and 220 non-teaching staff, ISCTE-IUL. Facing high demand, the student vacancies at the ISCTE-IUL have always been fully occupied.

ISCTE-IUL is too a research university, with nine research centers evaluated by the Foundation for Science and Technology, 4 qualified as excellent, 3 as very good and 2 as good (ISCTE-IUL).

3.2 Description of the IT Service

The IT Service of ISCTE-IUL is responsible for ensuring the development and maintenance of IT infrastructures and communications of ISCTE, management and administration of the system, technical support to users and the specialized training (DSI – ISCTE-IUL).

The Figure 13 show how are organized the IT Service.

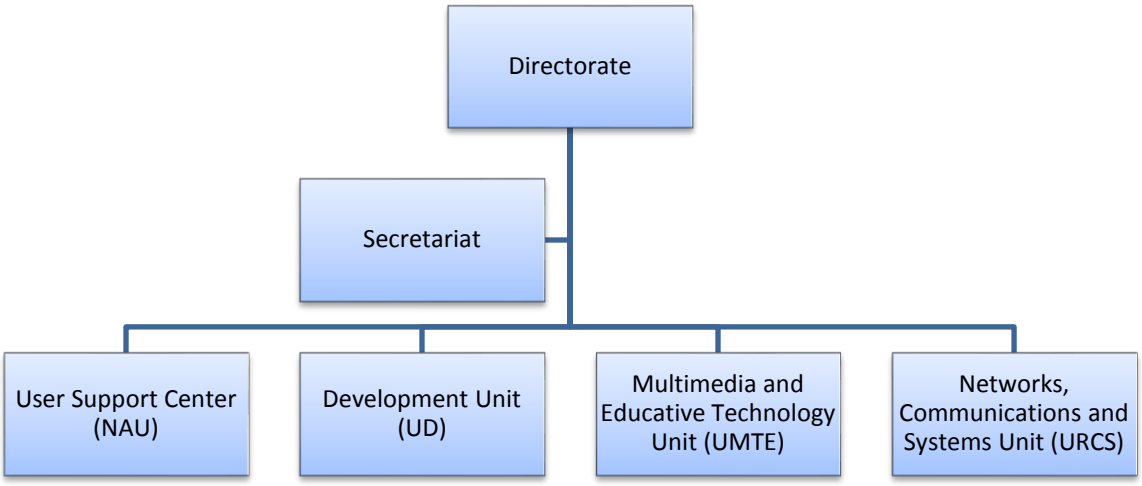

Figure 13 - IT Department Organizational Chart

On the top of the organization is the Directorate coordinated by the Director João Paulo Cavaco.

The Secretariat supports administratively all staff of the IT Services, simplify the institutional contacts and support the Director in their functions.

The IT Services are divided in 4 functional units, which are:

- User Support Center (NAU from the Portuguese *Núcleo de Apoio ao Utilizador*)

- Responsible to provide installation service, configuration, support and users assistance, as well as provide regular support to events that take place in ISCTE-IUL and which make use of equipment or informatics services or multimedia, as first line support;
- Establish and ensure compliance with Service Level Agreements (SLA), according to the services catalogue provided by the IT Service of ISCTE-IUL.

- Development Unit (UD from the Portuguese *Unidade de Desenvolvimento*)

- Propose and develop projects of applications and information systems that contribute to the service improvement of ISCTE-IUL;
- Maintain applications and the existing information systems, ensuring its regular functioning;
- Promote the integration of all the IT services of ISCTE-IUL, ensuring that they are up to date face to the available technologies;
- Continuously develop consulting activities within the institution, proposing solutions that increase the employee and teaching productivity and the quality of student learning.

- Multimedia and Educative Technology Unit (UMTE from the Portuguese *Unidade de Multimédia e Tecnologia Educativa*)

- Adapt, implement and operate technology platforms to support education, in particular, support the development of contents to support education, train teachers and students in

using these platforms and the development of these content and produce multimedia historical records of events and the initiatives of ISCTE-IUL.

- Networks, Communications and Systems Unit (URCS from the Portuguese *Unidade de Redes, Comunicações e Sistemas*)

Develop and manage computer networks and communications, maintain and manage existing systems and provide new services to support the information system of ISCTE-IUL, as well as:

- Propose, develop, implement and maintain infrastructures and network services which serve as a basis to the information system of ISCTE-IUL;
- Provide network and communications services that support video broadcast, video conferencing, telephony over IP and the traditional telephony;
- Maintain operational the networks of ISCTE-IUL, including cable and wireless network, as well as virtual private networks and others networks with specific uses;
- Ensure high level of reliability and security of networks, monitoring, detecting and defending them from possible attacks;
- Ensure the existence and safeguarding of event records in networks for subsequent audit;
- Administrate all IT systems of ISCTE-IUL, including servers and their services and workstations of end users, especially those that serve as the basis for information system of ISCTE-IUL;
- Keep the IT services updated and secure, and to propose, plan and implement new IT services;
- Ensure the reliability and security of all systems and services;
- Monitor, prevent, detect and defend systems and services from possible attacks and intrusions;
- Ensure the existence and safeguarding of access records to systems and services, for further audit;
- Manage and maintain the infrastructure and the IT equipment of communications, of support to systems and services provided by the IT Services;
- Implement mechanisms for managing the redundancy of equipment and infrastructure to ensure the continuous operation of services provided by the IT Services.

3.3 Description of the current Problem Management process

At the beginning of the study, it was not implemented at ISCTE-IUL a problem management process. The concept of problem was seen as an incident and it was treated as such, i.e. reactively, the incidents were reported based on failures or errors in the IT infrastructure and problems took the same treatment, without correlation of multiple incidents that expose the same symptoms, root-cause analysis, or a known-error database consultation. Thus, the return of the services to normal levels as soon as possible, with smallest possible business impact, is being performed, but the key activities of

problem management were not being undertaken, such as the investigation of root-cause and the resolution to prevent further incidents.

Incidents and problems were treated with a ticket system, the OTRS (Open-source Ticket Request System), however at ISCTE-IUL this solution became obsolete.

OTRS is an open-source trouble ticket system that allows a company to assign tickets for subsequent analysis and resolution. The tickets have a status associated such as a priority and support team responsible for the ticket. The tickets closed remain for historic and save information about the reported problem, however, due to the considerable volume of incidents reported, OTRS is no longer a good solution because, according to the IT Coordinator, there were not defined categories and catalogues standardized, making the research in the historic of tickets more difficult. Another gap in this solution was the inability in calculating the resolution time, making not possible the evaluation and report of the service, the performance and efficiency of the IT support teams and the compliance with the defined service level agreements.

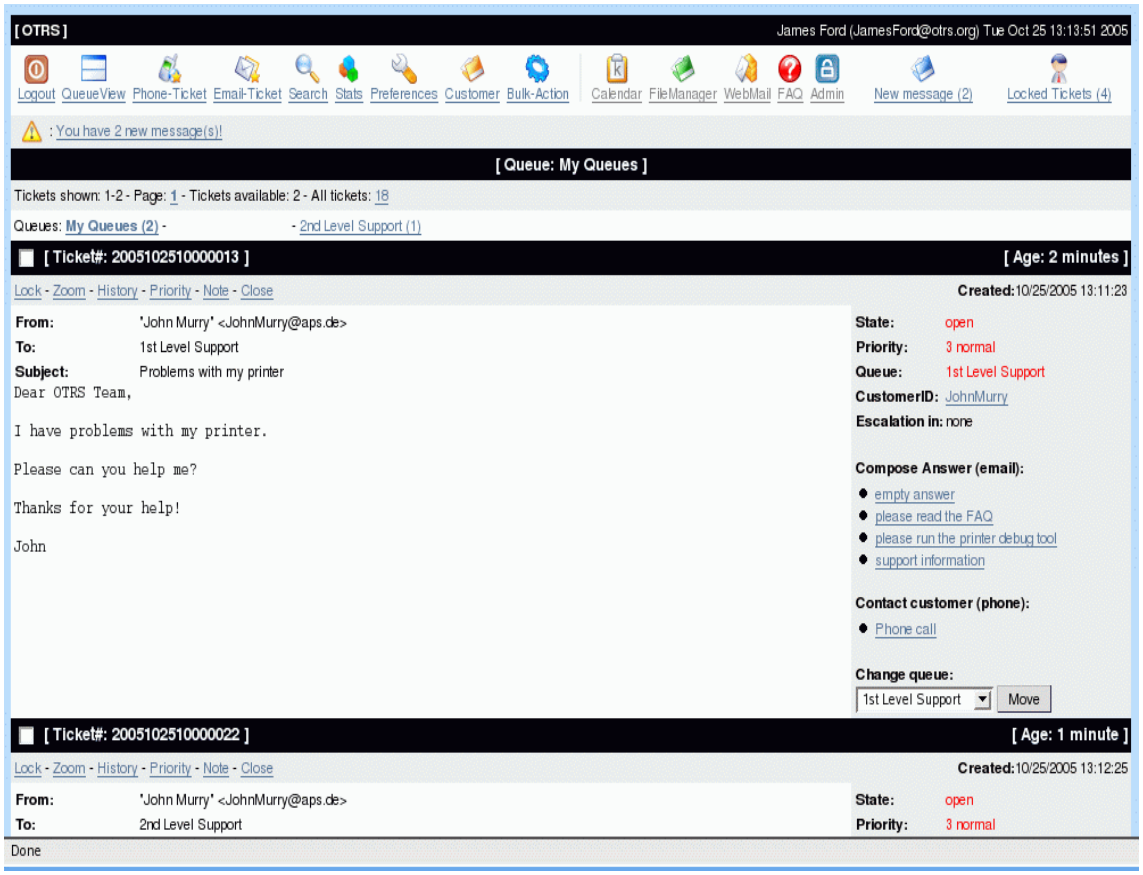

Figure 14 - OTRS Example (Dossy 2007)

Other tools that existed to help the IT services in maintain the normal level and solve the incidents/problems quickly were the Gralha and Wiki. These tools provide a service to store errors and known issues, as well as requests for product improvements and services. These are obsolete

solutions too because it leads to separate sets of data, increasing gaps in the comprehension of data and taking to dubious information, longer time in analysis and lower performance and efficiency in IT Services.

To overcome the inabilities revealed by the available tools, a new platform was acquired and implemented. This new application is the Easyvista, an IT Service Management tool aligned with the best practices proposed in ITIL, in order to enhance the achievement of the ISO/IEC 20000 for IT Service Management.

During dissertations in previous years, Easyvista was, in collaboration with the IT Services of ISCTE-IUL, parameterized in order to respond to the needs of the institution aligned with the strategy and improve the quality and management of the IT services. Actually, there are in place the Asset Management, Incident Management, Request Fulfillment and Change Management. During this dissertation in being implemented and parameterized the Problem Management process such as the design of the process and the roles and responsibilities associated with it.

3.4 IT Service Management Tool - EasyVista

EasyVista is an IT Service Management tool that provides solutions to support organization's IT service management strategy and ITIL best practices which can improve the quality of IT services providing flexibility through its availability anytime and anywhere and agility through its adaptability to evolving business requirements. EasyVista provides too automated workflows and wizards incorporating certified ITIL process improvement and methodologies.

3.4.1 Catalogs

There are defined catalogs in EasyVista, grouping elements that are presenting common characteristics. Each category is defined in a tree structure and the number of levels used in the tree structure depends on the degree of complexity needed.

With regards to processes, there are defined the Service Request Catalog, Incident Catalog and Problem Catalog, as shown in the Figure 15.

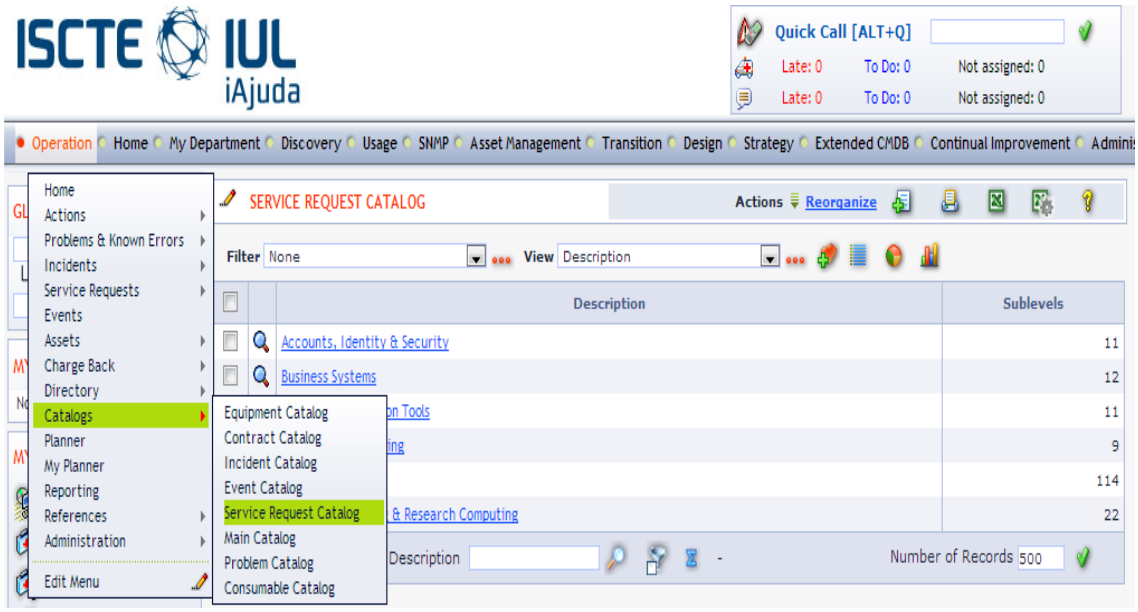

Figure 15 - EasyVista Catalogs

The Problem Catalog was created in the scope of this dissertation and it is aligned with the other catalogs (incidents and requests), following a similar tree structure, as shown in the Figure 16. This problem catalog reflects the major services where problem can emerge.

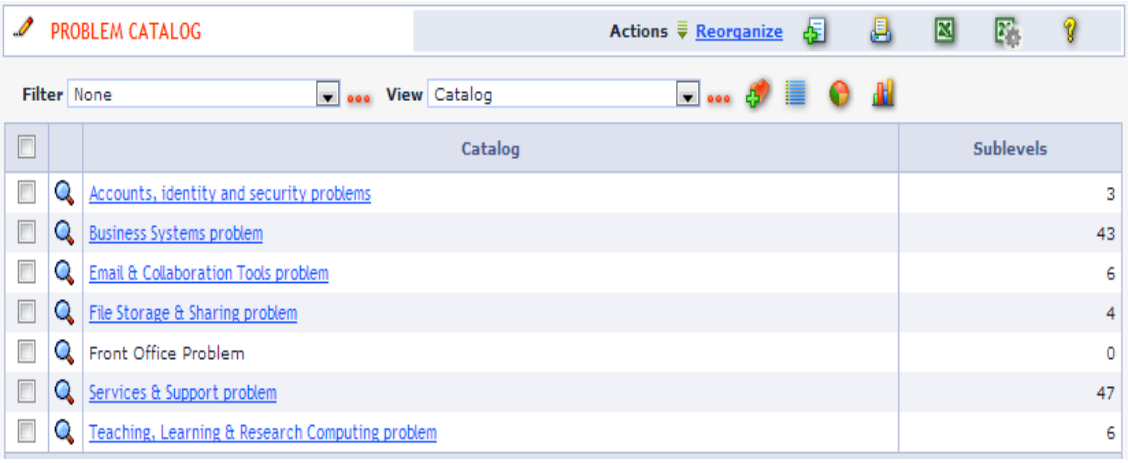

Figure 16 - EasyVista Problem Catalog

Each category of the catalog has information associated, such as a name, impact, default urgency (users can modify it when opening), SLA, group in charge and workflow, as shown in the Figure 17.

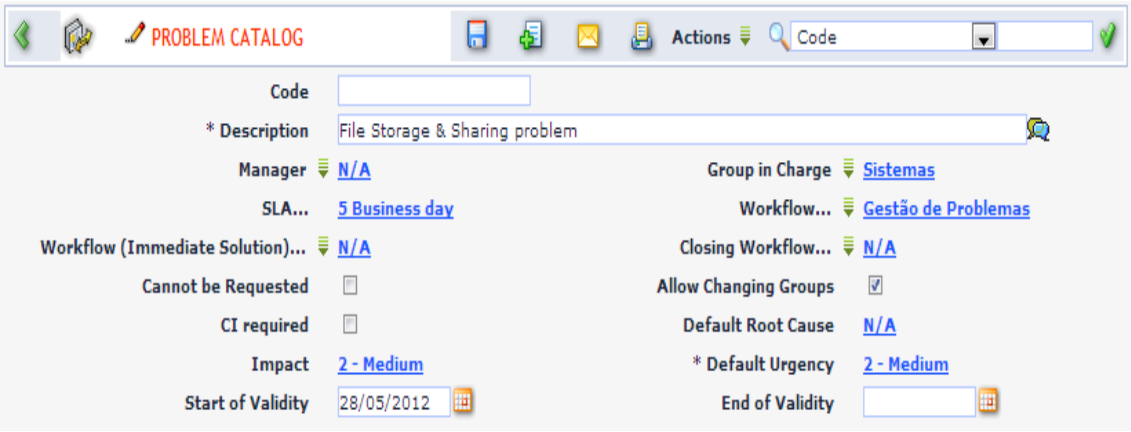

Figure 17 - EasyVista Topic Catalog Details

3.4.2 Service-level agreements

A service-level agreement is a deal between the service provider and the service requestor. In practice, the term SLA is used to refer the contracted delivery time (of service or performance). At ISCTE-IUL each SLA, measured in business days, is associated with a priority level, as shown in the Figure 18. This priority is calculated from the impact (acquired from the category of the catalog) and the urgency (acquired by default from the category of the catalog or from the input of user). These SLAs must be reviewed periodically in order to be aligned with the strategy of the institution, and must be monitored to confirm the accomplishment of the levels accorded and to have trusted information that support the decision-making.

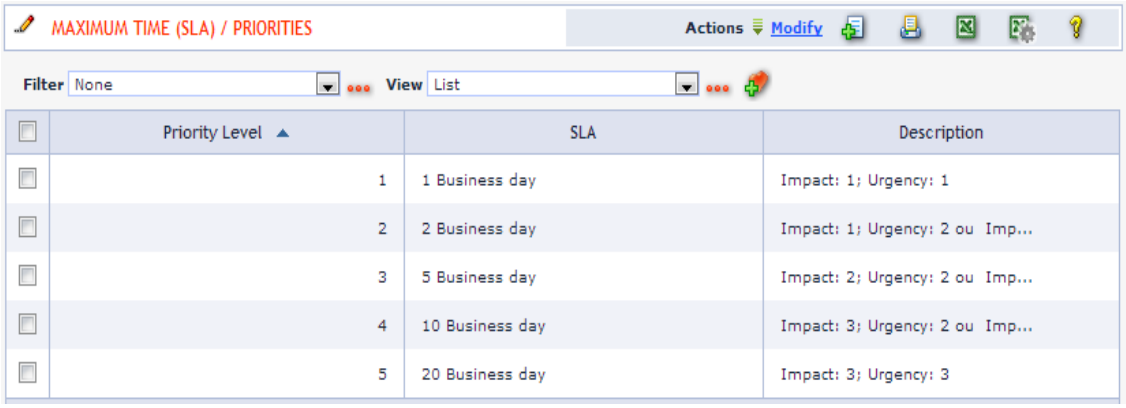

Figure 18 – Impact and SLAs Parameterization in EasyVista

3.4.3 Workflow

A workflow is a process that defines the steps necessary to achieve the solution. It specifies who must intervene and at which moment, between the moment where a person notifies a problem and the moment where the problem will be closed.

The workflow is comprised by a start step, intermediary steps and an end step.

- The start step defines the start of the process;
- The intermediary steps define sequential actions across the process. In each step is present (i) an action type, from a list of predefined actions types, that execute precise functions (intervention, validation) during a step, (ii) an role that allow to define the groups that need to intervene during the step, (iii) a OLA that define the available time to accomplish the intervention, (iv) an entry status where is defined the status before the step is executed, (v) an warning message that will be send automatically send by email and (vi) entry conditions, relating to previous steps, that must be carried out so that the current step can start;
- The end step defines the normal end of the process and the final status.

As part of this case study, it was created the problem management workflow to accompany the problem along the process, defining the steps and the stakeholders, as shown in the Figure 19.

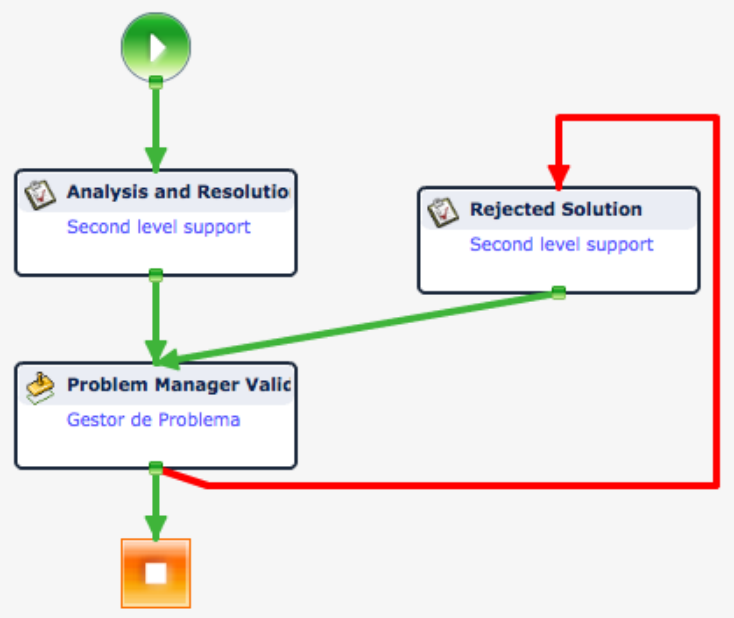

Figure 19 - Problem Management Workflow

3.4.3.1 Analysis and Resolution

After the registration of the problem, the Second Level Support teams receive the problem notification. The entry status is “In Progress”.

3.4.3.2 Problem Manager Validation

When a solution is founded, the problem manager must validate that solution. At this point, the entry status of the problem is “Pending Approvals”. In case of approval, the final status is “Solved”.

3.4.3.3 Resolution Rejected

The problem manager can reject the solution proposed by the team if it isn’t appropriate. A new solution must be found and submitted for approval. The enter status is “Rejected Operation”.

3.4.4 Roles

Roles are functions assumed by one or more groups in the organization, within the framework of the IT support. Each group has one or more employees belong to the group, allowing identifying the supports that need intervene during the processing.

Each role intervenes in workflow steps that coordinate the processing of requests. The roles allow specifying which support must intervene and when they must intervene during the process.

As part of this case study, it was created the Problem Manager and Problem Management Team.

3.4.5 Problems & Known Errors

Within the scope of this dissertation, it is important to analyze the problems and known errors.

Problems and known errors remain on the database containing all problems which can be the root-cause of incidents and the acceptable answers to solve the incidents.

The database is available for consultations for support users of the Service Desk, allowing them, when detect an incident, to search if a problem was already researched and found and possibly find the solution documented inherent to the problem description.

3.4.5.1 Problems

A problem documented without workaround or solution is something clearly identified and registered but for which there is no available solution.

Each problem has a manager, which is the person responsible for orientations, tracking, reviews and validations.

Problems are grouped by category, according to the defined catalogs and the tree catalogs structure. A larger number of levels of the tree structure will allow a better target in problem documentation, derived to the high level of detail to group related problems, increasing the performance in searching.

There is some detailed information that must me aggregated to the problem, as shown in the Figure 20, namely:

- **Problem number** - a unique ID that identifies the problem;
- **Manager** – the person in charge, that tracks and handles the solution of the problem;
- **Created by** – user that has inserted the problem in the system;
- **Status** – current status of the problem. When the problem is identified and resolved the status remains as solved;
- **Creation date** – the date when the problem was created;
- **Topic** - type that the problem is related to, grouping similar problems. According to the topic, it can be pre-defined a impact, support team and a workflow;
- **Priority** – calculated based on the pre-defined impact according to the topic of the catalog and the urgency inserted by the user. It defines the sequence of problems that must be investigated and resolved;

- **Location** – physical place where the problem was detected. Places with high volume of problems must have a review routine with higher frequency;
- **Description** – a description of the found problem, containing the report of the situation;
- **History** – the history records all the activities performed related to the investigation, diagnose and resolution of the problem. These activities have related the support person, group, action and time spent.

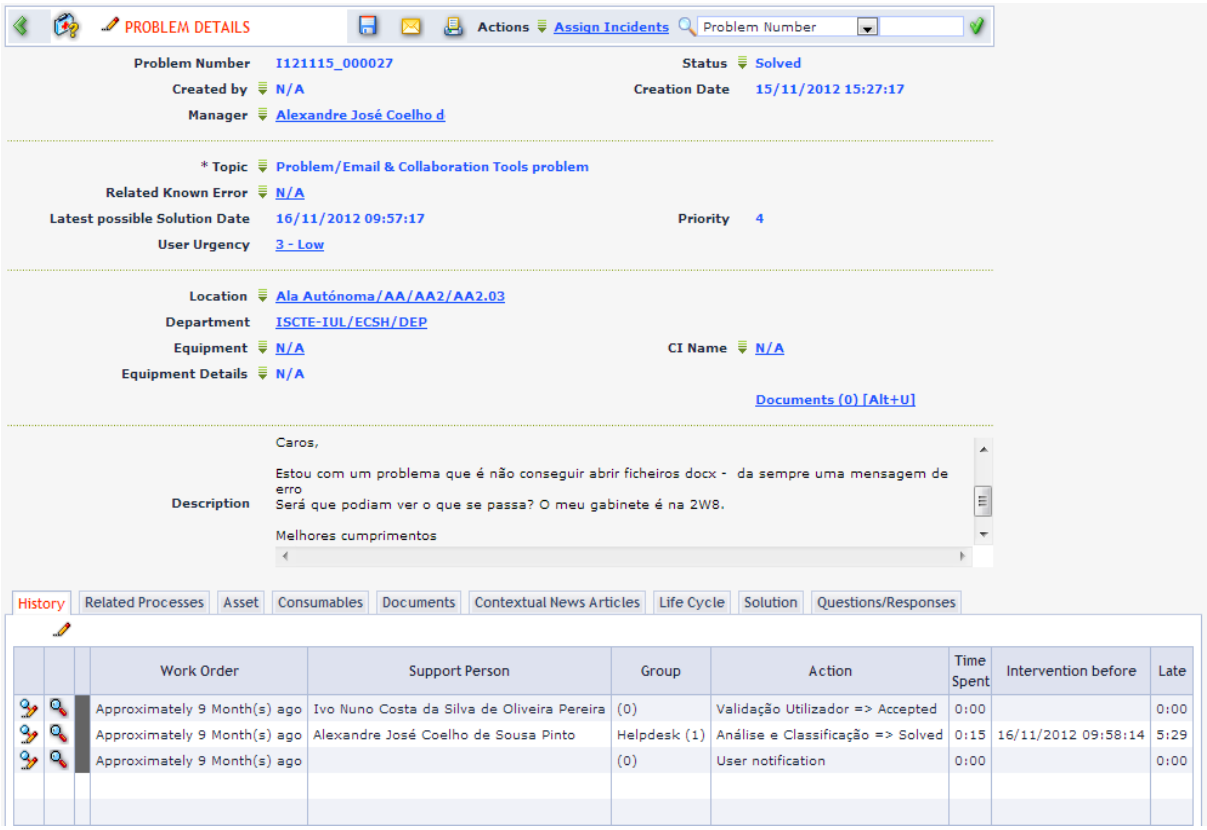

Figure 20 - EasyVista Problem Details

3.4.5.2 *Known errors*

Known errors were problems for which a workaround or a solution exists, decreasing the impact on the final user.

There is some detailed information that must me aggregated to the known error, as shown in the Figure 21, namely:

- **Known error number** – a unique ID that identifies the known error;
- **Creation date** – the date when the known error was created;
- **Status** – the status of the known error remains knowledge base;
- **Query** – question that the known error will respond;
- **Response** – detailed description with the steps required to achieve the resolution

- **Public** – checkbox specifying if the problem should be displayed when a users searches in the database of problems and known errors, differentiating if the known error is displayed in the Self Service (Font Office) and Service Desk module, or only in the Service Desk module;
- **Manager** – the person in charge, that tracked the solution of the problem and will be responsible for future clarifications;
- **Group** – the group who participated in the resolution of the problem and will help in future clarifications and interventions;
- **Topic** – type that the known error is related, grouping similar problems.

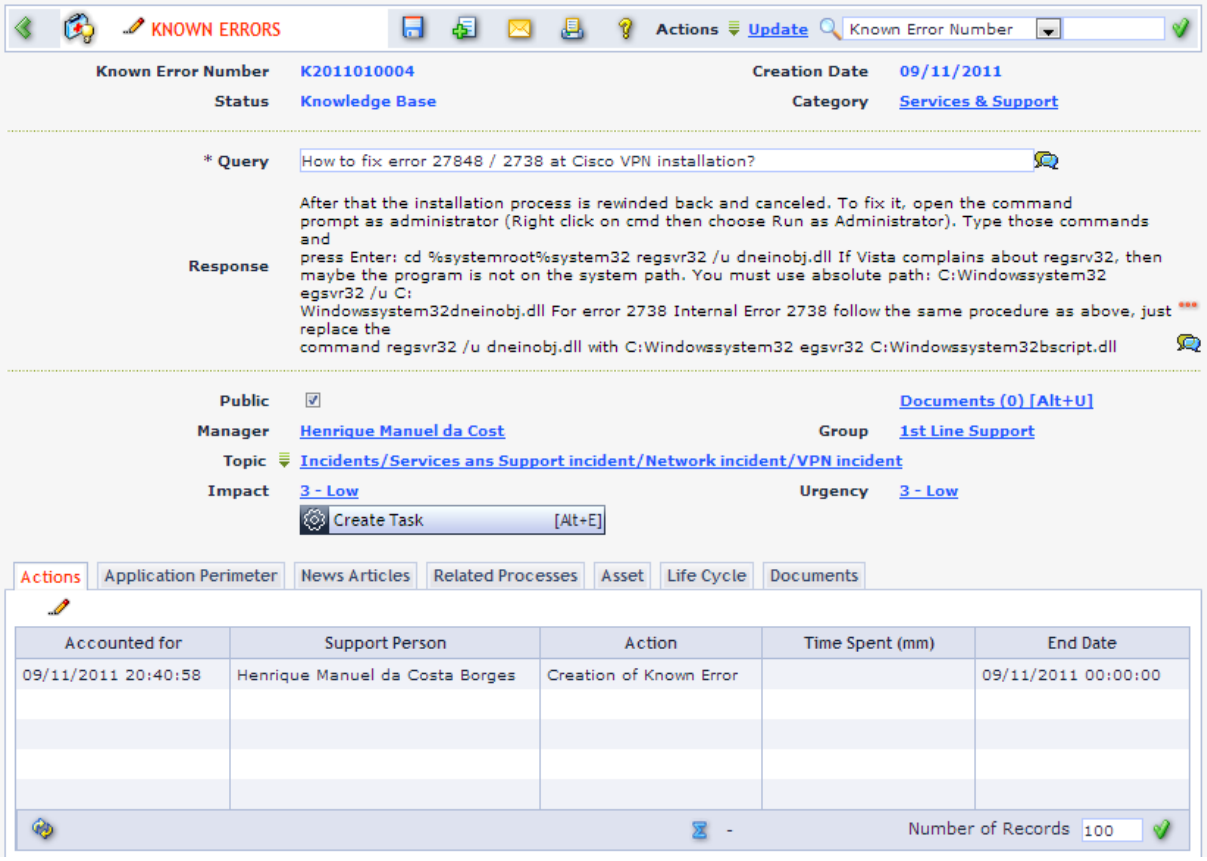

Figure 21 - EasyVista Known Error Details

3.5 Problem Management Process Design

The strategic alignment between the Corporate Governance and IT Governance allows having in the institutions a reliable IT service supplying the ongoing daily operations effectively and efficiently, not affecting the users and the normal course of the operations.

The ITIL Problem Management process appears in the level of IT processes and procedures where the interface with operational IT is done, and problems are handled with investigation and resolution, stabilizing the normal levels of the IT services, decreasing the disruption of essential services to the business and preventing recurrent incidents.

3.5.1 Roles and Responsibilities

To initiate the implementation of the problem management process is essential to define the roles and responsibilities needed by the process. The current structure at ISCTE-IUL and the number of members of each team is shown in the Figure 22.

The number of technicians present at the IT Department obligates that some of the members take charge of multiples roles. One of those cases is the coordinator of the NAU, Henrique Borges, which will assume the role of Problem Manager.

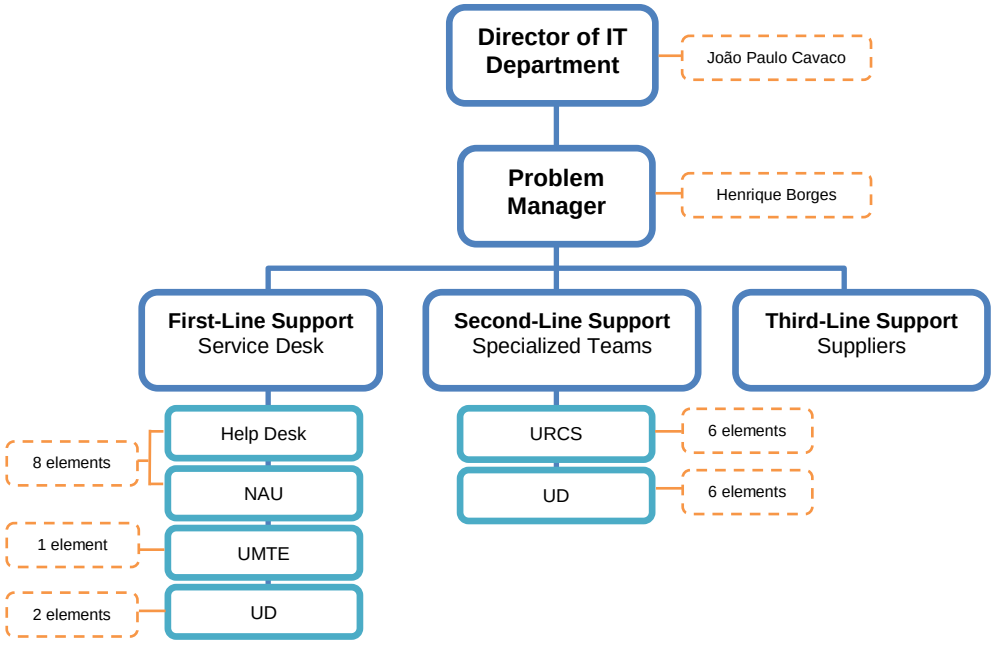

Figure 22 - IT Structure at ISCTE-IUL

For the lines involved in the process, it was elaborated a list of recommendation of functions and responsibilities that the stakeholders may fulfill.

3.5.1.1 Director of IT Department

The Director of IT Department is the governing authority whom the processes managers must report. At ISCTE-IUL the position of Director is in charge of João Paulo Cavaco.

The Director may be responsible for some of the following tasks:

- Establish the IT organizational structure;
- Coordinate the designing of IT processes;
- Establish IT roles, responsibilities and segregation of duties;
- Define de IT strategy;
- Discuss the IT annual budget;
- Develop and maintain IT policies;

- Coordinate the development of IT general controls in governance, operations, accesses, security, changes and developments;
- Identify personal performance benchmarks;
- Coordinate the development of Risk Management Policy;
- Negotiate and develop contracts to the acquisition of services and infrastructure with suppliers;
- Evaluate and select suppliers through a request for proposal (RFP);
- Evaluate the compliance with established procedures;
- Define service level agreements (SLAs) and operating level agreements (OLAs);
- Monitors and evaluate the suppliers services delivery;
- Coordinate the development and dissemination of the Information Security Policy and at the institution;
- Coordinate the development of the Disaster Recovery Plan (DRP) and Business Continuity Plan (BCP).

The Director of the IT Department can be classified, according to skills, as:

- **Technical:** medium;
- **Business:** medium;
- **Interpersonal:** high.

3.5.1.2 Problem Manager

The Problem Manager will coordinate all Problem Management activities and will have specific responsibility for manage the problem resolution groups to ensure the resolution of the problems according to the defined SLA targets, open and closure of problem records, review status of problems, formulate recommendations for improvement and create related request for change, evaluate the problem resolutions, manage the KEDB and ensure that third parties fulfill their contractual obligations.

In a general way, the Problem Manager is responsible for:

- Contact with others process Managers;
- Receive feedback about potential problems;
- Open and confirm the classification of problems;
- Support and coordinate in root cause analysis;
- Review the status of problems;
- Review the compliance with the established SLA.

Problem Manager can be classified, according to skills, as:

- **Technical:** high;
- **Business:** medium;
- **Interpersonal:** medium.

3.5.1.3 Service Desk

The Service Desk is responsible for managing day-to-day requests and users support. It is the primary point of contact for users when there is a service degradation or disruption. It provides too a point of coordination for several IT groups and processes. According to this, the Service Desk can examine the entry flow of incidents, identify repetitions and report a problem to the Problem Manager that will open a problem record and delegate functions to the support groups to resolve the existing errors.

At ISCTE-IUL the Service Desk is the 1st line support and it is composed by two levels, the Help Desk and the NAU (User Support Center, from the Portuguese Núcleo de Apoio ao Utilizador).

The Help desk is the destiny of the calls of users when looking for help in use of technology, and it can be characterized as:

- Solver – solve the issues during contact with the user through knowledge base and adequate training. The main objective is closing the issue without escalate to other team.
- Forwarder – depending on the type of issue reported by the user, the Helpdesk may not have the necessary knowledge to solve it. In these cases, the Help Desk receives the issue, record, notes the details and forwards the issue to the NAU. This team is responsible for supporting users and resolve issues related to set up and configure computers, peripherals and any other work relating to the computers, such as install and repair software or computer hardware.

According to Problem Manager, Henrique Borges, it was established that the Help desk cannot open problems. This task is the responsibility of NAU, Problem Manager or 2nd line teams. The problem can be open in accordance to Help Desk feedback when analyzing the entry flow of incidents (identifying repetitions and similarities), feedback provided by suppliers or through preventive maintenance performed by NAU and 2nd line teams.

In a general way, the 1st line is responsible for:

- Creating classifications (severity and impact) and escalation procedures;
- Detecting and recording issues, service requests and information requests;
- Classifying, investigating and diagnosing reduction of service levels;
- Resolving, recovering and closing issues;
- Informing users with status and updates;
- Producing management reporting.

Service Desk can be classified, according to skills, as:

- **Technical:** medium;
- **Business:** low;
- **Interpersonal:** high.

3.5.1.4 Second-Line Support

The second-line support groups are composed by professionals with greater technical skills than the Service Desk and with more time to spend to diagnosis and resolution without interference from users

telephone calls. These professionals are grouped in teams by support area, providing a more efficient approach to the errors divided by categories. The identified teams are the Systems Support Team, Network Support Team and the Development Support Team. These support line is requested when the first line could not solve the reported issue.

Some of the expected tasks by the second-line support teams are:

- Support the 1st line support;
- Solve escalated problems;
- Plan and implement a backup policy, procedures for data restoration and backup integrity tests with key-users;
- Maintain the IT security;
- Support IT changes;
- Monitors the infrastructure;
- Elaborate applicational documentation;
- Design and update enterprise infrastructure architecture;
- Prepare detailed design and technical software applicational requirements;
- Customize and implement automated functionality.

Second-line support teams can be classified, according to skills, as:

- **Technical:** high;
- **Business:** medium;
- **Interpersonal:** low.

3.5.1.5 Third-Line Support

Suppliers and maintainers compose the third-line support that will provide more technical knowledge to deal with more deep-rooted problems. The suppliers can too, in a proactive way, inform about discovered problems. Suppliers have the ability to solve unsolved problems in previous levels.

Some of the expected tasks by the suppliers are:

- Provide the contracted services;
- Fulfill with the established SLAs;
- Respond to the required RFP;
- Provide updates;
- Report detected problems;
- Support and help in problem solving.

Suppliers can be classified, according to skills, as:

- **Technical:** high;
- **Business:** low;
- **Interpersonal:** low.

3.5.2 Problem Management – Process Flow

The Problem Management process flow, according to OGC, is shown in the Figure 23, representing in a high level view the major activities that constitute the process.

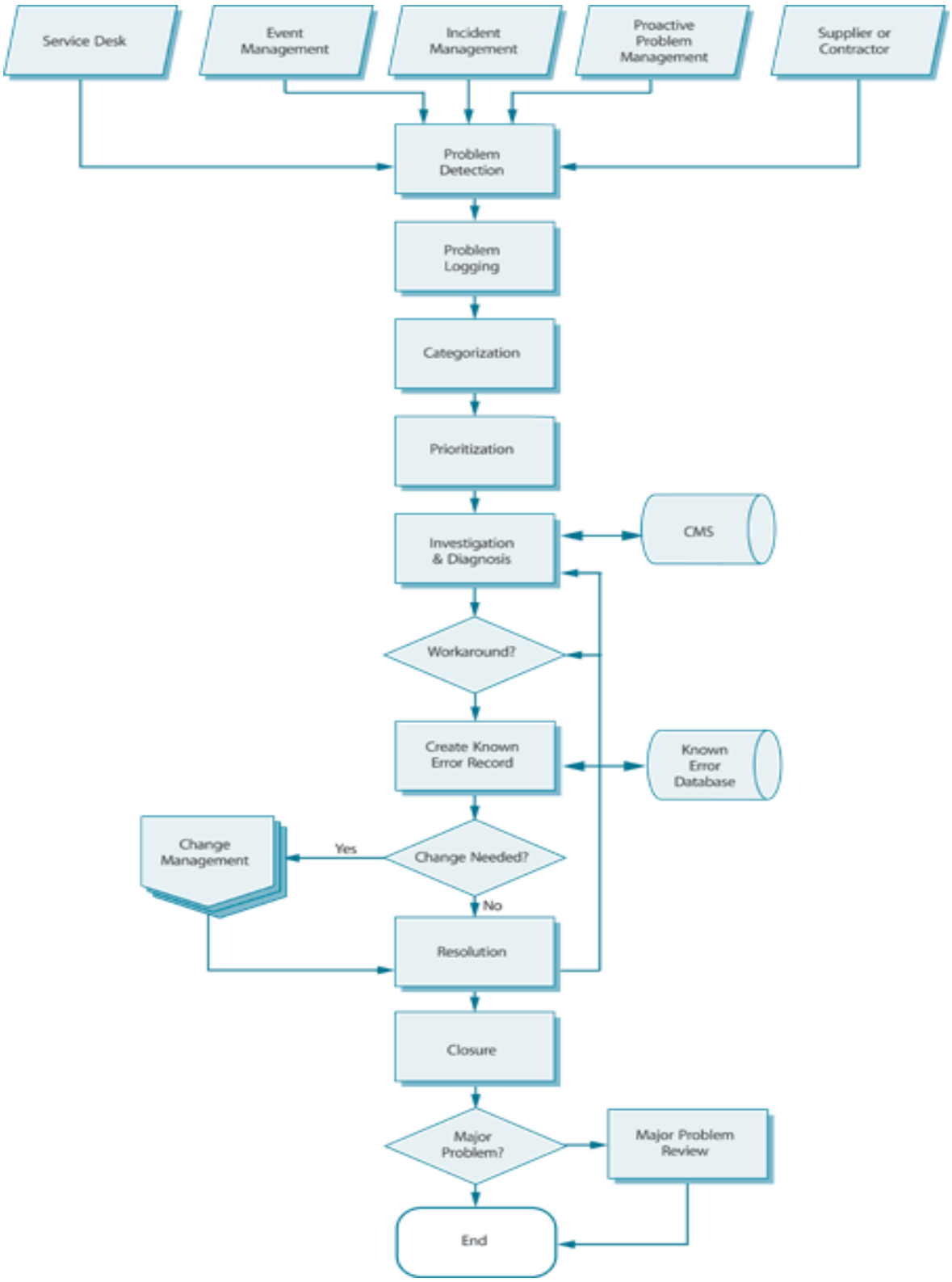

Figure 23 - ITIL Problem Magament Process Flow (OGC 2007)

According to the process flow it is possible to check the inputs and the main activities of the process. These activities comprise in particular the detection and logging of the problem, the categorization and prioritization, the investigation and diagnosis, the creation of known errors and change requests, the resolution and the closure of problem, and posterior review of the resolution implemented. These activities will be explained in detail further below.

3.5.3 Problem Management – BPMN Process Model

A primordial step to implement the Problem Management Process is the process design. According with this, the BPMN were used to model the process.

BPMN is a standard for business process modeling that provides a graphical notation for specify business processes. The primary goal of BPMN is to provide a standard notation easily understandable by all business stakeholders (OMG). The tool used to design the process was the Bizagi Process Modeler, a free process modeler with the standard BPMN notation.

The level of granularity used to model the process led to a large number of pages. Due to size constraints of the dissertation, the detailed process diagram was submitted and explained in detail in the attachments (Appendix A).

In this section is presented the process in a high level, with the stakeholders and the main activities, as shown in the Figure 24. This BPMN diagram shows the Problem Management Process design, under the ITIL recommendations and oriented to the flowchart shown above.

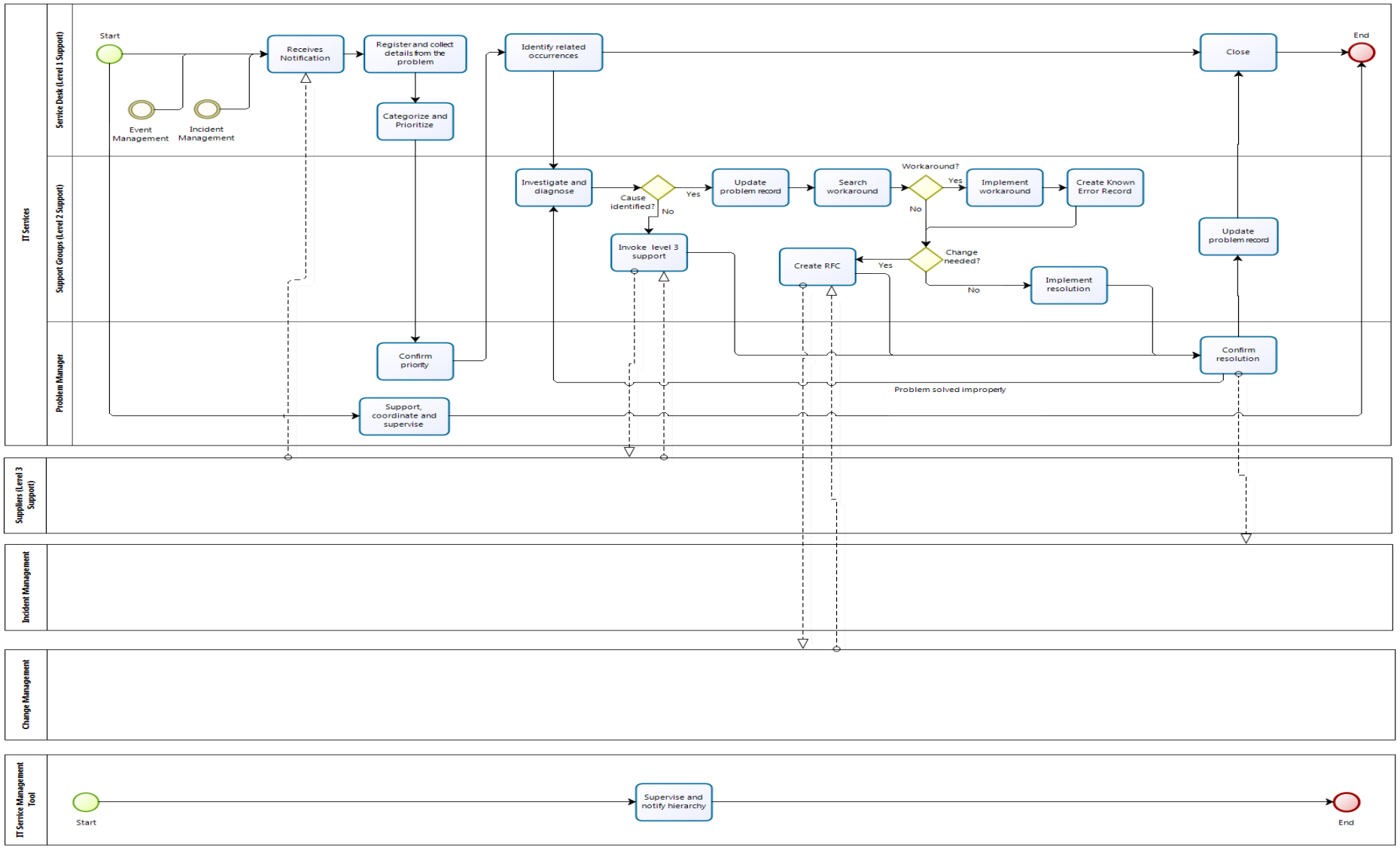

Figure 24 – High Level Problem Management Process Design

3.5.3.1 Register and collect details from the problem

All the problems reported to the Service Desk or when there are recurring incidents may give rise to the problem for future analysis and investigation. During the registration of the problem, all the details or incidents should be collected in order to facilitate the interpretation of the root-cause.

3.5.3.2 Categorize and prioritize

When the problem is created, it must be categorized correctly according to the problem catalog, in order to group related problems, to facilitate the allocation to the support team, easily traced in the future and to obtain reliable information for the production of reports (such as the trend of problems).

The prioritization is based on the defined impact and urgency. According to this inputs, priority is calculated allowing an approach more efficient in the order of problems resolution, giving priority to the most critical and that most affect the normal course of operations.

3.5.3.3 Identify related occurrences

Before initiate the investigation for the root-cause of the problem, it must performed a consultation to the known error database, identifying any related occurrence of the problem, using problem-matching techniques, improving the times for resolution the problems and decreasing the downtime of the services.

3.5.3.4 Close

After the confirmation of the Problem Manager, the problem can be formally closed. The Problem Manager should check if the problem record is updated, the problem is solved, if any change are correctly implemented and if any known error are correctly documented.

3.5.3.5 Investigate and diagnose

The problem is analyzed, the root-cause is investigated and possible permanent solutions are identified. If the resolution requires complex tasks, i.e. the resolution is not available in the Known Error Database, the investigation should be done by the level 2 support groups, or in case of lack of technical knowledge by the support teams by the suppliers, identified as level 3 support. The time of the investigation will depend on the nature of the problem, impact, urgency and consequently the level of priority.

In this activity, there are a number of useful problem solving techniques available that can be used to help diagnose and solve problems. All the investigations should be done with the consent of the Problem Manager, the responsible for coordinate the operations related to the problem management process.

3.5.3.6 Invoke level 3 support

Investigations are performed by the support groups but in case of lack of technical knowledge by these groups, level 3 support should be invoked, i.e. suppliers. The suppliers must have sufficient

knowledge to identify the root-cause and propose a possible solution to restore the normal service levels.

3.5.3.7 Update problem record

Throughout the process, the problem record should be updated, in order to have reliable information for further problem reporting. Some examples of information that should be updated and appear in the problem record is the status, workaround and implemented solution.

3.5.3.8 Search workaround

Sometimes it may be possible to solve the problem temporarily, without being the definitive solution, ie a workaround that can, at the moment, quickly solve the incidents caused by the problem. However it is important to work on a permanent resolution when it is justified. All the details of the workaround are documented within the problem record.

3.5.3.9 Implement workaround

According to the result of the activity of search workaround, it may be implemented a workaround to quickly and temporarily solve the incidents caused by the problem. After the implementation it is important to work on a permanent resolution when it is justified. All the details of the workaround are documented within the problem record.

3.5.3.10 Create Known Error Record

A known error record should be raised as soon as possible, more specifically when a workaround or a permanent solution has been found, mirroring that the research has positive and concrete results. It identifies the root-cause of the problem and will help to solve further incidents or problems, allowing identifying and restoring the service more quickly.

3.5.3.11 Create RFC

To solve some problems, a change in functionality is required. In these cases, requests for change must be raised, approved and implemented before complete the resolution of the problem. In the change management process it is decided if the change is appropriate to the situation. Depending on the priority of the problem, an emergency request for change can be raised. When the implementation of the change is finished, can be completed the problem resolution.

While the change is in the development phase, the known error database should be used to help solving quickly occurrences of problems or incidents.

3.5.3.12 Implement resolution

When the solution is discovered, it should be applied to resolve the problem as soon as possible. It may happen the situation of existence of two or more solutions for the problem. In these cases it should be weighted the best hypothesis in terms of price-quality.

According to the selected solution, it must be performed a review to design of the solution, develop a resolution plan, functional and technical description, test plan involving key-users and a follow-up plan for post-implementation.

In some cases, it may not be viable to implement the permanent solution. In these cases the impact of the problem is limited but the cost of resolution would be high, so it is recommended to use the detected workaround. In the known error record associated should appear the description of the known error in order to detect and resolve any recurrence quickly, restoring the normal service levels.

3.5.3.13 Confirm priority

In order to improve the resolution of problems, all the priorities of problems must be reviewed, giving priority to the real most urgent cases and with more impact in the normal course of the business.

3.5.3.14 Support, coordinate and supervise

During the analysis and investigation, the Problem Manager gives support and coordination to align the activities performed, allocate resources and to fulfill the service levels agreements.

3.5.3.15 Confirm resolution

The problem manager checks the implemented resolution and all the documented details. If any change has been completed and reviewed, the resolution has been applied and the problem record contains a full historical with all the activities performed, the problem record can be formally closed and the associated known error record should be updated with the description of the resolution implemented.

If resolution is not satisfactorily, the process returns to the investigation in order to perform another analysis.

3.5.3.16 Supervise and notify hierarchy

The IT Service Management Tool accompanies and gives support to the service operation.

3.5.4 Problem Management – BPMN Process Model Implemented at ISCTE-IUL

ITIL describes procedures and tasks that are not organization-specific, used and adapted to the reality of an organization for establish a minimum level of competency. The BPMN model above illustrates the problem management process according to the best practices recommended in ITIL. These best practices should serve as guidelines but not as obligations, because companies or institutions are different and there is no one-size-fits-all model. Each institution should take the best practices guidelines and adapt them to their own reality, changing some decisions and responsibilities, but keeping the essence of the process flow.

According to this, some changes were made to the process model created above, in order to adapt the process to the reality of ISCTE-IUL, aligned to the interviews done to the Coordinator of Service

Desk, the observations that were made and the knowledge acquired during the study of the Institution, the IT Department and the ITIL oriented platform used locally, the EasyVista. These changes resulted in a new diagram.

In this section is presented the process at ISCTE-IUL, with the stakeholders and the main activities, as shown in the Figure 25.

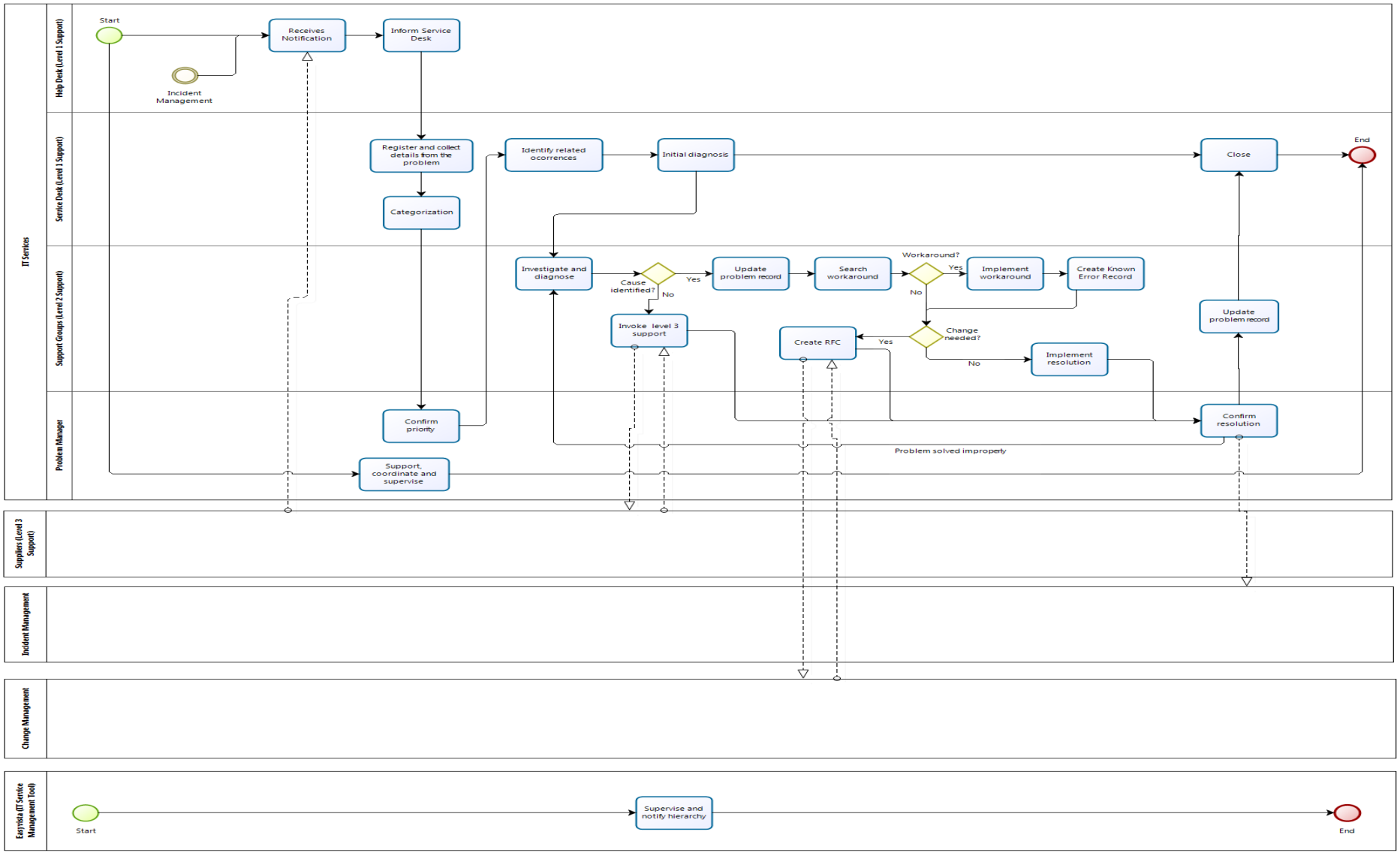

Figure 25 - High Level Problem Management Process Design at ISCTE-IUL

As recommended in the ITIL publications, the adaptation to the reality of ISCTE-IUL produced some changes to the original model created based on the best practices.

The main change is in the beginning of the process. At ISCTE-IUL, the Service Desk is decentralized and composed by two components: the Helpdesk to support users and resolve incidents; and the Service Desk to perform proactive actions and perform the initial analysis to problems in search of the root-cause. In order to this, the record of the problem is done by the Service Desk, responsible for problem solving. The Help Desk only receives the notifications that a problem may have occurred.

The Event Management Process is not yet implemented, so it was removed from the scope of the Problem Management process diagram implemented at ISCTE-IUL.

Another difference is the initial diagnosis, which is performed by the Service Desk and not by the Support Groups of the Level 2 Support. This allows solving problems that require less technical skills at the first level and escalate only the more complex problems that require high technical skills and a deeper investigation to identity a workaround and a permanent solution.

A final major difference is the categorization and prioritization activity. The IT service management tool EasyVista calculates automatically the priority of the problems based on the urgency inserted by the user and the impact inherent to the topic of the problem catalog.

3.5.5 Problem State Diagram

The Figure 26 shows the state diagram with the statuses that the problem can take throughout the problem management process. These statuses will permit to know how many problems are in each step of the process and allow calculating some metrics, e.g. number of metrics not assigned to a support person and percentage of rejected solutions.

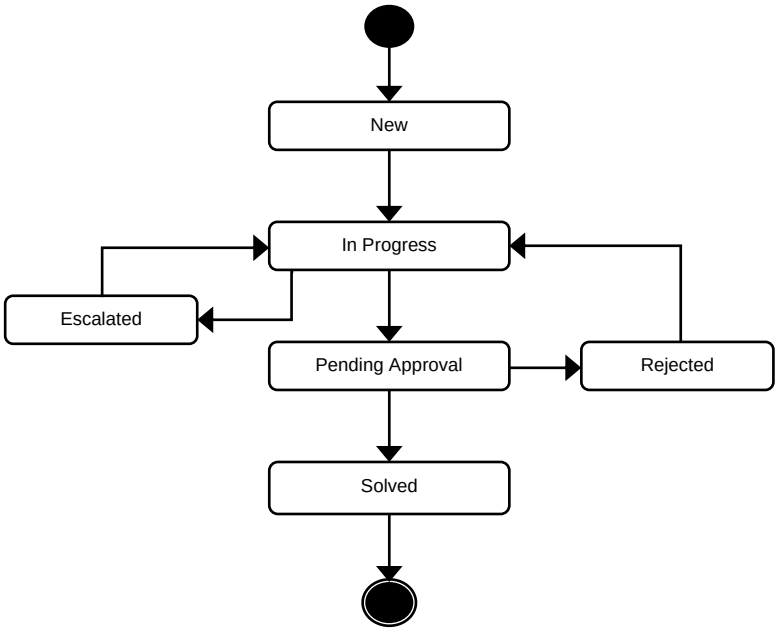

Figure 26 - Problem State Diagram

In order to understand the state diagram and to explain in more detail each one of the status, a description is shown in the Table 1 below.

Table 1 - Problem Status Description

State	Description
New	Initial state of the problem when it is registered.
In Progress	State acquired by the problem when it is assigned to a support person.
Escalated	State acquired by the problem when it is escalated to another support group.
Pending Approval	State acquired by the problem when the support group resolves it, but waits for the Problem Manager approval.
Solved	State acquired by the problem when the Problem Manager approves the proposed solution.
Rejected	State acquired by the problem when the Problem Manager does not approve the proposed solution.

3.5.6 RACI Matrix of the Problem Management Process

In order to complete the process, it was made a distribution of responsibilities to the different stakeholders using a RACI matrix (R – Responsible; A – Accountable; C – Consulted; I – Informed). The RACI matrix is a formal way to define the role of each stakeholder of the process, in this case the people who interact in the activities of the problem management process (Smith, 2005).

- **Responsible** – people or team that performs the activity and work to achieve the objective. It is possible to have multiple Responsible;
- **Accountable** – the Accountable have authority to approve or disapprove the work perform in the activity. Only one Accountable per activity is allowed.
- **Consulted** – people or entity that may have knowledge to help to perform the activity and can be consulted;
- **Informed** – an interested party in the process that should be informed only for information. The flow of data is just in one way, giving updates about the current state of the activity.

Table 2 - RACI Matrix of the Problem Management Process Implemented at ISCTE-IUL

Procedures and activities	Help Desk	Service Desk	Support groups	Problem Manager	Level 3 support
Problem logging	I	R/A	-	-	-
Categorization	-	R/A	-	-	-
Prioritization	-	R/A	-	I	-

Procedures and activities	Help Desk	Service Desk	Support groups	Problem Manager	Level 3 support
Investigation & Diagnosis	-	R	A	I	C
Create Known Error Record	-	R	A	I	-
Resolution	-	R	A	I	C
Resolution review and evaluation	-	I	I	R/A	-
Closure	-	R	A	I	-
Major problem review	I	R	A	I	-

4 Implementation of the Dashboards at ISCTE-IUL

ITIL recommends that the processes must be monitored and measured. According to that, and after the specification and implementation of the Problem Management Process, it is essential to have a mechanism that can response to the coordinator requirements and provide detailed information to support the decision-making process. In order with this philosophy, this chapter explains the study and the work performed to build the Service Operation dashboards that will measure the implemented process, the Incident Management process and the Request Fulfillment process, in accordance with the good practices in dashboards building. The dashboards will provide analytical capabilities that transmit clearly and immediately the most important information, consolidated and arranged, in a historical context, providing a strong meaning to the information presented.

4.1 Definition of Requirements

An entity should have implemented processes to maintain organized its structure and activities but is also essential to have controls that ensure the security and reliability of the processes and have implemented a report policy with a defined periodicity that permits to monitor the processes and to analyze the current situation of the entity.

Making a parallel with the “Plan-DO-Check-Act” Deming diagram, as shown in the Figure 27, currently it is intended to enter the third phase of the cycle and measure the specifications and the implementation that has been made, in order to do some improvements and adjustments.

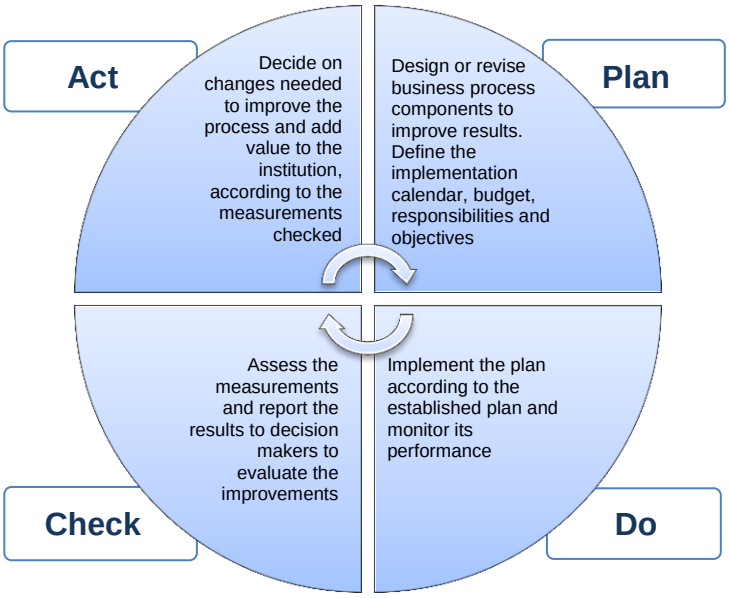

Figure 27 - The Deming Cycle (adapted from BSC 2013)

The processes to measure were defined and isn't only the Problem Management process, but also the Incident Management and the Request Fulfillment processes, creating a Service Operation report. This report will be sent to the Director of the IT Department and will permit to both processes Managers and Director to have a perception of the trends that are occurring in the IT environment.

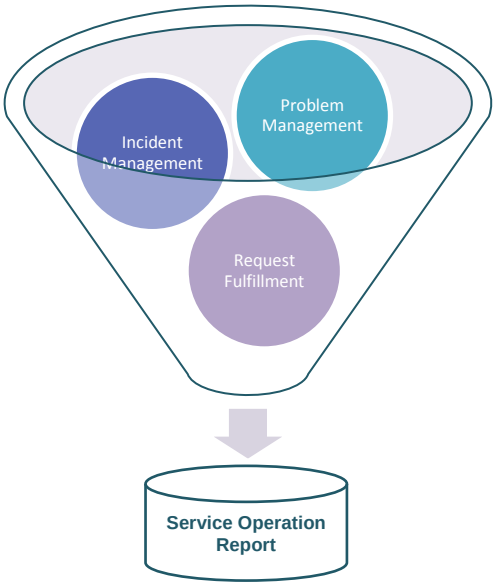

Figure 28 - Service Operation Report Inputs

The next step is to define de periodicity of the reports. In conversation with the NAU coordinator, Henrique Borges, it was established that the Director of the IT Department at ISCTE-IUL must receive a weekly Service Operation report to be aware of the actually situation of the department and take decisions based on facts in due time.

Advancing in the creating of reports, a very important step, the definition of metrics that will embody the reports and will permit transmit in numbers the real state of the IT environment present at the institution.

According to several studies and publications, plus the interviews performed during this study, it was possible to compile a list of metrics which can translate the reality in the IT environment present at the institution. After the listing, each one of the metrics was analyzed and evaluated in such a way to fit the metric to the reality of the case study, i.e., compare the required information to respond to the metric and evaluate if the information source, EasyVista, can provide it. To refine the list, a feedback was requested to the NAU Coordinator in order to evaluate the adequability of the metrics. Finally, after the refining, it was discussed the best metrics to integrate the dashboards that will be reported to the IT Director and the Vice-Rector.

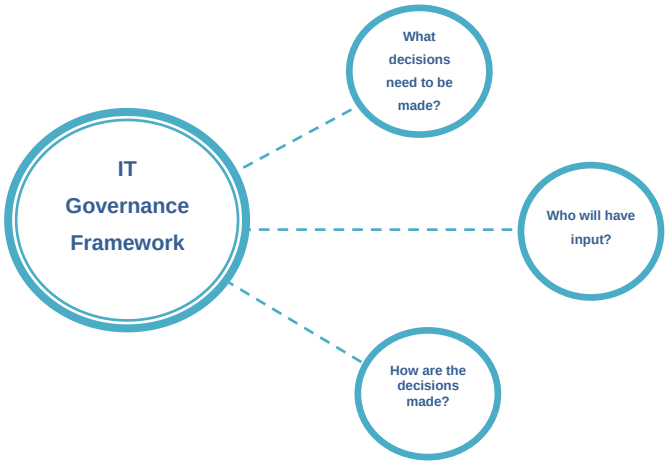

Figure 29 - Key Questions to Identify Metrics

The lists of metrics are shown below, grouped by process.

4.1.1 Incident Management

The list of compiled metrics for the incident management process is listed below:

- Number of incidents by status;
- Number of incidents by topic (Top 5) ;
- Number of incidents by urgency;
- Number of incidents by impact;
- Number of incidents by priority;
- Number of incidents by requesting person (Top 5) ;
- Number of incidents by location (Top 5) ;
- Number of incidents closed by employee (Top 5) ;
- Number of incidents closed by group (Top 5);
- Number of incidents by day of week;
- Number of incidents by time of day (Top 5) ;
- Number of incidents by input origin;
- Percent of incidents resolved by 1st Line Support;
- Percentage of incidents incorrectly categorized;
- Percentage of incidents by time of day (Top 5) ;
- Percentage of incidents by input origin;
- Percentage of incidents closed by employee (Top 5) ;
- Percentage of incidents closed by group (Top 5) ;
- Percentage of incidents closed within SLA by topic (Top 5);
- Percentage of incidents closed within SLA by urgency;
- Percentage of incidents closed within SLA by impact;
- Percentage of incidents closed within SLA by priority;

- Percentage of incidents closed within SLA by employee (Top 5);
- Percentage of incidents closed within SLA by group (Top 5);
- Average time to solve incidents by topic (Top 5 faster);
- Average time to solve incidents by topic (Top 5 slower);
- Average time to solve incidents by urgency;
- Average time to solve incidents by impact;
- Average time to solve incidents by priority;
- Average time to solve incidents by employee (Top 5 faster);
- Average time to solve incidents by employee (Top 5 slower);
- Average time to solve incidents by group (Top 5 faster);
- Average time to solve incidents by group (Top 5 slower);
- Average customer satisfaction by day of week.

4.1.2 Problem Management

The list of compiled metrics for the problem management process is listed below:

- Number of problems by status;
- Number of problems by topic (Top 5);
- Number of problems by urgency;
- Number of problems by impact;
- Number of problems by priority;
- Number of problems by requesting person (Top 5);
- Number of problems by location (Top 5);
- Number of problems closed by group (Top 5);
- Number of problems by day of week;
- Number of problems by time of day (Top 5);
- Percent of problems solved by 1st Line Support;
- Percentage of problems incorrectly categorized;
- Percentage of problems closed by group (Top 5);
- Percentage of problems by time of day (Top 5);
- Percentage of problems solved within SLA by topic (Top 5);
- Percentage of problems solved within SLA by urgency;
- Percentage of problems solved within SLA by impact;
- Percentage of problems solved within SLA by priority;
- Percentage of problems solved within SLA by group (Top 5);
- Average time to solve problems by topic (Top 5 faster);
- Average time to solve problems by topic (Top 5 slower);
- Average time to solve problems by urgency;
- Average time to solve problems by impact;
- Average time to solve problems by priority;

- Average time to solve problems by group (Top 5 faster);
- Average time to solve problems by group (Top 5 slower).

4.1.3 Request Fulfillment

The list of compiled metrics for the request fulfillment process is listed below:

- Number of requests by topic (Top 5);
- Number of requests by status;
- Number of requests by priority;
- Number of requests by day of week;
- Number of requests by hour of day (Top 5);
- Number of requests by user (Top 5);
- Number of requests fulfilled by employee (Top 5);
- Number of requests fulfilled by group (Top 5);
- Percentage of requests by topic (Top 5);
- Percentage of requests by status;
- Percentage of requests by priority;
- Percentage of requests by hour of day (Top 5);
- Percentage of requests fulfilled by employee (Top 5);
- Percentage of requests fulfilled by group (Top 5);
- Percentage of requests fulfilled within SLA by topic (Top 5);
- Percentage of requests fulfilled within SLA by priority;
- Percentage of requests fulfilled within SLA by employee (Top 5);
- Percentage of requests fulfilled within SLA by group (Top 5);
- Average time to fulfill requests by topic (Top 5 faster);
- Average time to fulfill requests by topic (Top 5 slower);
- Average time to fulfill requests by priority;
- Average time to fulfill requests by employee (Top 5 faster);
- Average time to fulfill requests by employee (Top 5 slower);
- Average time to fulfill requests by group (Top 5 faster);
- Average time to fulfill requests by group (Top 5 slower);
- Average cost of requests fulfillment by topic;
- Average customer satisfaction by day of week.

4.1.4 Service Operation Report Metrics

After the refining of the metrics and discussed the best metrics to integrate the dashboards that will be reported, we obtain a final list of metrics for each Service Operation processes.

Below is shown the final lists of metrics, the associated formulas of calculation and a description with the information that can be obtained from the metric, grouped by the Service Operation processes:

- Incident Management Process (Table 3);
- Problem Management Process(Table 4);
- Request Fulfillment Process (Table 5).

Table 3 - Incident Management Process Metrics

<table>
<tr><th>Incident Management</th><th>Formula</th><th>Description</th></tr>
<tr><td>Number of incidents by day of week</td><td>$x = \sum (incidents)\ by\ day\ of\ week$</td><td>This metric allows studying the current week and the counterpart week from the previous year, giving information about the emerging flow of incidents, to conclude if the IT services are getting better or worse, the days of the week with more incidents and the possibility to reinforce the proactivity in the daily activities.</td></tr>
<tr><td>Number of incidents by status</td><td>$x = \sum (incidents)\ \ by\ status$</td><td>This metric provides information about the number of incidents for the current week filtered by status. It is expected that at the end of the week, most of the incidents are in the status of solved.</td></tr>
<tr><td>Number of incidents by topic (Top 5)</td><td>$x = \ top5\ [\sum (incidents)\ by\ topic]$</td><td>This metric provides information about the number of incidents for the current week filtered by topic of catalog. The topics with the most volume of incidents will require more attention and proactive activities.</td></tr>
<tr><td>Number of incidents by priority</td><td>$x = \sum (incidents)\ by\ priority$</td><td>This metric provides information about the number of incidents for the current week filtered by priority. This allows having information about the incidents that are affecting the IT environment. It is expected that the most volume of incidents are with low priority. The priority is calculated automatically by the IT service management tool, EasyVista, according to the following:
<table>
<tr><th>Priority Level</th><th>Impact</th><th>Urgency</th></tr>
<tr><td>1</td><td>1 - High</td><td>1 - High</td></tr>
<tr><td>2</td><td>1 - High</td><td>2 - Medium</td></tr>
<tr><td>2</td><td>2 - Medium</td><td>1 - High</td></tr>
<tr><td>3</td><td>2 - Medium</td><td>2 - Medium</td></tr>
<tr><td>3</td><td>1 - High</td><td>3 - Low</td></tr>
<tr><td>3</td><td>3 - Low</td><td>1 - High</td></tr>
<tr><td>4</td><td>3 - Low</td><td>2 - Medium</td></tr>
<tr><td>4</td><td>2 - Medium</td><td>3 - Low</td></tr>
<tr><td>5</td><td>3 - Low</td><td>3 - Low</td></tr>
</table>
</td></tr>
</table>

Incident Management	Formula	Description
Average time (business days) to solve incidents by group (Top 5 slower)	$\bar{x} = top5\ slower\ [\left(\frac{\sum time\ to\ solve\ incidents}{\sum incidents}\right) by\ group]$	This metric provides information about the average time, counted in business days, to solve the incidents, filtered by the slower support groups. This allows knowing the slower groups, and further investigation can conclude if they need to be reinforced.
Number of incidents closed by group (Top 5)	$x = top5\ [\sum (incidents\ closed)\ by\ group]$	This metric provides information about the number of incidents closed by group. It is expected that the most of the incidents are closed by the first line support.
Percentage of incidents closed by group (Top 5)	$x = top5\ [\frac{\sum\ (incidents\ closed\ by\ group)}{\sum\ (incidents\ closed)} * 100\ ]$	This metric provides another view about the incidents closed by group. In this metric is shown the percentage of incidents closed by group, giving a greater perception of which groups solve more incidents. It is expected that the highest percentage of incidents solved is in the first line support.
Average customer satisfaction by day of week	$\bar{x} = top5\left[\frac{\sum(customer\ satisfaction\ evaluation)}{\sum(incidents\ solved)}\right]$	This metric allows studying the current week and the counterpart week from the previous year, giving information about the average customer satisfaction, to conclude if the IT services are getting better or worse, according to the feedback provided by the customers. It is expected that with the course of time and with the gain of maturity, the quality of the services and the efficiency and the effectiveness of the services be improved, leading to a better customer satisfaction.

Table 4 - Problem Management Process Metrics

<table>
<tr><th>Problem Management</th><th>Formula</th><th>Description</th></tr>
<tr><td>Number of problems by day of week</td><td>$x = \sum(problems)\ by\ day\ of\ week$</td><td>This metric allows studying the current week and the counterpart week from the previous year, giving information about the emerging flow of problems, to conclude if the IT services are getting better or worse, the days of the week with more problems and the possibility to reinforce the proactivity in the daily activities.</td></tr>
<tr><td>Number of problems by status</td><td>$x = \sum(problems)\ \ by\ status$</td><td>This metric provides information about the number of problems for the current week filtered by status. It is expected that at the end of the week, most of the problems are in the status of solved.</td></tr>
<tr><td>Number of problems by topic (Top 5)</td><td>$x = \ top5\ [\sum(problems)\ by\ topic]$</td><td>This metric provides information about the number of problems for the current week filtered by topic of catalog. The topics with the most volume of problems will require more attention and proactive activities.</td></tr>
<tr><td>Number of problems by priority</td><td>$x = \sum(problems)\ by\ priority$</td><td>This metric provides information about the number of problems for the current week filtered by priority. This allows having information about the problems that are affecting the IT environment. It is expected that the most volume of problems are with low priority. The priority is calculated automatically by the IT service management tool, EasyVista, according to the following:
<table>
<tr><th>Priority Level</th><th>Impact</th><th>Urgency</th></tr>
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<tr><td>2</td><td>1 - High</td><td>2 - Medium</td></tr>
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<tr><td>3</td><td>2 - Medium</td><td>2 - Medium</td></tr>
<tr><td>3</td><td>1 - High</td><td>3 - Low</td></tr>
<tr><td>3</td><td>3 - Low</td><td>1 - High</td></tr>
<tr><td>4</td><td>3 - Low</td><td>2 - Medium</td></tr>
<tr><td>4</td><td>2 - Medium</td><td>3 - Low</td></tr>
<tr><td>5</td><td>3 - Low</td><td>3 - Low</td></tr>
</table>
</td></tr>
</table>

Problem Management	Formula	Description
Average time (business days) to solve problems by group (Top 5 slower)	$\bar{x} = top5\ slower\ [\left(\frac{\sum (time\ to\ solve\ problems)}{\sum (problems)}\right) by\ group]$	This metric provides information about the average time, counted in business days, to solve the problems, filtered by the slower support groups. This allows knowing the slower groups, and further investigation can conclude if they need to be reinforced.
Number of problems closed by group (Top 5)	$x = top5\ [\sum (problems\ closed)\ by\ group]$	This metric provides information about the number of problems closed by group. According to the study of this metric, it is possible to know if there are some support groups overloaded with problems to solve, and some employees can be re-allocated.
Percentage of problems closed by group (Top 5)	$x = top5\ [\frac{\sum (problems\ solved\ by\ group)}{\sum (problems\ solved)} * 100\ ]$	This metric provides another view about the problems closed by group. In this metric is shown the percentage of problems closed by group, giving a greater perception of which groups solve more problems and if there are some groups overloaded with problems to solve.
Average time (business days) to solve problems by topic (Top 5 slower)	$\bar{x} = top5\ slower\ [\left(\frac{\sum (time\ to\ solve\ problems)}{\sum (problems)}\right) by\ topic]$	This metric provides information about the average time, counted in business days, to solve problems, filtered by the slower topics. Topics are associated with support groups and it can inform if there is any need for reinforcement if the time to solve problems tend to be very high.

Table 5 - Request Fulfillment Process Metrics

Request Fulfillment	Formula	Description
Number of requests by day of week	$x = \sum (requests)\ by\ day\ of\ week$	This metric allows studying the current week and the counterpart week from the previous year, giving information about the emerging flow of requests, to conclude how the IT services are being requested by the institution, providing value to it, and the days of the week with more requests in order to reinforce the Service Desk to solve request more quickly.

<table>
<tr><th>Request Fulfillment</th><th>Formula</th><th>Description</th></tr>
<tr><td>Number of requests by status</td><td>$x = \sum (requests)\ \ by\ status$</td><td>This metric provides information about the number of requests for the current week filtered by status. It is expected that at the end of the week, most of the requests are in the status of supplied.</td></tr>
<tr><td>Number of requests by topic (Top 5)</td><td>$x = \ top5\ [\sum (requests)\ by\ topic]$</td><td>This metric provides information about the number of requests for the current week filtered by topic of catalog. The topics with the most volume of requests will require more attention and possibly a higher allocation of employees and a higher allocation of equipment to support the requests of the customers.</td></tr>
<tr><td>Number of requests by priority</td><td>$x = \sum (requests)\ by\ priority$</td><td>This metric provides information about the number of requests for the current week filtered by priority. This allows having information about the requests that are being requested to the IT services. It is important to sensitize and educate the customers in order to provide a correct input about the urgency of the request, having a better prioritization system. The priority is calculated automatically by the IT service management tool, EasyVista, according to the following:

<table><tr><th>Priority Level</th><th>Impact</th><th>Urgency</th></tr><tr><td>1</td><td>1 - High</td><td>1 - High</td></tr><tr><td>2</td><td>1 - High</td><td>2 - Medium</td></tr><tr><td>2</td><td>2 - Medium</td><td>1 - High</td></tr><tr><td>3</td><td>2 - Medium</td><td>2 - Medium</td></tr><tr><td>3</td><td>1 - High</td><td>3 - Low</td></tr><tr><td>3</td><td>3 - Low</td><td>1 - High</td></tr><tr><td>4</td><td>3 - Low</td><td>2 - Medium</td></tr><tr><td>4</td><td>2 - Medium</td><td>3 - Low</td></tr><tr><td>5</td><td>3 - Low</td><td>3 - Low</td></tr></table></td></tr>
<tr><td>Average time (business days) to fulfill requests by group (Top 5 slower)</td><td>$\bar{x}\ = top5\ slower\ [\ (\frac{\sum time\ to\ fulfill\ requests}{\sum requests})\ by\ group]$</td><td>This metric provides information about the average time, counted in business days, to fulfill the requests, filtered by the slower support groups. This allows knowing the slower groups, and further investigation can conclude if they need to be reinforced.</td></tr>
</table>

Request Fulfillment	Formula	Description
Number of requests fulfilled by group (Top 5)	$x = top5\,[\sum(requests\ fulfilled)\ by\ group]$	This metric provides information about the number of requests fulfilled by group. According to the study of this metric, it is possible to know if there are some support groups overloaded with requests to fulfill, and some employees can be re-allocated.
Percentage of requests fulfilled by group (Top 5)	$x = top5\,[\frac{\sum(requests\ fulfilled\ by\ group)}{\sum(requests\ fulfilled)} * 100\,]$	This metric provides another view about the requests fulfilled by group. In this metric is shown the percentage of requests fulfilled by group, giving a greater perception of which groups fulfill more requests and if there are some groups overloaded with requests to fulfill.
Average customer satisfaction by day of week	$\bar{x} = top5\left[\frac{\sum(customer\ satisfaction\ evaluation)}{\sum(requests\ fulfilled)}\right]$	This metric allows studying the current week and the counterpart week from the previous year, giving information about the average customer satisfaction relatively to the requests, to conclude if the IT services are getting better or worse, according to the feedback provided by the customers. It is expected that with the course of time and with the gain of maturity, the quality of the services and the efficiency and the effectiveness of the services be improved, leading to a better customer satisfaction. If there is a higher customer satisfaction, the IT services are providing services with good quality and creating value to the institution.

4.2 Reporting Process

In this first approach, to the creation of reports, will be used the Microsoft Office tool Excel for more flexibility on handling the information.

The extraction from the EasyVista platform will be integrated in Excel spreadsheets and will be worked with pivot tables to produce clusters of relevant information, fed by the necessary dimensions, in order to respond to metrics. These clusters of information will allow producing graphics to support the decision-making process.

The graphics are the final step in the process of reporting and will be analyzed weekly by the NAU Coordinator, and the Director of de IT Department, in order to have an idea about the real state of the operations, an historic of occurrences and some prediction of that will happen.

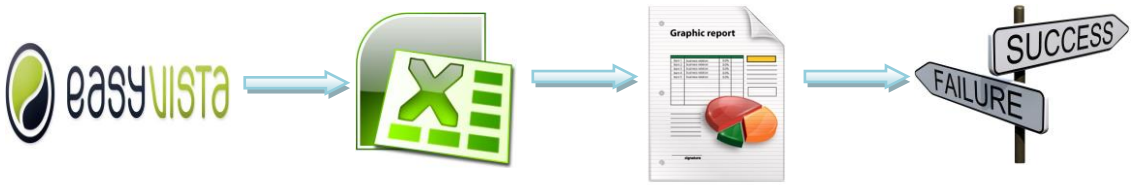

Figure 30 - Flow of Data and Information

Defined the flow of information, it is important starting to automate the process. The first step is to go to the root of the flow, i.e. EasyVista platform, and parameterize it to extract the maximum information with the minimum number of tasks. This step was done by taking raw information, without any filter, that will be worked in Excel. The extracting raw allows acquire a large amount of data with few steps and timely, as shown in the Figure 31.

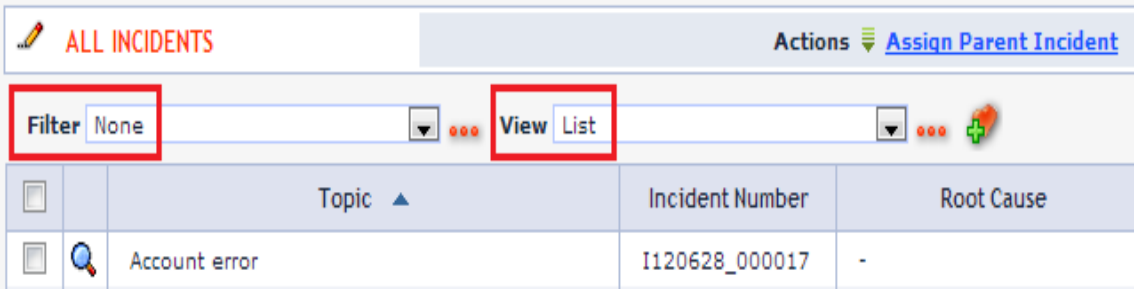

Figure 31 - EasyVista Extraction Parameterization

The next step is to integrate the extraction in the Excel spreadsheet and actualize the file. This operation will update the pivot tables and, consequently, the graphics, producing the weekly report.

After automate the process, it is priority to define the responsible for controlling the flow and integration of information. This function will be attributed to a member of NAU, with the help and supervising of the NAU coordinator. The process of dashboard creation is explained in more detail in the Appendix B.

This way, it is reached a level of maturity that allows taking some comfort in the report process, having reliable information.

4.3 Dashboard Design

The dashboards were designed having in mind the study performed and the best practices in dashboards design, showing the most important information in a simple way, allowing people to quickly perceive the current situation at the IT department. The dashboards created were designed with simplicity with the objective to be user-friendly, and a simple cluster of information.

At this point, it is important to remember and reflect about the questions that emerged at the initial study of dashboards, to define the real scope and importance of the dashboards, being important to find reasons that make me believe that the dashboards will be useful:

- Who is the audience?
- What value will the dashboard add?
- What type of dashboard am I creating?

Reflecting and responding to these questions, we have that the audience of the dashboards is the Coordinator of the NAU and the IT Director. They have a deep knowledge about the IT Department and the IT operations, therefore were discussed the metrics that integrate the dashboards with these entities. The metrics are therefore aligned with the decisions that our audience are making and provides information about the questions they need to answer.

The value that the dashboards will provide to the institution is related to:

- the IT processes measurement, which is not being done;
- visual presentation of the performance measures;
- the support to the decision making in a simple process of extraction, treatment of information and communicates the conclusions clearly and immediately;
- ability to generate detailed reports showing new trends;
- have a historical basis that shows the trends of the IT processes and the operations of the IT support groups;
- control the in a better way the IT environment;
- align IT strategy;
- refine SLAs and objectives;
- measure efficiencies and inefficiencies; and
- save time in investigations and studies.

The type of dashboards that I am creating, are graphically dashboards based on excel graphics (columns chart, line chart and pie chart) showing the data present in the background pivot tables. Some requirements were taken into account during the design, namely, the presence of a lot of information, few colors, smart graphs, user-friendly design and time overview. These graphics measure the Service Operation Processes in the scope of the dissertation, Incident Management Process, Problem Management Process and Request Fulfillment Process, according to the metrics agreed and documented above, providing information about the decisions that the responsible for the IT Department need to take. The periodicity established is weekly and all the metrics are under this

periodicity, measuring the process in a weekly basis. The dashboards will run in a standalone software application and will be saved and reported to the upper hierarchy. It is too a way to show to the responsible of the Corporate Governance how the IT are working and adding value to the institution, and a way to justify costs and reinforcements.

The data was grouped logically, resumed with Excel pivot tables and transformed in graphics, as shown below in the Figure 32, where are presented an example of the data flow steps.

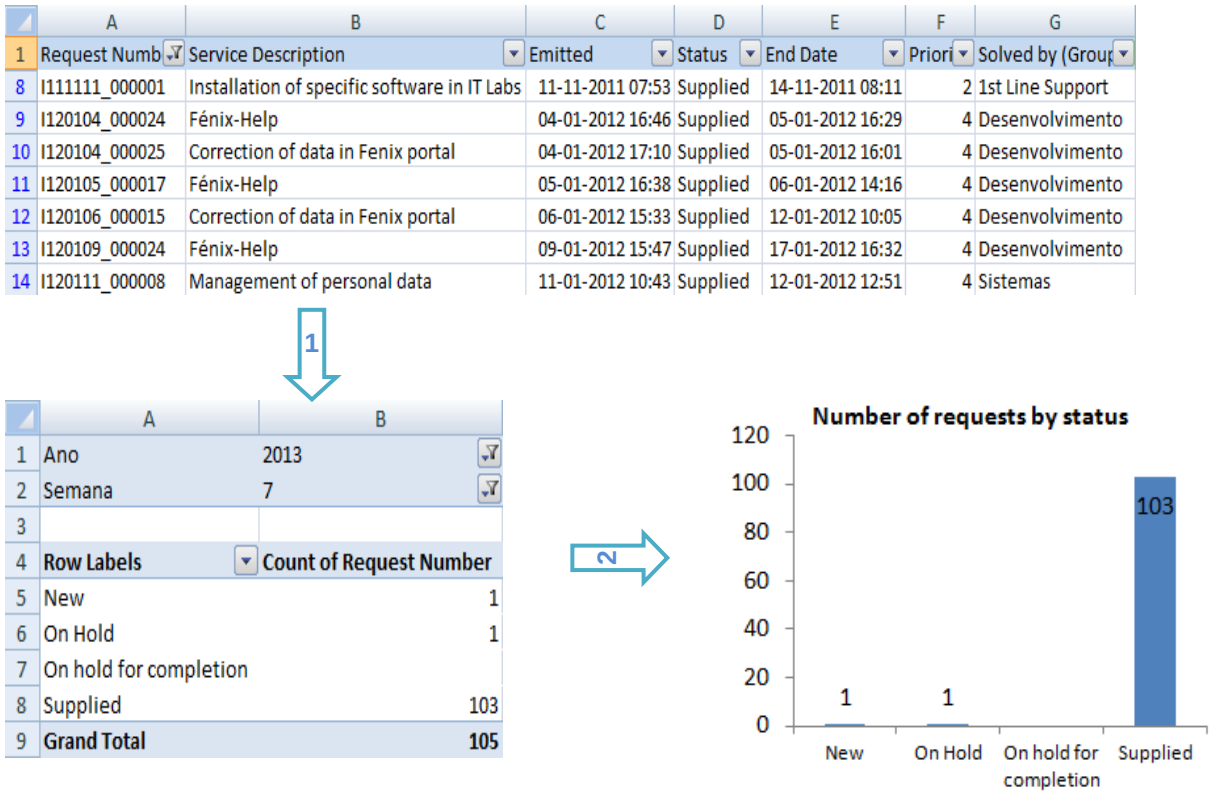

Figure 32 - Dashboard Creation Flow

The final product of the dashboards, after the process of extract data, integrate in Excel, summarize with pivot tables and produce graphics that contextualizes the data providing useful information, is shown below.

4.3.1 Incident Management Dashboard

The final result of the Incident Management Process dashboard is shown in the Figure 33.

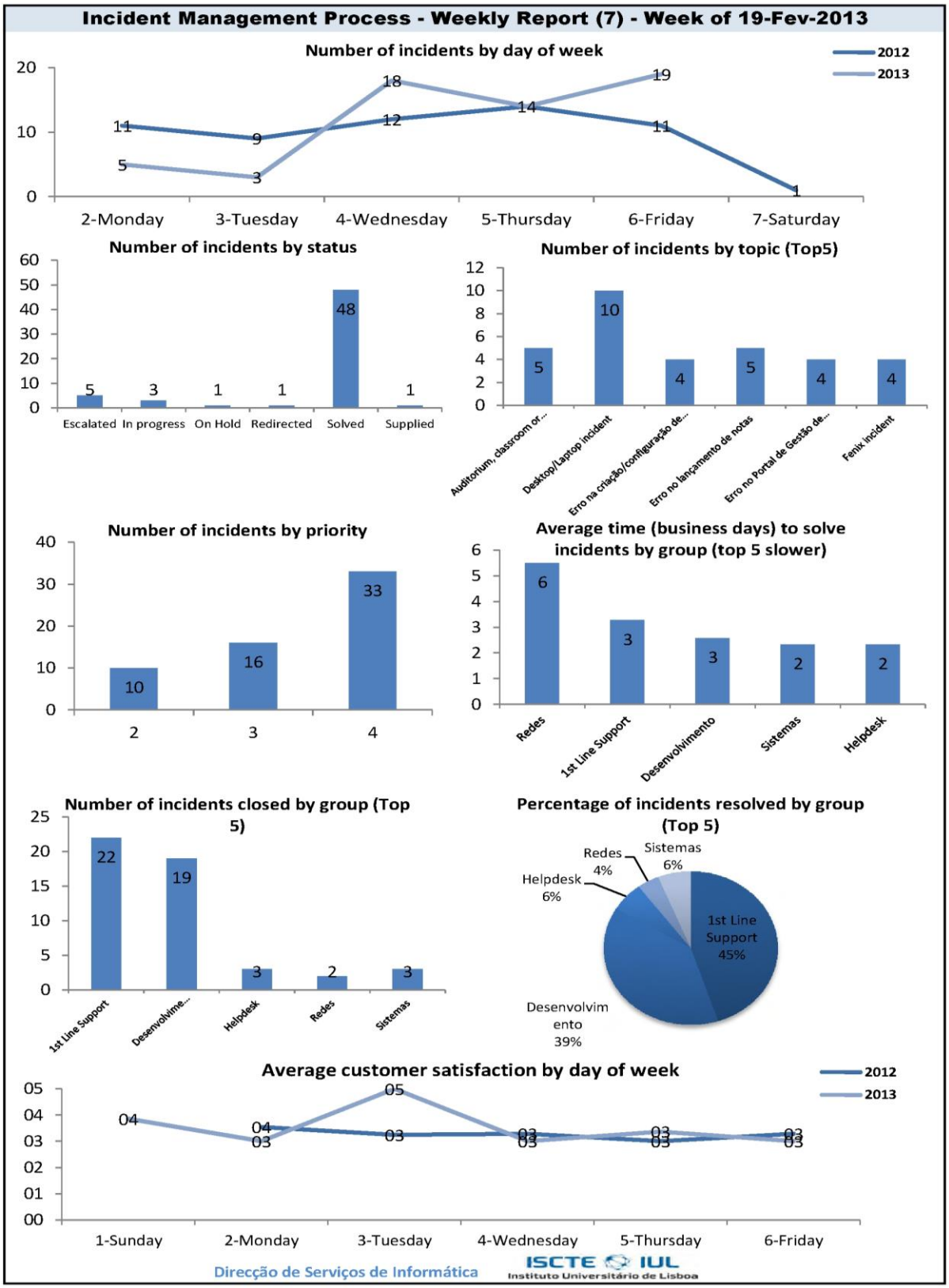

Figure 33 - Incident Management Process Dashboard

4.3.2 Problem Management Dashboard

The final result of the Problem Management Process dashboard is shown in the Figure 34.

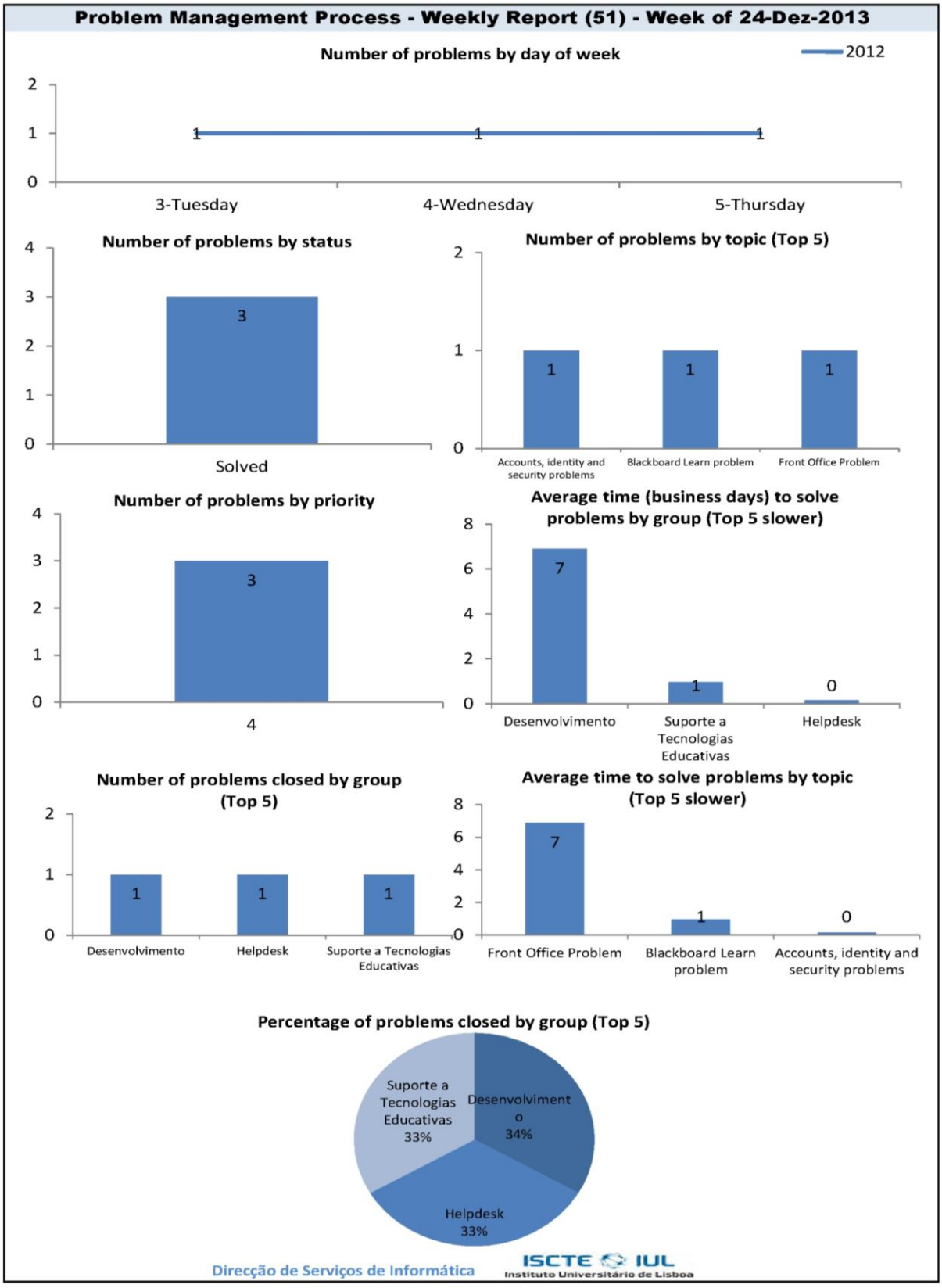

Figure 34 - Problem Management Process Dashboard

4.3.3 Requests Fulfillment Dashboard

The final result of the Request Fulfillment Process dashboard is shown in the Figure 35.

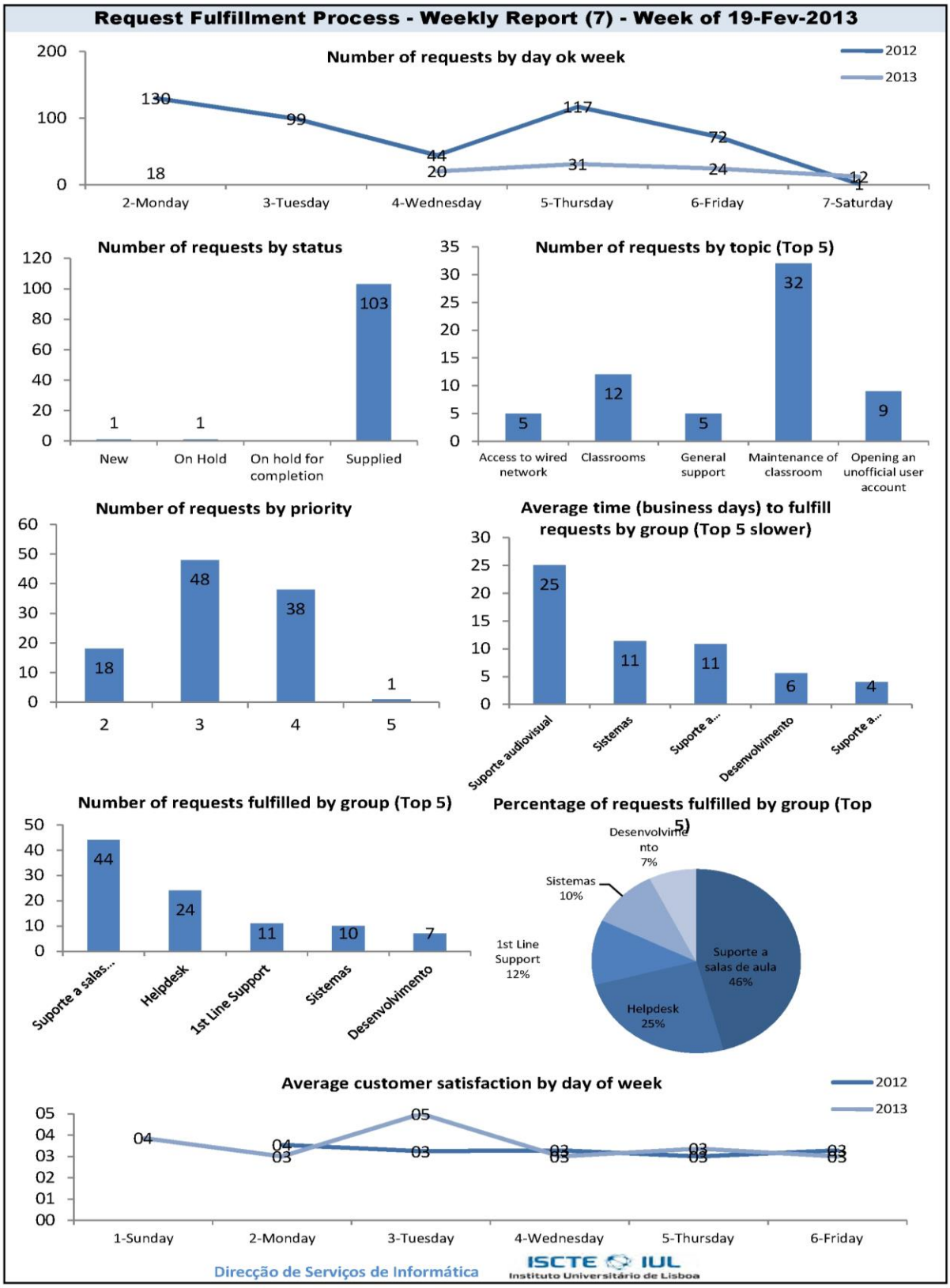

Figure 35 - Request Fulfillment Process Dashboard

5 Final Considerations

The present dissertation focused on the implementation of the ITIL®V3 problem management process at the IT Services of ISCTE-IUL and of the Service Operation dashboards for three processes: Problem Management, Incident Management and Request Fulfillment. These last two processes were the subject of two previous master theses (Ferreira 2011 and Barroso 2011). Currently, these processes have achieved a stable maturity as the ITSM tool is used by the academic community to register incidents and requests. The problem management process was implemented in the course of this research work under the close supervision and testing of the NAU coordinator. Since this is a new process, the maturity level of the process data cannot be compared to the former discussed processes. The path forward is to incentive the usage of the ITSM tool to manage IT problems in order to have more data for analysis and improve the process. It is critical that all levels of management at the University, i.e., Rectory, IT Director and IT managers, provide the required sponsoring of these practices. This will allow the usage and improvement of these IT processes, and most importantly will enable decisions to be made according to the real data presented in periodic dashboards.

As presented in the beginning of this dissertation, the main problem addressed was the inefficient and reactive problem management process currently in place at ISCTE-IUL, specifically:

- The imprecise association of an incident to a problem, the temporary workarounds that are often mismanaged, and the lack of an efficient review of the implemented solutions;
- The lack of an efficient and updated system to record all the information about problems and known errors, that increases the time spent in inquires;
- The poorly defined problem management process does not have a strong communication with the change management process, which may cause adverse effects, such as mismanaged changes;
- The generic information provided by the ITSM tool does not cover all the necessary requirements to support the decision-making of the IT Services Director and managers.

Three research questions were formulated. After the study and investigation on scope of this dissertation, it is possible to elaborate the answers to those questions.

Is it possible to adapt the best practices of ITIL®v3 Problem Management Process to the IT services of ISCTE-IUL?

The first approach in this dissertation was the evaluation of the process to treat IT problems at ISCTE-IUL. This process did not exist because the concept of a problem was seen as an incident, requiring only the restoring of affected services. Important components for problem management were missing, such as proactivity and root-cause investigation. Starting then from the best practices studied in the ITIL publications, it was begun the design of the process, as well as the roles and responsibilities, support groups and the IT platform supporting the process, EasyVista. Subsequently, the process design was adapted to the reality of ISCTE-IUL, according to the NAU coordinator and the observations and parameterizations made. Currently, the process design is completed, but the operationalization and the internalization of the ITIL best practices are not yet fully embedded in the IT

staff. Therefore, yes it is possible to adapt the best practices of ITIL®v3 Problem Management Process to the IT Services of ISCTE-IUL.

Is it possible to extract sufficient information from the ITSM tool implemented at ISCTE-IUL (EasyVista) to build service operation dashboards?

The EasyVista is the tool currently used at ISCTE-IUL to support IT service management. It is an ITIL oriented platform where the processes are being progressively implemented, as well as the related items, as catalogs and workflows. The parameterization of each process allows recording and saving all the information regarding the processes. For the incident management process and the request fulfillment process, the EasyVista already contains a solid data repository which allows extracting and producing reliable information. This is not the case for the problem management process, since it was only recently implemented. However, it is expected that in the near future it will reach a level of maturity and a volume of data similar to other Service Operation processes implemented. During the process of production of the dashboards it was verified that extracting the information from EasyVista was effective, enabling the development of dashboards with the required metrics. The analysis of these metrics will support the decisions and will allow the refinement and negotiation of the SLAs established. Therefore, yes it is possible to extract sufficient information from the ITSM tool implemented at the ISCTE-IUL, EasyVista, to build service operation dashboards.

Can these service operation dashboards be considered useful to support the decision-making and justify the allocation of resources and costs regarding the service operation processes?

The dashboards are built and ready for production. The metrics contained on it were discussed and agreed with the NAU Coordinator according to the major activities and decisions required to sustain daily operations. It is essential to continue the usage of the ITSM platform, EasyVista, and register all the inputs, in order to increase the volume of data for analysis of trends, supporting better the decision-making process. The dashboards are populated with the extracted data and the objective is to produce reliable information with a rapid visualization of critical metrics. The continuous production of weekly dashboards will add value to the IT Services. This point is quite clear for management, such as the NAU Coordinator and the IT Director, supporting the allocation of resources and investments in ineffective areas. Concrete cases of that is, for example, the metric that measures the time to solve incidents by team or the number of requests solved by team, where, in discussion with the NAU Coordinator, it is clearly visible if a team is being ineffective or if a team is being overloaded with incidents, problems or requests to solve and fulfill. This analysis could lead to an adjustment and a reallocation of resources, reinforcing those areas that may be at risk of compromising the normal operation of the IT Services. Therefore, yes, the service operation dashboards can be considered useful to support the decision-making and justify the allocation of resources and costs regarding the service operation processes.

The EasyVista revealed to be a good ITSM tool, supporting the implemented processes and recording the data related to it. All the data integrated in the Excel to build the dashboards is extracted from it, on an efficient manner.

This dissertation was written in English to increase the visibility of the work that is being performed at ISCTE-IUL, facilitate the dissemination of results and to share knowledge and experience with other Higher Education Institutions, nationally and internationally.

In a personal perspective, this dissertation allowed me to have contact with the ITIL®V3 and its best practices, as well as the studies and implementations in other companies and HEI. It was a very interesting topic that is very used in the business world, but with little documentation at the level of HEI, especially in Portugal. Therefore, it was motivating to be working for this cause and give my contribution to the development of the subject and obviously, the improvement of the IT Services of ISCTE-IUL, which was one of the major objectives inherent to the development of this project and this dissertation.

With this work it is expectable that the IT Service staff will acquire more knowledge and experience in ITIL®v3 best practices, which in turn may result in a better acceptance for new practices, for example, an improvement in resistance to change.

5.1 Future work

In the scope of the problem management process implementation, roles and responsibilities for each support line and for the IT Director and Problem Manager were proposed. This proposal should be evaluated, updated with the changes considered important, formally documented and implemented at the IT Services of ISCTE-IUL, in order to have a correct distribution of a wide proposal of activities to perform and responsibilities to have. Due to the fact of the existence of few employees in the IT Services, some activities could be discarded and some responsibilities accumulated.

It is important to continue the adoption of the ITIL®V3 processes and best practices. The Service Operation processes are, little by little, becoming complete. The incident management process and the request fulfillment process was modeled by Paulo Ferreira (2010) and implemented by Ricardo Barroso (2011). The problem management was modeled and implemented during the development of this dissertation. To move one step forward towards the completeness of the Service Operation processes implementation and improvement of the maturity of the IT Services, it is important to plan the implementation of the Event Management process. This process monitors all events that occur through the IT infrastructure with the main goals of detecting events, investigating and determining the correct control action (preferably in a automate way by routine activities with alarming of warnings and exception associated). This could lead to an early detection of incidents, reducing the downtime (OGC 2007). ISCTE-IUL should continue the adoption of the ITSM best practices, as proposed by the ITIL®V3, which will be an important contribution to achieve the quality certification ISO/IEC 20000:2011, one of the strategic goals of the IT Services.

According to the conclusion of the implementation of ITIL®V3 processes, it should be performed an audit by an specialized entity in order to evaluate the practices implemented and to advise about important improvements. In this way, is ensured compliance with the best practices recommended and the documentation formally defined.

Probably the most important to achieve the success is the incentive which comes from the top management. It is recommended that the Rectory and IT Director develop a strong and close communication strategy with the IT staff, based on weekly performance dashboards. In this way, the Service Operation processes will be periodically monitored and actions can be performed proactively to improve the service operation level.

After stabilizing the Service Operation dashboards and the process of reporting, it should be considered to continue the previous work of Business Intelligence, initiated during the implementation of a data mart for the Asset Management process by Ricardo Martins (2010). In the following year, Ricardo Barroso (2011) implemented another conformed data mart for the Change Management process. Although an initial data warehouse for ITSM has been developed providing basic reporting capabilities, the system has never been used to support daily operations. The system became inoperable due to problems with the virtualization of some machines, leading to the loss of configurations and connections to the database, and to flows of the ETL[1] system. Another important aspect that may have contributed to this situation is the lack of training of the IT staff on Microsoft SQL Server BI platform. In this dissertation, Excel was chosen as the BI application for data visualization. In this way, training is no longer an issue, since the IT staff uses it regularly for other projects. However, a complete BI environment has not been provided. Specifically, the dashboards are only related to one service operation processes, and it is not possible to combine data from other processes (e.g., asset management). It is recommended for future business intelligence projects, a strong sponsorship and support from the top management, in order to prevent these projects to fall into forgetfulness.

With the stabilization of processes and reports, in order to improve the maturity of the IT Services, it is essential to have an approach to knowledge dissemination within the institution. This will raise awareness in all the people that daily intervene with the IT Services. With a good communication strategy, the academic community can be aware of the existence of the IT service management tool, its functionalities, what it stands for the institution and the support that it provides. This communication strategy should be effective to the point of when people have some *IT issue*, they must quickly think about open a ticket using the EasyVista platform (iajuda.iscte.pt). This will increase the volume of reliable data, which will then reflect the real performance of IT operations.

It should also be done an investment in an in-depth study with other HEI to compare the management practices in place and share knowledge and experience. Another way to share the experience gained from the developed projects is the writing of papers to promote, nationally and internationally, the debate and sharing of knowledge, work, investigation and conclusions. At ISCTE-IUL this has become a reality with the participation on the activities of EUNIS, the European University Information Systems organization. An extended abstract, was submitted and presented at EUNIS 2012, an international congress that address topics such as Information Technology and Information Systems. This extended abstract has the title of *IT service management using the ITIL® framework: the experience of ISCTE – University Institute of Lisbon*.

[1] ETL: Extraction, Transformation and Loading

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Appendix A Detailed BPMN Process Diagram

As explained in the section 3.5.3, a primordial step to implement the Problem Management Process is the process design. According with this, the BPMN were used to model the process.

The level of granularity used to model the process led to a large number of pages. Due to size constraints of the dissertation, the detailed process diagram is presented in this Appendix.

A.1 BPMN Problem Management Process- Identification and Loggin

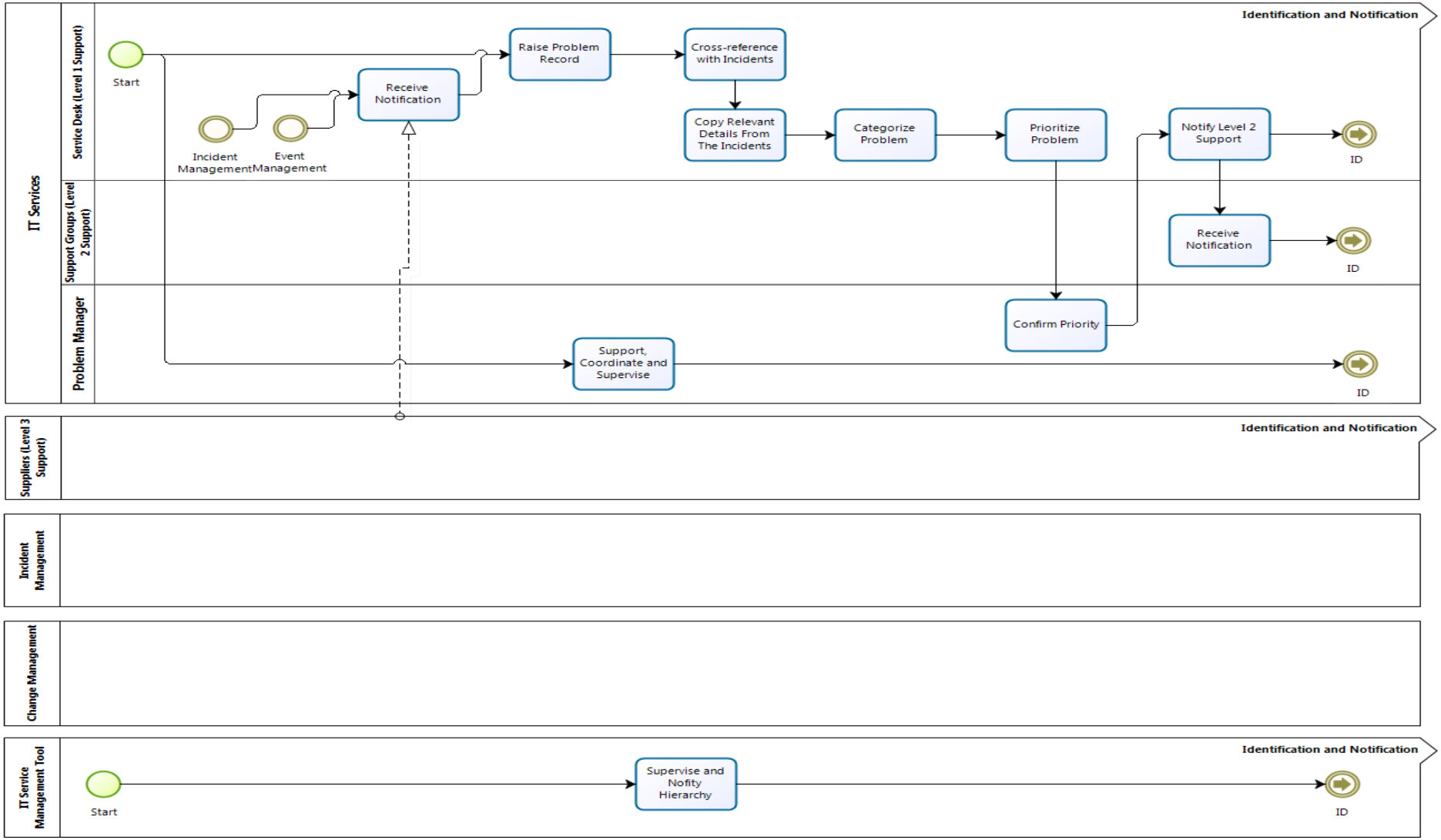


Figure 36 - BPMN Problem Management Process- Identification and Loggin

A.1.1 Receive Notification

The Service Desk receives a notification from the Incident Management Process, Event Management Process or from the Suppliers, informing about the failure.

A.1.2 Raise Problem Record

A problem record is raised giving initiating the problem history.

A.1.3 Cross-reference with Incidents

Performing a cross-reference with the related incidents could improve the root-cause detection, in order to understand the related symptoms that affect the IT environment.

A.1.4 Copy Relevant Details From the Incidents

All the gathered details from the incidents must be recorded within the problem record, allowing to perform an information correlation.

A.1.5 Categorize Problem

The problem must be categorized correctly according to the defined Problem Catalog, in order to group related problems, to facilitate the allocation to the support team, easily traced in the future and to obtain reliable information for the production of reports (such as the trend of problems).

A.1.6 Prioritize Problem

The prioritization is based on the defined impact and urgency. According to this inputs, priority is calculated allowing an approach more efficient in the order of problems resolution, giving priority to the most critical and that most affect the normal course of operations.

A.1.7 Notify Level 2 Support

When the first approach to the problem is concluded, the Service Desk notifies the Level 2 Support, informing about the current situation.

A.1.8 Receive Notification

When the first approach to the problem is concluded, the Level 2 Support receives the notification coming from the Service Desk.

A.1.9 Support, Coordinate and Supervise

The Problem Manager should give support, coordination and supervise in all the activities performed during the process.

A.1.10 Confirm Priority

The priority defines the approach performed, influencing the strategy of the IT Services. In order to that, the Problem Manager should approve the priority of each problem recorded.

A.1.11 Supervise and Notify Hierarchy

The IT Service Management tool controls the timings in problem solving and triggers warnings to inform the responsible people. It is considered that the tool supervise and notify hierarchy of each activity within the problem management process.

A.2 BPMN Problem Management Process- Investigation and Diagnosis

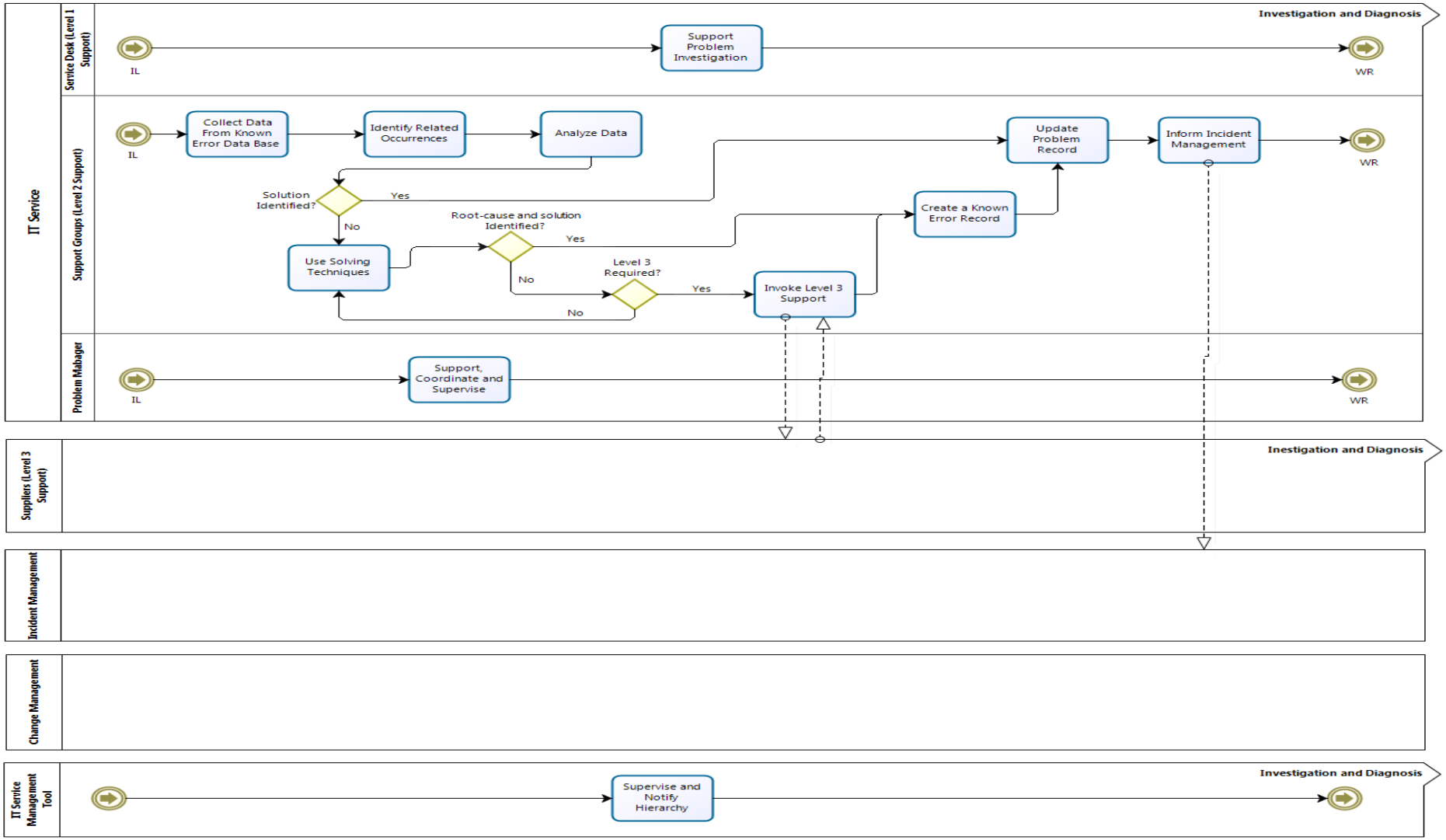


Figure 37 - BPMN Problem Management Process- Investigation and Diagnosis

A.2.1 Support Problem Investigation

Service Desk should provide support to problem investigation, if necessary.

A.2.2 Collect Data From Known Error Database

The first approach to the problem investigation is to check the Known Error Database and gather relevant information.

A.2.3 Identify Related Occurrences

The related occurrences should be collected for analysis.

A.2.4 Analyze Data

According to the related occurrences collected, an overall analysis should be performed, identifying a possible root-cause for the reported problem.

A.2.5 Use Solving Techniques

If there are not any related occurrence, solving techniques such as chronological analysis, pain value analysis, Kepner and Tregoe, brainstorming, Ishikawa diagrams or Pareto Analysis should be performed.

A.2.6 Invoke Level 3 Support

If a root-cause and a solution to the reported problem were not identified, should be considered to use the services of the suppliers, i.e. the Level 3 support.

A.2.7 Create a Known Error Record

As soon as the diagnosis is completed, a Known Error Record should be created in the Known Error Database, helping to solve further incidents and problems, increasing the efficiency and effectiveness in resolving issues.

A.2.8 Update Problem Record

When a root-cause and a solution are identified, the Problem Record should be updated, recording updated information.

A.2.9 Inform Incident Management

When a root-cause and a solution are identified, and a Known Error Record created, a message should be transmitted to the Incident Management, informing about the current situation of the investigation and possible solution for some problems.

A.2.10 Support, Coordinate and Supervise

The Problem Manager should give support, coordination and supervise in all the activities performed during the process.

A.2.11 Supervise and Notify Hierarchy

The IT Service Management tool controls the timings in problem solving and triggers warnings to inform the responsible people. It is considered that the tool supervise and notify hierarchy of each activity within the problem management process.

A.3 BPMN Problem Management Process - Workaround and Recovery

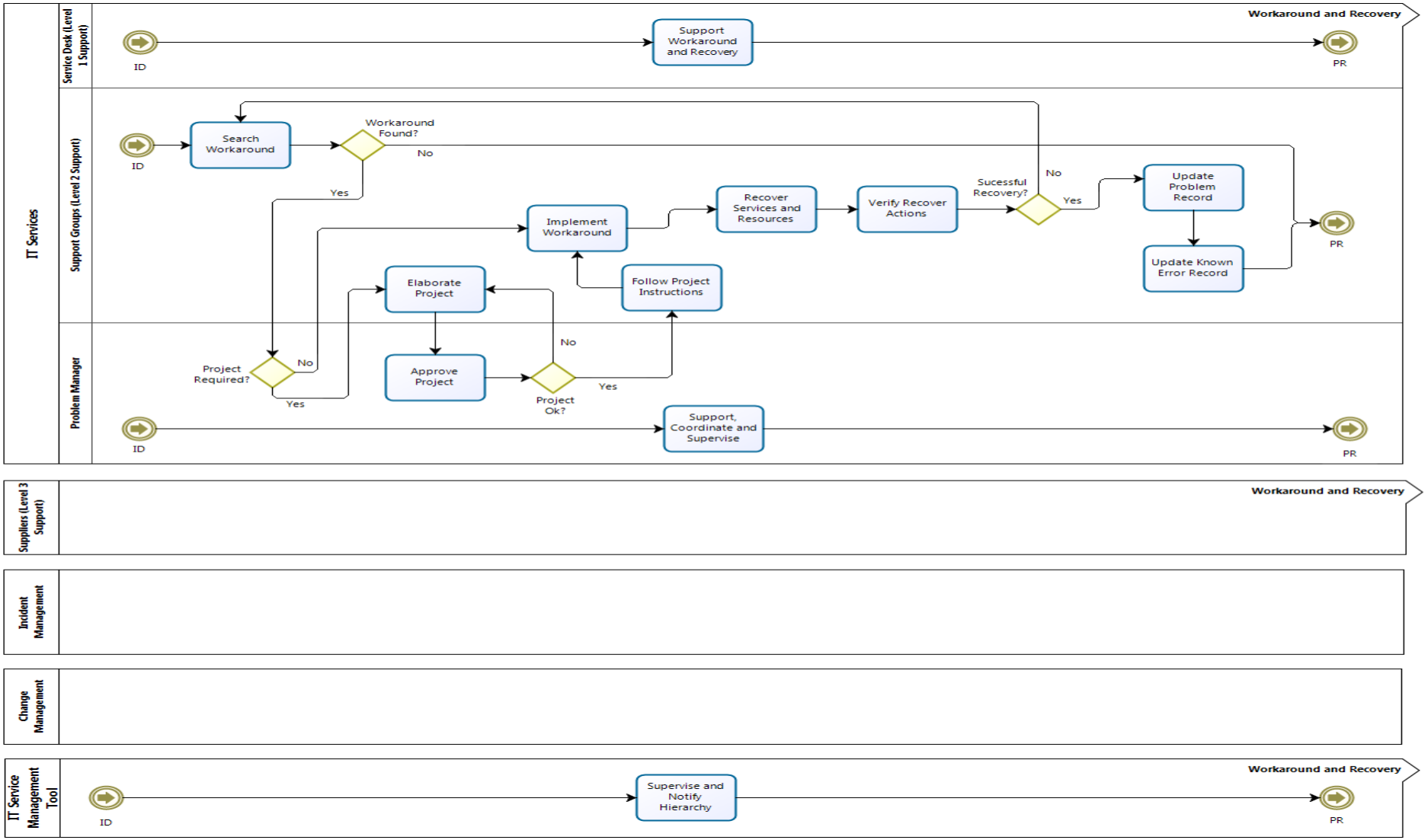


Figure 38 - BPMN Problem Management Process - Workaround and Recovery

A.3.1 Support Workaround and Recovery

Service Desk should provide support to workaround and recovery activities, if necessary.

A.3.2 Search Workaround

In some cases, a workaround may be possible to find, quickly recovering the services and solving temporarily the incidents caused by the problem. It is however recommended that the work on a permanent solution continues, where it is justified.

A.3.3 Elaborate Project

Some workarounds must be accompanied by a previous project definition, as defined by the Problem Manager. This way, the workaround implementation is formally defined, containing the steps required to perform and rollback procedures.

A.3.4 Follow Project Instructions

When the project is required by the Problem Manager, it should provide guidance during the workaround implementation.

A.3.5 Implement Workaround

The workaround is operationalized according to the defined requirements.

A.3.6 Recover Services and Resources

After the workaround implementation, the services can be restored and incidents temporarily solved.

A.3.7 Verify Recover Actions

The post implementation should be monitored.

A.3.8 Update Problem Record

According to the conclusions reached during the monitoring of the post implementation, the Problem Record should be updated.

A.3.9 Update Known Error Record

The conclusions achieved should be documented through the update of the Known Error Record.

A.3.10 Approve Project

When necessary, the Problem Manager should approve the elaborated project containing the guidelines for the workaround implementation.

A.3.11 Support, Coordinate and Supervise

The Problem Manager should give support, coordination and supervise in all the activities performed during the process.

A.3.12 Supervise and Notify Hierarchy

The IT Service Management tool controls the timings in problem solving and triggers warnings to inform the responsible people. It is considered that the tool supervise and notify hierarchy of each activity within the problem management process.

A.4 BPMN Problem Management Process - Problem Resolution

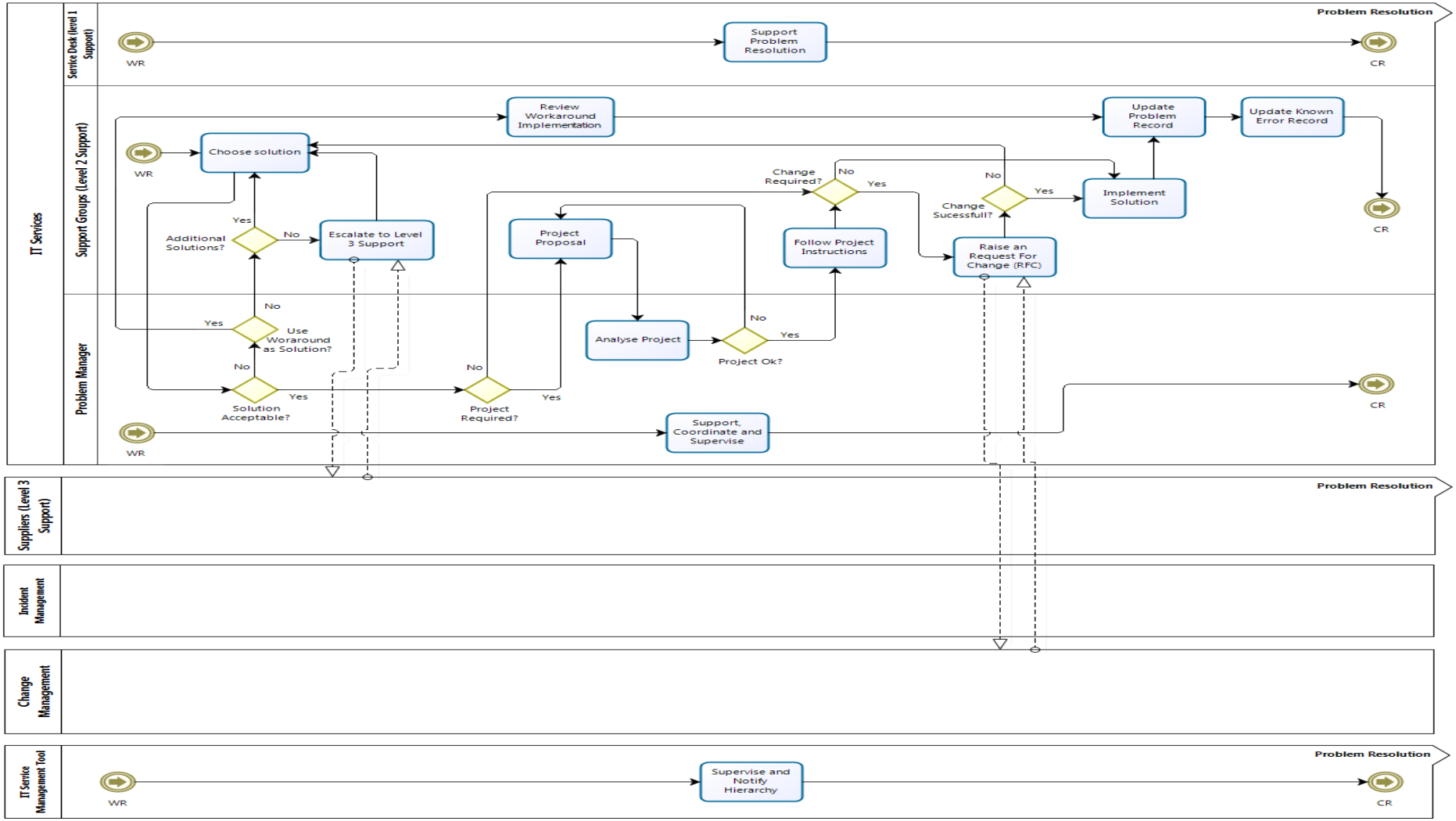


Figure 39 - BPMN Problem Management Process - Problem Resolution

A.4.1 Support Problem Resolution

Service Desk should provide support to problem resolution, if necessary.

A.4.2 Choose Solution

According to the investigation results, it should be proposed a solution to solve the reported problem.

A.4.3 Escalate to Level 3 Support

If the proposed solution is rejected by the Problem Manager, the use of the workaround as a permanent solution is not indicated and there are no more solutions, the problem resolution should be escalated to the suppliers, i.e Level 3 Support.

A.4.4 Project Proposal

If the solution is accepted by the Problem Manager and a project is required to implemented the solution, it should be developed and presented a project proposal. This way, the solution is formally defined, containing the steps required to perform and rollback procedures.

A.4.5 Follow Project Instructions

When the project is required by the Problem Manager, it should provide guidance during the solution implementation.

A.4.6 Raise a Request for Change

Some solutions require a change to solve correctly the issues reported. To these solutions, a request for change should be raised.

A.4.7 Implement Solution

The solution should be implemented according to decisions taken and the documentation formalized.

A.4.8 Update Problem Record

According to the conclusions reached during the implementation solution, the Problem Record should be updated.

A.4.9 Update Known Error Record

The conclusions achieved with the solution implementation should be documented through the update of the Known Error Record.

A.4.10 Review Workaround Implementation

If the impact is limited and the cost of the solution does not compensate the investment, a decision may be taken to maintain the workaround description in the Known Error Record to quickly solve incidents and problems, and restore the services.

A.4.11 Analyse Project

When necessary, the Problem Manager should analyze the elaborated project containing the guidelines for the solution implementation.

A.4.12 Support, Coordinate and Supervise

The Problem Manager should give support, coordination and supervise in all the activities performed during the process.

A.4.13 Supervise and Notify Hierarchy

The IT Service Management tool controls the timings in problem solving and triggers warnings to inform the responsible people. It is considered that the tool supervise and notify hierarchy of each activity within the problem management process.

A.5 BPMN Problem Management Process - Closure and Review

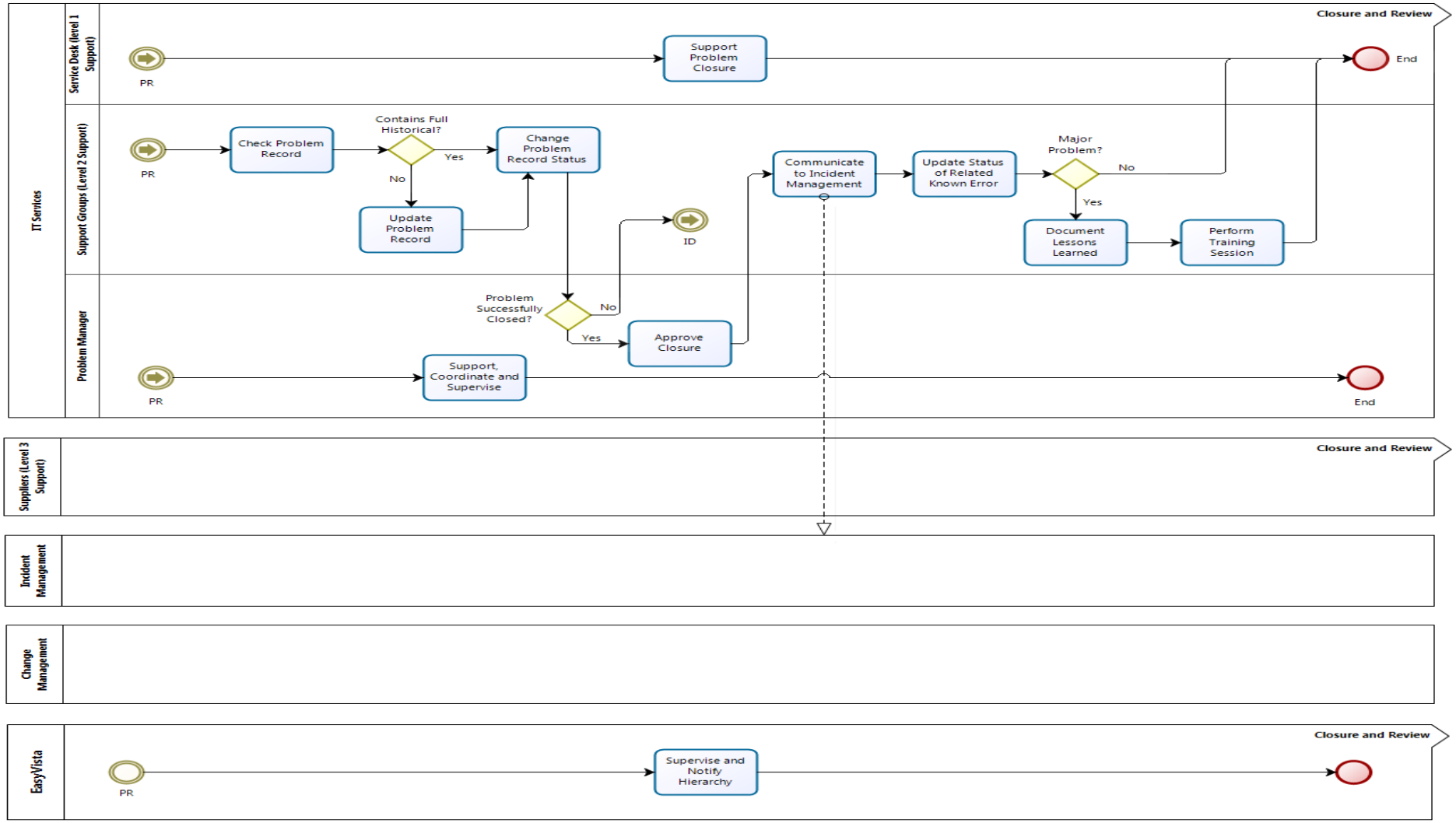


Figure 40 - BPMN Problem Management Process - Closure and Review

A.5.1 Support Problem Closure

Service Desk should provide support to problem closure, if necessary.

A.5.2 Check Problem Record

A review to the problem record should be performed in order to evaluate if it is updated with a full historical, containing all the performed activities and the decision taken.

A.5.3 Update Problem Record

If the problem record not contains all the performed activities and the decisions taken, it must be updated. With this, it could be used in further training and working instructions.

A.5.4 Change Problem Record Status

The problem record status should be changed to *solved*, informing the Problem Manager that the solution has been already implemented and it is pending for approval.

A.5.5 Communicate to Incident Management

The implemented solution should be communicated to the Incident Management to inform about the progress achieved and to help in incidents solving.

A.5.6 Update Status of Related Known Error

The status of the Known Error should be changed, in order to show that the process of investigation and solution implementation is finished. At this point, the Known Error Record has documented the accorded and justified solution.

A.5.7 Document Lessons Learned

According to the priority of the problem, a review should be performed to learn any lessons for the future, providing training and awareness for the IT staff.

A.5.8 Perform Training Sessions

According to the developed documentation about lessons learned, a training session should be performed while memories are still fresh, providing regular training to the IT staff.

A.5.9 Support, Coordinate and Supervise

The Problem Manager should give support, coordination and supervise in all the activities performed during the process.

A.5.10 Approve Closure

If the problem has been correctly solved and documented, the Problem Manager can formally approve the problem closure.

A.5.11 Supervise and Notify Hierarchy

The IT Service Management tool controls the timings in problem solving and triggers warnings to inform the responsible people. It is considered that the tool supervise and notify hierarchy of each activity within the problem management process.

Appendix B Dashboard Building User Guide

In scope of this dissertation, is the building of Service Operation dashboards for the Incident Management Process, Problem Management Process and the Request Fulfillment Process.

All the dashboards use the same process of building. In order to that this user guide shows how to create a weekly dashboard, the periodicity defined, to the Request Fulfillment Process.

The first step is to access the site of the EasyVista and log in with the user's credentials, as shown in the Figure 41 and Figure 42.

Figure 41 - EasyVista Site

Figure 42 - EasyVista Login

The next step is to access the Operation menu, Service Requests and Requests, as shown in the Figure 43.

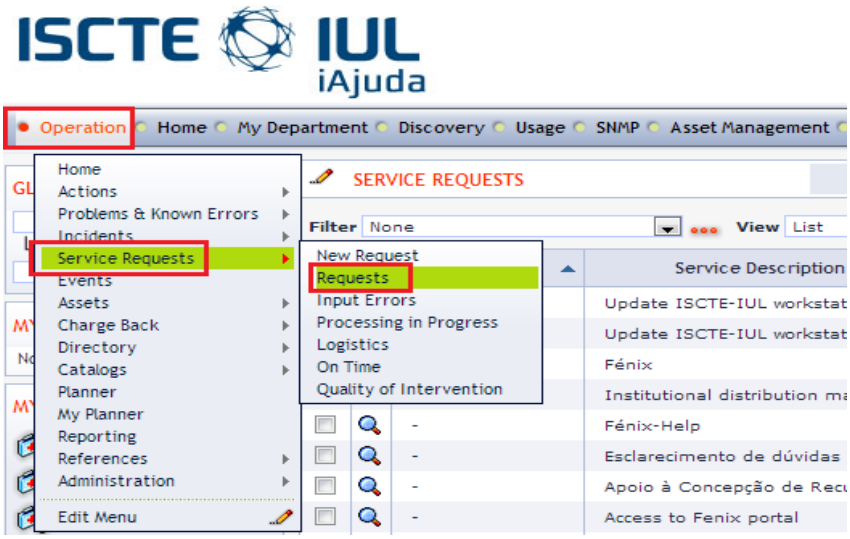


Figure 43 - Service Requests

Move forward, the filter should be set to None and the View to List and, after that, the extraction could be performed clicking in the Excel icon, as shown in the Figure 44. Depending on the volume of data and the network speed, this could take some time. It is locally created a zip file with the aspect of the Figure 45.

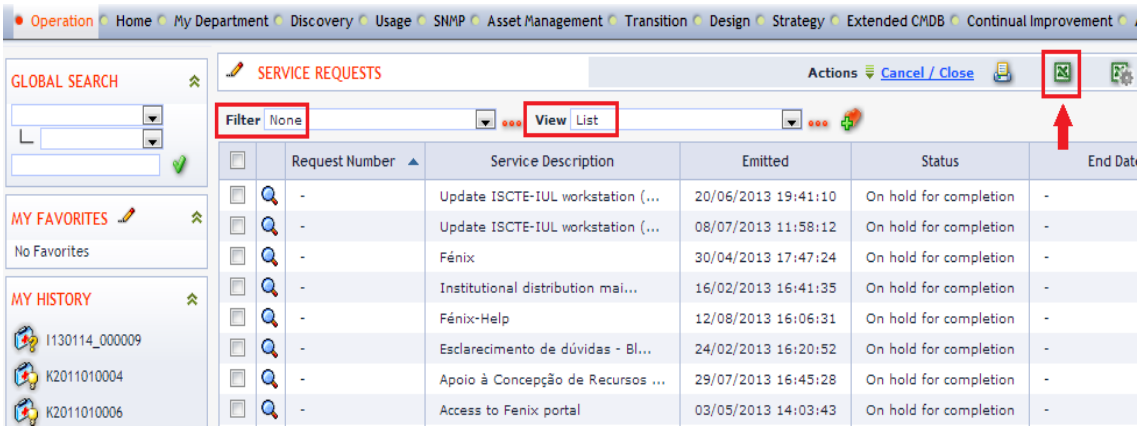


Figure 44 - EasyVista Extraction Parametrization

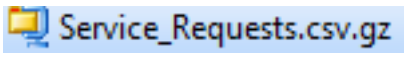


Figure 45 - EasyVista Extraction Zip File

Opening the zip file, it is available the data that will be used to fed de dashboard, as shown in the Figure 46. To select the data, place the cursor in the A1 cell, press CTRL + Shift + Right, CTRL + Shift + Down and CTRL + C.

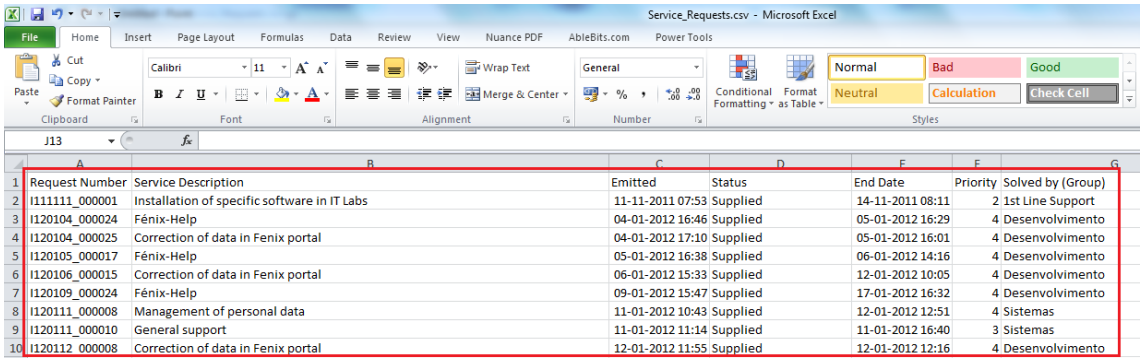
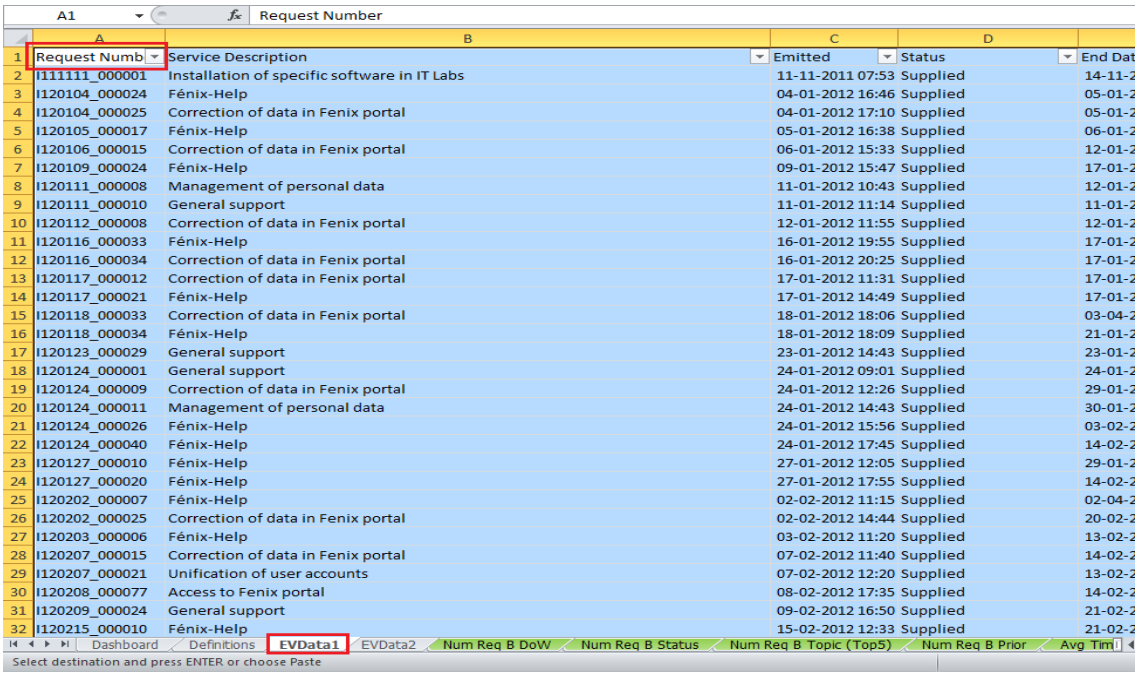


Figure 46 - EasyVista Zip File Data

At this point, the needed data is in memory and ready to paste in the dashboard.

The next step is to open the dashboard Excel file and select the EVData1 sheet, as shown in the Figure 47. Select the A1 cell and press CTRL + V.



Request Numb	Service Description	Emitted	Status	End Dat
I111111_000001	Installation of specific software in IT Labs	11-11-2011 07:53	Supplied	14-11-2
I120104_000024	Fénix-Help	04-01-2012 16:46	Supplied	05-01-2
I120104_000025	Correction of data in Fenix portal	04-01-2012 17:10	Supplied	05-01-2
I120105_000017	Fénix-Help	05-01-2012 16:38	Supplied	06-01-2
I120106_000015	Correction of data in Fenix portal	06-01-2012 15:33	Supplied	12-01-2
I120109_000024	Fénix-Help	09-01-2012 15:47	Supplied	17-01-2
I120111_000008	Management of personal data	11-01-2012 10:43	Supplied	12-01-2
I120111_000010	General support	11-01-2012 11:14	Supplied	11-01-2
I120112_000008	Correction of data in Fenix portal	12-01-2012 11:55	Supplied	12-01-2
I120116_000033	Fénix-Help	16-01-2012 19:55	Supplied	17-01-2
I120116_000034	Correction of data in Fenix portal	16-01-2012 20:25	Supplied	17-01-2
I120117_000012	Correction of data in Fenix portal	17-01-2012 11:31	Supplied	17-01-2
I120117_000021	Fénix-Help	17-01-2012 14:49	Supplied	17-01-2
I120118_000033	Correction of data in Fenix portal	18-01-2012 18:06	Supplied	03-04-2
I120118_000034	Fénix-Help	18-01-2012 18:09	Supplied	21-01-2
I120123_000029	General support	23-01-2012 14:43	Supplied	23-01-2
I120124_000001	General support	24-01-2012 09:01	Supplied	24-01-2
I120124_000009	Correction of data in Fenix portal	24-01-2012 12:26	Supplied	29-01-2
I120124_000011	Management of personal data	24-01-2012 14:43	Supplied	30-01-2
I120124_000026	Fénix-Help	24-01-2012 15:56	Supplied	03-02-2
I120124_000040	Fénix-Help	24-01-2012 17:45	Supplied	14-02-2
I120127_000010	Fénix-Help	27-01-2012 12:05	Supplied	29-01-2
I120127_000020	Fénix-Help	27-01-2012 17:55	Supplied	14-02-2
I120202_000007	Fénix-Help	02-02-2012 11:15	Supplied	02-04-2
I120202_000025	Correction of data in Fenix portal	02-02-2012 14:44	Supplied	20-02-2
I120203_000006	Fénix-Help	03-02-2012 11:20	Supplied	13-02-2
I120207_000015	Correction of data in Fenix portal	07-02-2012 11:40	Supplied	14-02-2
I120207_000021	Unification of user accounts	07-02-2012 12:20	Supplied	13-02-2
I120208_000077	Access to Fenix portal	08-02-2012 17:35	Supplied	14-02-2
I120209_000024	General support	09-02-2012 16:50	Supplied	21-02-2
I120215_000010	Fénix-Help	15-02-2012 12:33	Supplied	21-02-2

Figure 47 - Dashboard Data Copy

The next step is to perform another extraction, to have data related with the customer satisfaction. The steps to gather these data are very similar. In the EasyVista, access to the Operation menu, Service Requests and Quality of Intervention, as shown in the Figure 48.

Figure 48 - EasyVista Quality of Intervention Data

Set the filter to None and the view to List and click in the Excel icon to extract the data. After that, open the zip file, copy the data and paste it in the EVData2 sheet, as explained before.

Now, it is needed to refresh all the outputs that are gathering these data. To perform this operation, select the Excel separator Data and Refresh All option, according to the Figure 49.

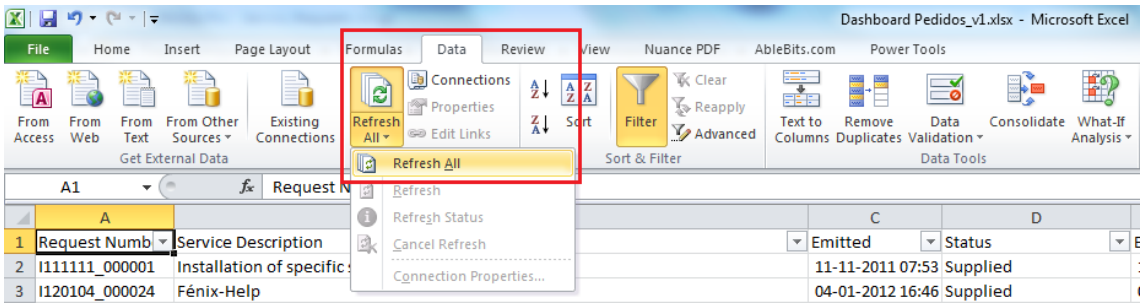


Figure 49 - Dashboard Data Refresh

At this point, the data is integrated and updated, and a final step is required to build the weekly dashboard. According to the week of the year that the dashboard address, it is needed to go through the green Excel sheets and define the week in scope, as exemplified in the Figure 50.

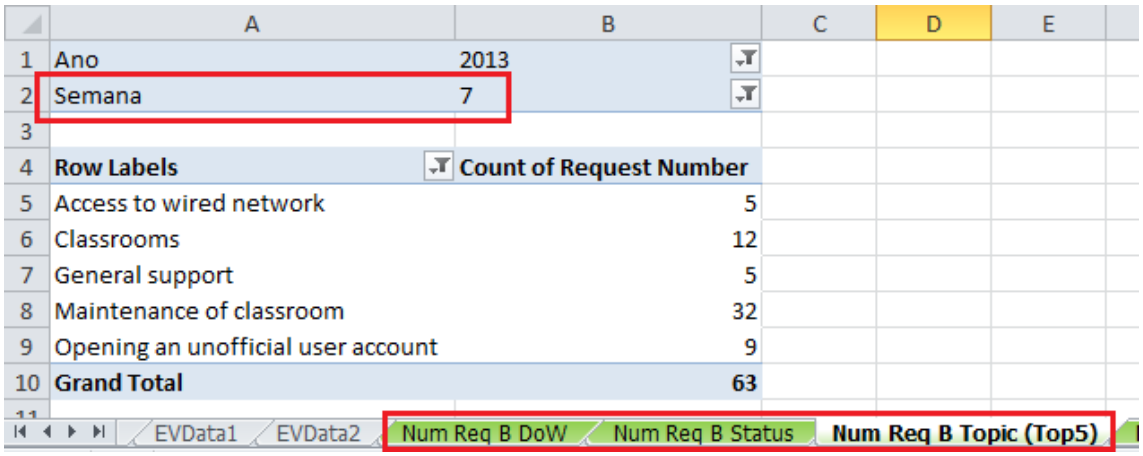


Figure 50 - Dashboard Week Parametrization

Appendix C Planning

Initially, it was designed a planning to perform the work. The initial planning suffers differences and adjustments because with the initiation of a professional active life, all the expected dates no longer make sense. Another change in the development of the dissertation, with impact in the planning, is related with the alteration in the scope of the second part of the dissertation. Therefore the dates were adjusted to the similar reality of the project, and the additional tasks were added, showing guidelines across the performed work. The Figure 51 shows the tasks list, with dates and dependencies.

	Task Name	Duration	Start	Finish
1	Reading of recommended bibliography	490 days	Sat 01-10-11	Thu 15-08-13
2	Introduction development	23 days	Thu 01-12-11	Sat 31-12-11
3	State of the Art development	23 days	Mon 02-01-12	Wed 01-02-12
4	State of the Art presentation	3 days	Thu 02-02-12	Mon 06-02-12
5	Review of the implemented ITIL processes	9 days	Mon 06-02-12	Thu 16-02-12
6	Design of the problem management process with BPMN	21 days	Fri 17-02-12	Fri 16-03-12
7	Discussion of the designed model with the responsible	12 days	Mon 19-03-12	Tue 03-04-12
8	Model adaptation to the reality of ISCTE-IUL	12 days	Wed 04-04-12	Thu 19-04-12
9	Implementation of the problem management process	23 days	Fri 20-04-12	Tue 22-05-12
10	Review of the Data Marts implemented	23 days	Wed 23-05-12	Fri 22-06-12
11	Redefinition of the scope	9 days	Sat 20-10-12	Wed 31-10-12
12	Clarifying the objectives	11 days	Thu 01-11-12	Thu 15-11-12
13	Follow-up of the work performed	11 days	Fri 16-11-12	Fri 30-11-12
14	Metrics compilation	12 days	Mon 15-04-13	Tue 30-04-13
15	Adaptation of metrics to the data present at EasyVista	10 days	Wed 01-05-13	Tue 14-05-13
16	Dashboards metrics filtering	13 days	Wed 15-05-13	Fri 31-05-13
17	Dashboard of Service Operation design	11 days	Mon 03-06-13	Mon 17-06-13
18	Dashboard implementation	22 days	Tue 18-06-13	Wed 17-07-13
19	Written development of the dissertation	425 days	Tue 07-02-12	Sun 22-09-13
20	Final delivery	6 days	Mon 23-09-13	Mon 30-09-13

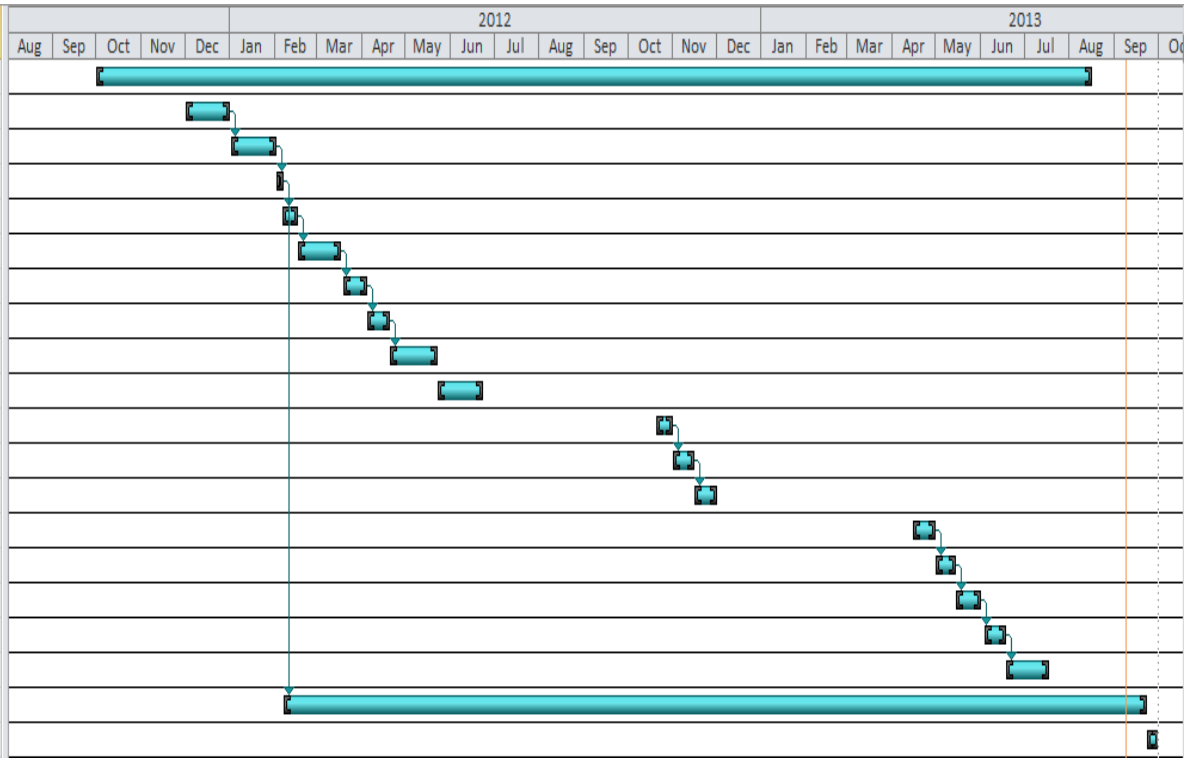


Figure 51 – Tasks List Gantt Chart

Appendix D ITIL®V3 Global Scheme

The Figure 52 shows the ITIL V3 global scheme where the processes of the reference board are organized by the service lifecycle.

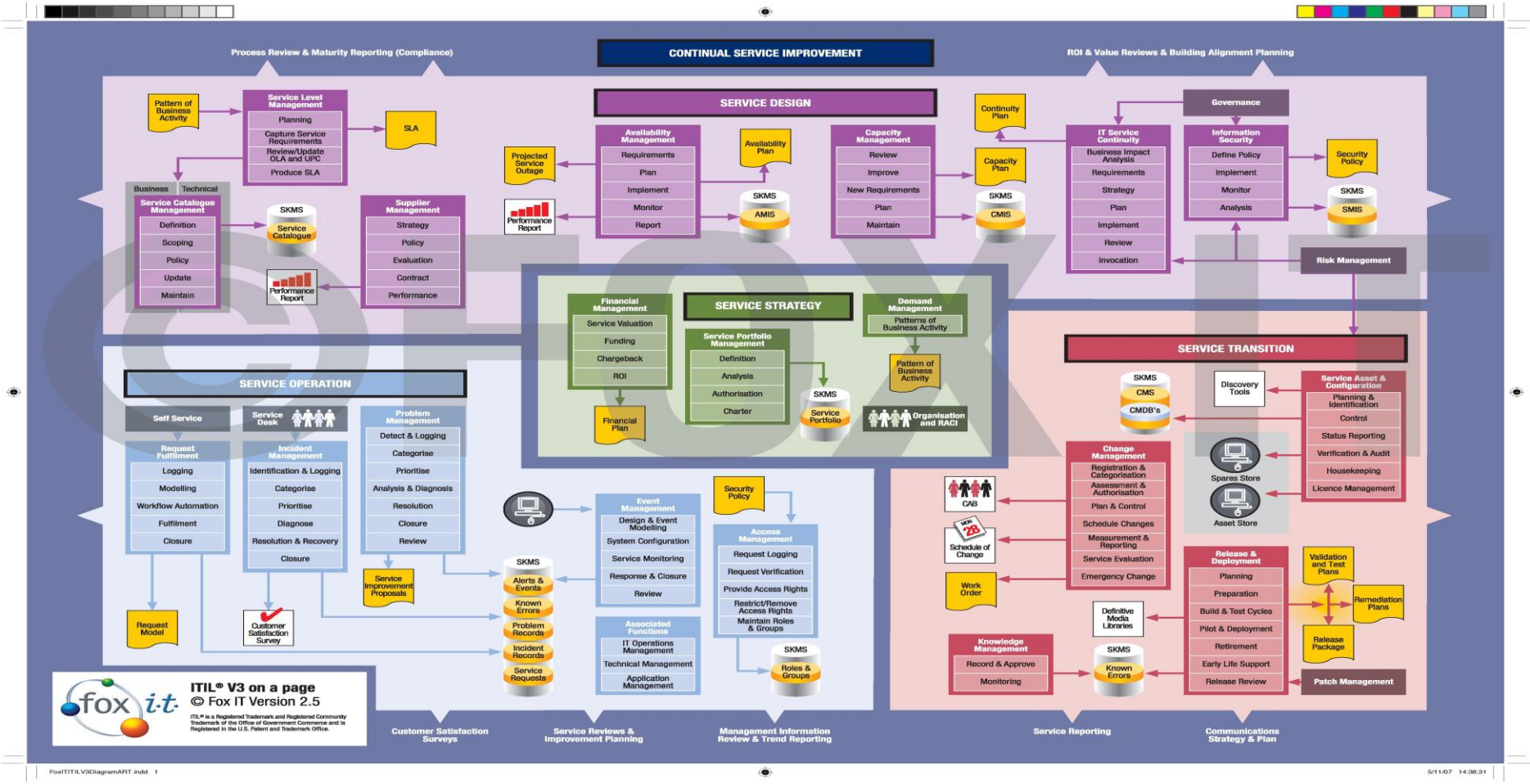


Figure 52 - ITIL®V3 Global Scheme (Fox IT s.d.)